Bid Document

(Two-Envelope Bidding Process)

Name of work: Contract Package MNS-01: Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.

Bid No: HORC/HRIDC/MNS-01/STN/2025

Contract title: Composite Works Contract (Civil, Electrical, Road works and other associated works)

Project: Haryana Orbital Rail Corridor Project

Employer: Haryana Orbital Rail Corporation Limited

Country: INDIA

Issued on: 06.02.2025

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Invitation for Bids (IFB)

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Section 1: Instructions to Bidders (ITB)

A. General

1. Scope of Bid

1.1 In connection with the Invitation for Bids indicated in the **Bid Data Sheet (BDS)**, Haryana Orbital Rail Corporation Limited (HORCL), hereinafter referred to as the 'Employer', issues these Bidding Documents for the Procurement of Works as specified in Section 5: Works Requirements. The name, identification, number of contract(s) for the National Competitive Bidding (NCB) are provided in the **BDS**.

1.2 Throughout these Bidding Documents:

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

2. Source of Funds

2.1 The required funds have been sourced by EMPLOYER, unless otherwise specified in the **BDS**.

3. Corrupt Practices

3.1 The Employer requires that bidders, suppliers, and contractors observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Employer:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, of any thing of value to influence the action of any party in the procurement process or the execution of a contract;

(ii) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a contract;

(iii) "collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of the Employer, designed to influence the action of any party in a procurement process or the execution of a contract;

(iv) "coercive practice" means harming or threatening to harm, directly or indirectly, persons, or their property to influence their participation in a procurement process, or affect the execution of a contract;

(b) will reject a Bid for award if it determines that the bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract; and

(c) will sanction a party or its successor, including declaring ineligible, either indefinitely or for a stated period of time, to participate in Employer's activities, if it at any time determines that the firm has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for, or in executing a contract of the employer.

4. Eligible **Bidders**

4.1 A Bidder may be a natural person, private entity, government-owned entity, or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture (JV). The Bidder must ensure the following:

(a) In case of Single Entity:

(i) Submit Power of Attorney authorizing the signatory of the bid to commit the bidder.

(b) In case of Joint Venture:

(i) The number of partners in the JV shall not be more than that indicated in the Bid Data Sheet **(BDS)**;

(ii) Submit MOU, as per form given in Section 4.

(iii) The JV shall nominate a Representative through Power of Attorney (Form given in Section 4) who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

(iv) Submit Power of Attorney by individual partners to lead partners as per form given in Section 4.

(v) In case a Joint Venture is the successful bidder, the Joint Venture Agreement should be entered by the Joint Venture partners. The duly signed Joint Venture Agreement should be submitted along with the Performance Security to the employer after notification of the award of contract within 28 days.

(c) Foreign Firm(s) shall only be eligible to participate either as a single entity or as a partner in JV, if they have already opened project office in India and have to submit proof of the same along with the bid, failing which the bid shall be rejected.

(d) Any bidder from a country which shares a land border with India will be eligible to bid, only if the bidder is registered with the Competent Authority as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 (Public Procurement No.1). However, it will not apply to bidders from those countries (even if sharing land border with India) to which the Government of India has extended lines of credit or in which the Government of India is engaged in development projects as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 (Public Procurement No.2) or any amendments thereof.

1) "Bidder from a country which shares a land border with India" means:

i. An entity incorporated, established or registered in such a country; or

ii. A subsidiary of an entity incorporated, established or registered in such a country; or

iii. An entity substantially controlled through entities incorporated, established or registered in such a country; or

iv. An entity whose beneficial owner is situated in such a country; or

v. An Indian (or other) agent of such an entity; or

vi. A natural person who is a citizen of such a country; or

vii. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

2) The *beneficial owner* for the purpose of 1) above will be as under:

i. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has a controlling ownership interest or who exercises control through other means.

Explanation—

a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five percent of shares or capital or profits of the company.

b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decision including by virtue of their shareholding or management rights or shareholders agreements or voting agreements.

ii. In case of partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together or through one or more juridical person, has ownership or entitlement to more than fifteen percent of capital or profits of the partnership;

iii. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together or through one or more juridical person, has ownership of for entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;

iv. Where no natural person is identified under (i) or (ii) or (iii) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;

v. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

(e) Eligible bidder can be either 'Class-I Local' or 'both Class-I Local and Class-II Local' or 'combination of Class-I Local, Class-II Local and Non-local', as defined below.

i. Class-I Local- means a supplier or service provider, whose goods, services or works offered for procurement meets the minimum local content of 50%.

ii. Class-II Local- means a supplier or service provider, whose goods, services or works offered for procurement meets the minimum local content of 20%.

iii. Non-local- means a supplier or service provider, who does not meet the requirements as per i and ii above.

The Bidders are required to submit a declaration using 'Form-MII' of Section 4 Bidding Forms.

In keeping with the Public Procurement (Preference to Make in India) Order 2017, as amended from time-to-time up to 28 days prior to

deadline for submission of bids, in case any bidder, who does not meet the eligibility criteria as prescribed vide clause 4.1 above, shall participate at its own risk & cost and Employer shall not be liable for any loss or damage caused to the bidder.

4.2 Deleted.

4.3 A Bidder shall not have conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process, if, including but not limited to:

(a) they have controlling shareholders in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or

(e) a Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which the party is involved. However, this does not limit the inclusion of the same subcontractor in more than one bid; or

(f) a Bidder participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; or

(g) a Bidder was affiliated for any period(s)during last two years before the date of issue of Invitation for Bids with a firm or entity that has been hired (or is proposed to be hired) by the Employer as Engineer for the contract.

4.4 The bidder will be disqualified if:

a. The bidder or any of its constituents has been blacklisted/ banned business dealings for all Government Departments or by Ministry of Railways or by EMPLOYER at any time till finalization of bids, except in cases where such blacklisting/ banning has been withdrawn by Competent Authority or has ceased on the deadline for submission of the bids, for which satisfactory evidence is to be produced.

b. Any previous contract of the bidder or any of its constituents had been terminated for contractor's failure or part terminated for its failure as a JV partner with forfeiture of its full Performance Security, by Haryana Orbital Rail Corporation Limited (HORCL) at any time starting from 3 years before the deadline for submission of bids and upto one day before the date of opening of price bids;

Provided, however, there is no stay order or declaration by any Court against such termination of the Contract by Haryana Orbital Rail Corporation Limited. or such termination of the Contract has not been revoked by Haryana Orbital Rail Corporation Limited or competent authority of the EMPLOYER has not passed an order of non-applicability of disqualification of the bidder or any of its constituents despite such termination.

c. The bidder or any of its constituents has been imposed delay damages of 5% or more of contract value by EMPLOYER due to delay in the

implementation of any previous contract within the period of last 2 years before the deadline for submission of bids (Period of 2 years shall be reckoned from the date on which the total accrued amount of Delay Damages has reached 5% or more of the contract price) or such accrued delay damages has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and EMPLOYER has acceded to the same in the interest of the project or the work under the previous contract in question has not been completed before the deadline for submission of bids, unless imposition of such delay damages has been set aside by the Competent Authority.

d. The bidder or any of its constituents:

i. has suffered bankruptcy/insolvency or

ii. has any ongoing case of insolvency before the NCLT/any Court where Interim Resolution Professional (IRP) has been appointed or is at any later stage of the insolvency process

on the deadline of submission of bids or thereafter till finalization of bids.

e. The Bidder is found ineligible by the Employer, in accordance with ITB-3.

f. The Bidder or its constituent(s) has been declared by EMPLOYER to be a poor performer and the period of poor performance is still in force on the deadline for submission of bids.

OR

The Bidder or its constituent(s) has been declared by EMPLOYER to be a poor performer at any time after the deadline for submission of Bids and upto one day before the date of opening of Price Bids.

g. The Bidder or any of its constituents has changed its name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of Chapter XI of Vigilance Manual of Indian Railways (available on website of Indian Railways), consequent to having been banned business dealings or suspended business dealings or having been declared poor performer.

h. The Bidder or any of its constituents is from a country which shares a land border with India and is not registered with the Competent Authority as stated in DoE Order no 6/18/2019-PP dtd 23 July 2020 .

i. Bidder is an Entity of such countries, which have been identified by the Railway Ministry as not allowing Indian Companies to participate in their Government procurements for any item related to Railway Ministry, shall not be allowed to participate, except for the list of items published by the Railway Ministry permitting their participation.

j. Bidder fails to disclose any previous transgressions made in respect of Code of Integrity [Rule 175 (1) of General Financial Rules 2017] with any entity in any country during the last three years or of being debarred by any other procuring entity

The Bidder shall submit an affidavit stating that they are not liable to be disqualified as per this Sub-Clause using the appropriate Performa given in Section 4. Non-submission of an affidavit by the bidder shall result in summary rejection of his bid.

4.5 Bidders shall immediately inform the Employer in case they cease to fulfill eligibility in terms of ITB 4.3 & 4.4. In case the Bidder fails to inform the Employer or submits a false affidavit his Bid shall be summarily rejected and Bid security shall be forfeited. The Bidder shall also be liable for Banning of Business dealings for a period up to five years.

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment and services to be supplied under the Contract shall be from the approved sources as specified in Section 5: Works Requirements.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Document consists of Volume-I (Parts I, II and III) and Volume-II, which includes all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8.

Volume-I

PART I: Bidding Procedures

Section 1: Instructions to Bidders (ITB)

Section 2: Bid Data Sheet (BDS)

Section 3: Evaluation and Qualification Criteria (EQC)

Section 4: Bidding Forms (BDF)

PART II: Work's Requirements

Section 5: Works' Requirements (WRQ)

PART III: Conditions of Contract and Contract Forms

Section 6: General Conditions of Contract (GCC)

Section 7: Special Conditions of Contract (SCC)

Part A: Contract Data (CD)

Part B: Specific Provisions (SP)

Section 8: Contract Forms (COF) – Annexes to SCC

Volume-II

Bill of Quantities(BOQ)

6.2 The Invitation for Bids (IFB) issued by the Employer is not part of the Bidding Document.

6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.

6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of **the** bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the **BDS** or raise his inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received no later than twenty one (21) days prior to the deadline for submission of bids. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself on its own responsibility all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

7.3 The Bidder and any of its personnel or agents will be granted permission by the Employer to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the Bidder, its personnel, and agents will release and indemnify the Employer and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the **BDS** either in person or through video conferencing. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 The Bidder is requested, as far as possible, to submit any questions in writing, to reach the Employer not later than one week before the meeting.

7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addenda.

8.2 Any addendum/corrigendum issued shall be part of the Bidding Document.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 22.2

C. Preparation of Bids

9. Cost of Bidding

9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in English. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in English in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1 The Bidder shall submit both technical and financial bids through e tendering portal only.

11.2 Initially, only the Technical Bids are opened through e tendering portal. The Technical Bids are evaluated by the Employer. No amendments or changes to the Technical Bids are permitted. Bids with Technical Bids which do not conform to the specified requirements will be rejected as deficient Bids.

11.3 Price Bids of technically compliant Bids shall be opened through e tendering portal of EMPLOYER at a date and time advised by the Employer. The Price Bids are evaluated and the Contract is awarded to the Bidder whose Bid has been determined to be the lowest evaluated substantially responsive Bid.

11.4 The Technical Bid shall contain the following :

(a) Scanned copy of Letter of Technical Bid in accordance with ITB 16;

(b) Scanned copy of Bid Security, in accordance with ITB Clause 19;

(c) Scanned copy of alternative Technical Bid, if permissible, in accordance with ITB Clause 13;

(d) Scanned copy of written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB Clause 20.2;

(e) Scanned copy of documentary evidence in accordance with ITB Clause 17 establishing the Bidder's qualifications to perform the contract; and

(f) Scanned copy of any other document required in the **BDS**.

11.5 The Price Bid shall contain the following :

(a) Duly completed and signed scanned copy of Letter of Price Bid;

(b) Summary sheet completed online as per ITB 14

(c) Online alternative Price Bid corresponding to the alternative Technical Bid, if permissible, in accordance with ITB Clause 13; and

(d) any other document required in the **BDS**.

12. Bid Letters and Price Schedules

12.1 The Bidder shall submit the Technical Bid and the Price Bid online through etendering portal using appropriate letter formats furnished in Section 4: Bidding Forms. These forms must be completed without any alterations to their format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

12.2 The Bidder shall submit, as part of the Price Bid, including the Bill of Quantities through online e –Tendering portal.

13. Alternative Bids

13.1 Unless otherwise indicated in the **BDS**, alternative bids shall not be considered.

13.2 When alternative periods for completion are explicitly invited, a statement to that effect will be included in the **BDS**, as will the method of evaluating different periods for completion.

14. Bid Prices and Discounts

14.1 The prices quoted by the Bidder online in the MS-Excel sheet of Bill of Quantities (BOQ) uploaded on eProcurement Portal shall conform to the requirements specified below.

14.2 In the Vol. II, quantity and unit rates and thereby the amount against each item have been indicated. From this, price of each schedule/bill has been worked out and indicated in the MS-Excel sheet BOQ uploaded on eProcurement Portal. The Bidder shall quote single percentage (%) Excess (+) or Less (-) on the estimated amount for Schedule 'A' and Schedule 'B' in the prescribed place of Bill of Quantities in MS-Excel file**. The rates quoted by the Bidder in** MS-Excel Sheet BOQ **will only be considered for evaluation of Price Bids. Rates offered through any other medium or at any other location will not be considered.**

14.3 Deleted

14.4 The Bidder can modify its bid and resubmit it any number of times through e Tendering portal before the deadline for submission of bids. Any other correspondence in connection with the bid is not permissible and shall not be considered in bid evaluation.

14.5 Unless otherwise provided in the **BDS** and the Contract, the rates and prices quoted by the Bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract. In such a case, the indices and weightings for the price adjustment formulae shall be as specified in the **Tables of Adjustment Data included in Vol. II, Bill of Quantities.**

14.6 Bids are being invited for individual contract.

14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause (including standard specifications), as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

14.8 Deleted.

14.9 Bidder should note that non-submission of the Letter of Price Bid (LPB) shall be liable for rejection of his Bid. Non submission of MS Excel sheet of BOQ by the Bidder on eProcurement Portal shall result in summary rejection of his Bid.

15. Currencies of Bid and Payment

15.1 The currency of the Bid and the payment currency shall **be Indian Rupees (INR)** only. The prices shall be quoted by the Bidder entirely in **Indian Rupees (INR)** only.

15.2 Deleted

16. Documents Comprising the Technical Bid

16.1 The Bidder shall furnish a commitment in Letter of Technical Bid (LTB) for deployment of equipment and personnel as stipulated in Section 5: Works' Requirement.

16.2 The Bidder shall furnish commitment in LTB for submitting construction method statement for all major activities of work and get this approved from the Engineer prior to the commencement of works on that activity in case of award of contract.

16.3 The Bidder shall furnish a commitment in Letter of Technical Bid (LTB) for adhering to mobilisation and construction schedule as stipulated in Section 5: Works' Requirement.

16.4 Bidder should note that non-submission of the Letter of Technical Bid (LTB) by the Bidder shall be liable for rejection of his Bid.

17. Documents Establishing the Qualifications of the Bidder

17.1 To establish its qualifications to perform the Contract in accordance with Section 3: Evaluation and Qualification Criteria, the Bidder shall submit as part of its Technical Bid the information requested in the corresponding information sheets included in Section 4: Bidding Forms.

17.2 Domestic Bidders, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility as described in ITB 34.

18. Period of Validity of Bids

18.1 Bids shall remain valid for a period of 180 days after the Bid submission deadline date prescribed by the Employer. A Bid valid for a shorter period shall be liable for rejection by the Employer as nonresponsive Bid.

18.2 In exceptional circumstances, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a Bid security is requested in accordance with ITB 19, it shall also be extended upto the date mentioned in the letter of request for extension. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid.

19. Bid Security/ Bid Security Declaration

19.1 Unless otherwise specified in the **BDS**, the Bidder shall furnish as part of its bid, in original form, either a Bid Security Declaration or a Bid Security in original form and for the said amount of Indian Rupees as specified in the **BDS**.

19.2 If a Bid Security Declaration is required pursuant to ITB 19.1, it shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a contract for a period of 3 (three) years, if a Bid Security Declaration is executed

19.3 If a Bid Security is specified pursuant to ITB 19.1, the Bid Security shall be, at the Bidder's option, in any of the following forms:

(a) A Cashiers or Banker's certified cheque or Bank draft drawn on a Scheduled/Nationalized Bank in India in favour of "Haryana Orbital Rail Corporation Limited" payable at Gurugram; or

(b) An unconditional Bank Guarantee using the Form given in Section 4: Bidding Forms. The Bank Guarantee shall be from a bank having minimum net worth of over INR 500 million from the specified banks as under:

(i) **a Scheduled Bank in India, or**

(ii) **a Foreign Bank having their operations in India, or**

(iii) **a Foreign Bank which do not have operations in India is required to provide a counter-guarantee by State Bank of India,**

The Bid Security shall be valid upto the date as mentioned in **BDS**, or upto the date mentioned in the letter of request for extension, if any under ITB 18.2.

In case the Bidder has opted for Bid security in the form of an unconditional Bank guarantee, the bidder should upload the scanned copy of Bank Guarantee with the Bid. The original Bank Guarantee should be delivered in person to the official nominated as indicated in the Bid Data Sheet within 5 working days of deadline of submission of bids. Non submission of scanned copy of Bank Guarantee with the bid on e-tendering portal and/or non submission of original Bank Guarantee within the specified period shall lead to summary rejection of bid. The details of the BG, physically submitted should match with the details available in the scanned copy and the data entered during bid submission time, failing which the bid will be rejected.

19.4 Any Bid not accompanied by an enforceable and compliant Bid Security or Bid Security Declaration, as required in accordance with ITB 19.1, shall be liable for rejection by the Employer as nonresponsive Bid.

19.1 The Bid security of the Bidders who have been determined to be nonresponsive for opening of their Price Bids shall be returned as promptly as possible after the opening of Price Bids. The Bid Security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's signing the Contract and furnishing the Performance Security pursuant to ITB 41.

19.2 The Bid security of the successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required Performance Security.

19.3 The Bid security may be forfeited or the Bid Security Declaration executed;

(a) if a Bidder withdraws its Bid during the period of bid validity specified by the Bidder on the Letter of Bids, except as provided in ITB 18.2 or

(b) if a Bidder misrepresents or omits the facts in order to influence the procurement process;

(c) if the successful Bidder fails to:

(i) sign the Contract in accordance with ITB 40;

(ii) furnish a Performance Security in accordance with ITB 41;

(iii) accept the correction of its Bid Price pursuant to ITB 32.2; or

(iv) furnish a domestic preference security if so required.

(d) if the undertaking of the affidavit submitted by the Bidder or its constituents in pursuance to ITB Clause 4.4 or any of the declarations of Letter of Technical Bid or Letter of Price Bid submitted by the Bidder has been found to be false at any stage during the process of Bid evaluation.

19.4 The Bid Security of a JV shall be in the name of the JV that submits the bid. If the JV has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.

20. Format and Signing of Bid

20.1 The Bidder shall submit Technical Bid and the Price Bid as described in ITB Clause 11 through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in).

20.2 The Bids shall be digitally signed by a person dully authorized to sign on behalf of the Bidder.

20.3 DELETED

D. Submission and Opening of Bids

21. Online submission and opening of bids

21.1 The Bidder shall submit the Technical and Price Bid through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in)

21.2 DELETED

21.3 DELETED

21.4 DELETED.

21.5 DELETED

21.6 No details about price proposal shall be disclosed directly or indirectly in the technical proposal failing which the Bid shall be rejected.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer through e tendering portal Govt. of Haryana (https://etenders.hry.nic.in) only not later than the date and time indicated in the **BDS**.

22.2 The Employer may, at its discretion, extend the deadline for the submission of Bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

23.1 The e-Tendering portal cannot accept any bid once the deadline for the Bid submission has lapsed.

24. Withdrawal, Substitution, and Modification of Bids

24.1 A Bidder may withdraw, or modify its Bid after it has been submitted through e-Tendering portal before the deadline for submission of Bids.

24.2 DELETED.

24.3 No bid may be withdrawn, or modified in the interval between the deadline for submission of Bids and the expiration of the period of Bid Validity specified by the Bidder on the Letter of Bid or any extension thereof.

25. Bid Opening

25.1 The Employer shall conduct the opening of Technical Bids through e-tendering portal of Govt. of Haryana (https://etenders.hry.nic.in).

25.2 The Price Bids shall remain unopened until the time of opening of the Price Bids on Procurement Portal. The date, and time, of the opening of Price Bids will be notified to the Bidders in writing through email.

25.3 DELETED

25.4 DELETED

25.5 DELETED

25.6 DELETED

25.7 DELETED

25.8 At the end of the evaluation of the Technical Bids, the Employer will intimate Bidders who have submitted substantially responsive Technical Bids. The date and time of the opening of Price Bids will be advised in writing through email.

25.1 The Employer will notify Bidders in writing whose Technical Bid have been determined as nonresponsive to the requirements of the Bidding Document or failed to meet the Qualification Criteria, advising them the grounds on which their Technical Part of Tender failed to meet the requirements of the Tender Document. The Bid security of the Bidders shall be returned as per due process.

25.2 The Employer shall conduct the opening of Price Bids through e tendering portal of Govt. of Haryana (https://etenders.hry.nic.in)of all Bidders who submitted substantially responsive Technical Bids and who have been determined qualified as a result of technical evaluation.

25.3 DELETED

25.4 DELETED

E. Evaluation and Comparison of Bids

26. Confidentiality

26.1 Information relating to the examination, evaluation & comparison, pre-qualification of Bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.

26.2 Any attempt by a Bidder to influence the Employer in the examination, evaluation & comparison and pre-qualification of the Bids or Contract award decisions may result in the rejection of its Bid.

26.3 Notwithstanding ITB Sub-Clause 26.2, from the time of opening the Technical Bids to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it should do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation & comparison and pre-qualification of the Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its Bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the prices or substance of the Bid shall be sought, offered, or permitted, by the Employer in the evaluation of the Price Bids.

27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its Bid may be rejected.

28. Deviations, Reservations, and Omissions

28.1 During the evaluation of Bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.

29. Determination of Responsiveness

29.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the Bid itself, as defined in ITB11.

29.2 A substantially responsive bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.

29.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Bid, in particular, to confirm that all requirements of Section 5 (Works Requirements) have been met without any material deviation or reservation.

29.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

30. Nonconformities, Errors, and Omissions

30.1 Provided that a bid is substantially responsive, the Employer may waive any nonconformities in the bid that do not constitute a material deviation, reservation or omission.

30.2 Provided that a bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Bid related to documentation requirements. Requesting information or documentation on such nonconformities shall not be related to any aspect of the price of the Bid. Failure of the Bidder to comply with the request may result in the rejection of its bid.

30.3 Deleted

31. Qualification of the Bidder

31.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders are qualified to perform the Contract satisfactorily.

31.1 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB Clause 17, to clarifications in accordance with ITB Clause 27 and the qualification criteria indicated in Section 3: Evaluation and Qualification Criteria. Factors not included in Section 3: Evaluation and Qualification Criteria shall not be used in the evaluation of the Bidder's qualification. The determination shall not take into consideration the qualifications of other firms such as the Bidder's subsidiaries, parent entities, affiliates, subcontractors (other than Specialized Subcontractors if permitted), or any other firm(s) different from the Bidder.

31.2 An affirmative determination of Technical Bid shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Price Bid of the Bidder remain unopened on e-Tendering portal.

31.3 DELETED

31.4 DELETED

32. Correction of Arithmetical Errors and Omissions in Price Bid and Evaluation of Bid Price

32.1 In evaluating the Price Bid of each Bid, the Employer shall correct any arithmetical errors on the following basis

(a) if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of

the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;

(b) If there is discrepancy between percentage rate quoted by the Bidder for a Schedule or Bill and corresponding amount calculated in the MS Excel BOQ, the amount shall be corrected on basis of percentage rated quoted by the Bidder, unless in the opinion of the Employer there is an obvious decimal error in the percentage rate quoted by the Bidder, the corresponding amount for the Schedule or Bill shall govern and the percentage rate shall be corrected;

(c) there is an error in a total corresponding to the addition or subtraction of amounts of Schedule or Bill, the amount of Schedule or Bill after arithmetical correction as per (a) and (b) above shall prevail, and the total shall be corrected; and

(d) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a), (b) and (c) above.

32.2 Bidders shall be requested to accept correction of arithmetical errors. Failure to accept the correction in accordance with ITT 32.1, shall result in the rejection of the Bid.

33. Conversion to Single Currency

33.1 For evaluation and comparison purposes the currencies of the Bid shall be Indian Rupees **(INR)**.

34. Purchase Preference

34.1 The Purchase Preference shall be available to Class-I Local Bidder. Margin of Purchase Preference (MPP) shall be as specified in **Bid Data Sheet**.

34.2 If a Bidder or any of its constituents has been debarred by any procuring entity for violation of the 'Public Procurement (Preference to Make in India) Order 2017', shall not be eligible for preference for procurement for the duration of debarment. The debarment for such procuring entities shall take effect prospectively from the date on which it comes to the notice of the Employer.

35. Evaluation of Bids

35.1 The Employer shall evaluate Price Bids of each Bid for which the Technical Bids have been determined to be substantially responsive. The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be permitted.

35.2 To evaluate the price Bid of a bid, the Employer shall consider the following:

(a) the Bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities, but including Day Work items, where priced competitively;

(b) DELETED

(c) DELETED

(d) DELETED

(e) application of all the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria).

35.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be taken into account in bid evaluation.

35.4 Deleted.

35.5 If the Bid, which results in the lowest Evaluated Bid Price is substantially on lower side and/or seriously unbalanced in the opinion of the Employer, the Employer shall seek written clarifications from the Bidder, including detailed price analyses of its Bid price in relation to the subject matter of the contract, scope, proposed methodology, schedule, allocation of risks and responsibilities and any other requirements of the Bid Document.

35.6 After examining the clarifications given and the detailed price analyses presented by the Bidder, the Employer may as appropriate:

(a) accept the Bid, if the evidence provided satisfactorily accounts for the low Bid price, in which case the Bid is not considered abnormally low; or

(b) accept the Bid, but require that the amount of the Performance Security be increased at the expense of the Tenderer to a level sufficient to protect the Employer against financial loss. The amount of the Performance Security shall generally be not more than 20% of the Contract Price; or

(c) reject the Tender, if the evidence provided does not satisfactorily account for the low tender price and make a similar determination for the next ranked Tender, if required.

36. Comparison of Bids

36.1 The Employer shall compare all substantially responsive bids to determine the lowest evaluated bid, in accordance with ITB 34 and 35.

37. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

37.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

F. Award of Contract

38. Award Criteria

38.1 The Employer shall award the Contract to the Bidder whose bid is substantially responsive to the Bidding Document and whose offer has been determined to be the lowest evaluated Bid subject to ITB 38.2 and 38.3 below. In case of more than one bids are evaluated to be lowest, Contract shall be awarded to the bidder having higher average annual construction turnover in equivalent INR within the last three financial years.

38.2 The works contracts are not divisible in nature. Hence, following procedure shall be followed for award of the contract:

i. Among all qualified bidders, the lowest bidder will be termed L1. If L1 is 'Class-I local bidder', the contract will be awarded to L1.

ii. If L1 is not 'Class-I local bidder', the lowest bidder among the 'Class-I local bidder', will be invited to match the L1 price subject to Class-I local bidder's price falling within Margin of

Purchase Preference (MPP) and the contract shall be awarded to 'Class-I local bidder' subject to matching the price of L1.

iii. In case such lowest eligible 'Class-I local bidder' fails to match the price of L1, the 'Class-I local bidder' with next higher bid within MPP shall be invited to match the price of L1 and so on, and contract shall be awarded accordingly.

iv. In case none of the 'Class-I local bidder' within MPP matches the L1 price, the contract will be awarded to L1 bidder.

38.3 The Employer has the right to review at any time prior to award of contract that the qualification criteria as specified in Section 3: Evaluation and Qualification Criteria are still being met by the Bidder whose offer has been determined to be the lowest evaluated Bid. A Bid shall be rejected if the qualification criteria as specified in Section 3: Evaluation and Qualification Criteria are no longer met by the Bidder whose offer has been determined to be the lowest evaluated Bid. In this event the Employer shall proceed to the next lowest evaluated Bid to make a similar reassessment of that Bidder's capabilities to perform satisfactorily.

39. Notification of Award

39.1 Prior to the expiration of the period of Bid Validity or any extension thereof, the Employer shall notify the successful Bidder, in writing, that its bid has been accepted. The notification letter (hereinafter and in the Conditions of Contract and Contract Forms called the "Letter of Acceptance") shall specify the sum that the Employer will pay the Contractor in consideration of the execution and completion of the Works (hereinafter and in the Conditions of Contract and Contract Forms called "the Contract Price") and the requirement for the Contractor to remedy any defects therein as prescribed by the Contract.

39.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

40. Signing of Contract

40.1 Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

40.2 Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

41. Performance Security

41.1 Within twenty-eight (28) days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the Performance Security in accordance with the Conditions of Contract, subject to ITB 35.5, using for that purpose the Performance Security Form included in Section 8: Contract Forms, or another form acceptable to the Employer.

The contractor may commence the work within 42 days of issue of LOA subject to the condition that, no payment will be made to the contractor till completion of the following: -
1. Submission of Enforceable Performance Guarantee
2. Signing of Contract agreement.

In case contract is terminated on account of non-submission of Performance Security within the specified time or extended time, the Employer shall be entitled to forfeit Bid Security, damages paid if any, and other dues payable against that contract.

41.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

41.3 The above provision shall not apply to the furnishing of a Domestic Preference Security, if so required.

42. Jurisdiction of Courts

The bidding process shall be governed by and construed in accordance with the laws of India and the Courts as indicated in Bid Data Sheet shall have exclusive jurisdiction over all the disputes/issues arising under, pursuant to and/ or in connection with the bidding process.

43. Make In India

43.1 The provisions of revised 'Public Procurement (Preference to Make in India) Order 2017' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no. P-45021/2/2017-PP (BE-II) dated 16.09.2020, as amended from time to time up to 28 days prior to deadline for submission of bids, shall be applicable to the bidding process and award of the contract shall be done accordingly.

43.2 **Local Content**: The amount of value added in India, which unless otherwise prescribed by Railway Ministry, be the total value of the item procured (excluding net domestic indirect taxes) minus value of imported content in the item (including all custom duties) as proportion of total value, in percent. Services such as transportation, insurance, installation, commissioning, training, and after sales services like AMC / CMC etc. are not local value addition for an imported product.

***

[Section 2: Bid Data Sheet (BDS)]

This section consists of provisions that are specific to each procurement and supplement the information or requirements included in Section I – Instructions to Bidders.

A. Introduction

ITB 1.1	The number of the Invitation for Bids is*:* HORC/HRIDC/MNS-01/STN/2025
ITB 1.1	The Employer is: **Haryana Orbital Rail Corporation Limited**
ITB 1.1	The name of the NCB is: **Contract Package MNS-01**: Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.
ITB 1.3	**Add new sub-clause ITB 1.3** **Instructions for Online Bid Submission:** The Bidders are required to submit soft copies of their Bid electronically on the eProcurement portal of Government of Haryana i.e. https://etenders.hry.nic.in, using valid Digital Signature Certificates. The instructions given below are meant to assist the Bidders in registering on the e-procurement Portal, prepare their bids in accordance with the requirements and submitting their Bids online on the eProcurement Portal. **Registration:** i) Bidders are required to enrol on the above-mentioned eProcurement portal by clicking on the link "Online Bidder Enrollment" on the Portal which is free of charge. ii) As part of the enrolment process, the Bidders will be required to choose a unique username and assign a password for their accounts. iii) Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the eProcurement Portal. **A. Obtaining a Digital Certificate:** i. The Bids submitted online should be encrypted and signed electronically with a Digital Certificate to establish the identity of the Bidder online. These Digital Certificates are issued by an Approved Certifying Authority, by the Controller of Certifying Authorities, Government of India. ii. A Digital Certificate is issued upon receipt of mandatory identity (i.e. Applicant's PAN Card) and Address proofs and verification form duly attested by the Bank Manager / Postmaster / Gazetted Officer. Only upon the receipt of the required documents, a digital certificate can be issued. For more details please visit the website – https://etenders.hry.nic.in iii. The Bidders may obtain Class-II or III digital signature certificate from any Certifying Authority or Sub-certifying Authority authorized by the Controller of

	Certifying Authorities or may obtain information, application format and documents required for the issue of digital certificate. iv. The Bidder must ensure that he/she comply by the online available important guidelines at the portal https://etenders.hry.nic.in for Digital Signature Certificate (DSC) including the e-Token carrying DSCs. For any queries related to e-Bidding process (registration, online e-bid submission/withdrawal, uploading of documents), Bidder may contact the below representative of NIC: **Ms. Manju Aggarwal** **Technical Director,** **Scientist-E, NIC.** **Panchkula.** **E - mail:** a.manju@nic.in **Help Desk:** 0172 – 584257, 94170-69017. v. Bidder for a particular Bid must be submitted online using the digital certificate (Encryption & Signing), which is used to encrypt and sign the data during the stage of Bid preparation. In case, during the process of a particular Bid, the user loses his digital certificate (due to virus attack, hardware problem, operating system or any other problem) he will not be able to submit the Bid online. Hence, the users are advised **to keep a backup of the certificate** and also keep the copies at safe place under proper security (for its use in case of emergencies). vi. In case of online Bidding, if the digital certificate issued to the authorized user of a firm is used for signing and submitting a Bid, it will be considered equivalent to a no-objection certificate/power of attorney/lawful authorization to that User. The firm has to authorize a specific individual through an authorization certificate signed by all partners to use the digital certificate as per Indian Information Technology Act 2000. Unless the certificates are revoked, it will be assumed to represent adequate authority of the user to Bidder on behalf of the firm in the department Bids as per Information Technology Act 2000. The digital signature of this authorized user will be binding on the firm. vii. In case of any change in the authorization, it shall be the responsibility of management/ partners of the firm to inform the certifying authority about the change and to obtain the digital signatures of the new person/ user on behalf of the firm/ company. The procedure for application of a digital certificate however will remain the same for the new user. viii. The same procedure holds true for the authorized users in a private/Public limited company. In this case, the authorization certificate will have to be signed by the directors of the company.

B. Opening of an Electronic Payment Account:

For purchasing the Bid documents online, Bidders are required to pay the Bid documents fee online using the electronic payment gateway service through their Debit Cards & Internet Banking accounts. For online payments guidelines, please refer to the Home page under tab "Guidelines for hassle free Bid Submission" of the eProcurement Portal of Government of Haryana, https://etenders.hry.nic.in

C. Pre-requisites for online Bidding:

In order to operate on the electronic Bid management system, a user's machine is required to be set up. A help file on system setup/Pre-requisite can be obtained from National Informatics Center or downloaded from the home page of the website - https://etenders.hry.nic.in the link for downloading required java applet & DC setup are also available on the Home page of the eProcurement Portal.

D. Online Viewing of Invitation of Bids (IFB):

The Bidders can view the IFB and the time schedule (Key Dates) through the single portal eProcurement system on the Home Page at https://etenders.hry.nic.in

E. Downloading of Bid Documents:

The Bid documents can be downloaded free of cost from the eProcurement portal https://etenders.hry.nic.in. However, Bidders are required to pay a fee of **INR 15,000.00** as cost of Bid Document before submission Bid online.

F. Key Dates:

The Bidders are strictly advised to follow dates and times as indicated in the online Invitation of Bids. The date and time shall be binding on all Bidders. All online activities are time tracked and the system enforces time locks that ensure that no activity or transaction can take place outside the start and end dates and the time of the stage as defined in the online Invitation of Bids.

G. Online Payment of Cost of Bid Documents and E-Service Fee:

The online payment of Cost of Bid Documents and E-Service Fee of INR 1180.00 shall be made using the secure electronic payment gateway by Bidders online directly through Debit Cards & Internet Banking accounts.

The secure electronic payments gateway is an online interface between Contractors and Debit card/online payment authorization networks.

H. Preparation & Submission of online Applications/Bids:

	i. Detailed Bid documents may be downloaded from eProcurement website (https://etenders.hry.nic.in) from **06.02.2025 (09:00 Hrs. IST) to 18.03.2025 (15:00 Hrs IST.)** and Bid mandatorily be submitted online following the instruction appearing on the screen. ii. **Scan copy of Documents to be submitted/uploaded for Technical Bid under online PQQ/ Technical Envelope:** All documents shall be prepared and scanned in file formats PDF /JPEG/MS WORD format such that file size does not exceed 10 MB) and uploaded during the on-line submission of PQQ or Technical Envelope. **iii. Price Bid shall be submitted mandatorily online under Commercial Envelope and original not to be submitted manually** ***NOTE:*** ***(A) Bidders participating in online Bids shall check the validity of his/her Digital Signature Certificate before participating in the online Bidss at the portal*** https://etenders.hry.nic.in**.** ***(B) For help manual, please refer to the 'Home Page' of the*** **eProcurement *website at*** https://etenders.hry.nic.in
ITB 4.1(b)	Joint Venture/Consortium is not permitted to participate in this Bid
ITB 4.1 c	Shall not be applicable being a Domestic Bidding.
ITB 4.1 d	Shall not be applicable being a Domestic Bidding.
ITB 4.1 e	Eligible Bidder for this work is *'Class-I Local'*
ITB 4.4 h	Shall not be applicable being a Domestic Bidding.
ITB 4.4 i	Shall not be applicable being a Domestic Bidding.

B. Bidding Documents

ITB 7.1	For **Clarification of Tender purposes** only, the Employer's address is: **Attention:** Chief Project Manager/West **Street address:** Haryana Rail Infrastructure Development Corporation Limited (HRIDC), IRCON Tower-2, Plot No. 16, Sector-32, **Floor:** 3rd floor **City:** Gurugram **ZIP code:** 122018 **Country:** India **Telephone:** 0124 2979623 **E-mail:** etendering@hridc.co.in

<table>
<tr><td>ITB 7.4</td><td>Replace the entire Sub-Clause 7.4 with the following:

There will be NO Pre-Bid Meeting for this Bid. However, Bidder may submit their Bid related queries in the following format:

<table>
<tr><th>Query No.</th><th>Reference to Bid Document

(Clause/ Para No. & Page No.)</th><th>Brief Description of Clause/ Para No.</th><th>Query Raised</th></tr>
<tr><td>1.</td><td></td><td></td><td></td></tr>
<tr><td>2.</td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td></td><td></td><td></td></tr>
<tr><td>5.</td><td></td><td></td><td></td></tr>
<tr><td>etc.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

The prospective Bidders can submit their Bid related queries through email along with an editable soft copy (MS Word) on the email id (i.e. etendering@hridc.co.in).</td></tr>
<tr><td>ITB 7.5</td><td>The Bidder shall submit any Bid related queries in writing, to reach the Employer not later than 25.01.2025, 1800hrs IST.</td></tr>
<tr><td>ITB 7.6</td><td>Replace ITB 7.6 with the following:

Response to Bid related queries, without identifying the source, will be uploaded on e-Procurement portal, https://etenders.hry.nic.in. Any modification to the Bid Document that may in the sole discretion of the Employer become necessary as a result of the Bid related queries shall be made by the Employer exclusively through the use of an Addendum/Corrigendum pursuant to ITB 8.</td></tr>
<tr><td>ITB 8.2</td><td>Replace ITB 8.2 with the following:
Any addendum/Corrigendum issued shall be part of the Bid Documents and shall be uploaded on eProcurement portal, https://etenders.hry.nic.in .
The onus is on the Bidders to visit the eProcurement portal to see the addenda published by the Employer.</td></tr>
</table>

C. Preparation of Bids

ITB 10.1	The language of the bid is: **English.** All correspondence exchange shall be in **English** language.

ITB 11.2	Alternative technical solutions **are not** permitted.
ITB 11.4	**Replace the entire ITB Sub-Clause 11.4 with the following:** The Bidder shall submit all the documents in its Technical Bid as per the Checklist CL (A. Technical Bid) given in Section 4: Bidding Forms.
ITB 11.5	**Replace the entire ITB Sub-Clause 11.5 with the following** The Bidder shall submit all the documents in its Financial Bid as per the Checklist CL (B. Financial Bid) given in Section 4: Bidding Forms.
ITB 13.1	Alternative bids **will not be** permitted.
ITB 13.2	Alternative times for completion **will not be** permitted.
ITB 19.1	Bidder shall furnish a Bid Security for an amount of **INR 21,50,000/- (INR Twenty One Lacs and Fifty Thousands only).**
ITB 19.2	Not Applicable
ITB 19.3	**Replace the ITB 19.3 with the following:** The amount for Bid Security shall be be paid online by eligible Bidders on eProcurement Portal of Govt. of Haryana ((https://etenders.hry.nic.in)) in favor of Haryana Rail Infrastructure Development Corporation Limited using the electronic payment gateway service.
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: (a) In case of Private/Public Companies or Limited Liability Partnership (LLP) firms, a Power of Attorney from the Director of the Company who has been authorized by the Board of Directors through resolution to sign on behalf of the Company. Copy of Board Resolution shall also be submitted. (b) In case of Proprietory Bidder, Power of Attorney duly signed by the Proprietor. (c) In case of Partnership firms, Power of Attorney duly signed by all the Partners. (d) In case of Limited Liability Partnership (LLP) firms, a Power of Attorney issued by the LLP in favour of the individual to sign the Bid on behalf of the LLP and create liability against the LLP.

D. Submission and Opening of Bids

ITB 22.1	For Bid submission purposes eProcurement website address is: https://etenders.hry.nic.in .

	The start date for Bid submission is: **Date: 11.03.2025** **Time: 11:00 hrs. IST** The deadline for Bid submission is: **Date: 18.03.2025** **Time: 15:00 hrs. IST**
ITB 25.1	The online bid opening shall take place at eProcurement portal https://etenders.hry.nic.in. **Bid Opening**: **Date: 18.03.2025** **Time: 15:30 hrs. IST**
ITB 34.1	**34.1 Purchase preference for Make in India:** **34.1.1** The purchaser shall take due consideration of Public Procurement (Preference to Make in India) Order, dated 15.06.2017. In this regard, Railway Board letter No. 2015/RS(G)/779/5 dated 03.08.2017 which is revised vide Railway Board letter No. 2020/RS(G)/779/5 dated 12.06.2020, which is further revised vide Public Procurement (Preference to Make in India) Order, dated 16.09.2020 circulated vide Railway Board letter No. 2015/RS(G)/779/5 (Vol. III) dated 25.09.2020 which is further revised vide Public Procurement (Preference to Make in India) Order, dated 19.07.2024 circulated vide Railway Board letter No. 2020/RS(G)/779/2/Pt.1 (E3322671) dated 20.08.2024 may be downloaded from Railway Board's website. **34.1.2** Local content: For the purpose of above policy, the minimum local content for Class I supplier shall be 50% and 'margin of purchase preference' shall be 20%. **34.1.3** As para 9(b) of Make in Indian Policy letter dt.19.07.2024, if procurement value is in excess of Rs. 10 Crore. The Class-I local supplier/Class-II local supplier are required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accounts (in respect of suppliers other than companies) giving the percentage of local content. **34.1.4** Procurement under this tender shall comply with the Clause 10(d) (ii) of Public Procurement (Preference to Make in India) Order, dated 19.07.2024 which states "Entities of countries which have been identified by the nodal ministry/department as not allowing Indian Companies to participate in their Government procurement for any item related to that nodal ministry shall not be allowed in Government procurement in India for all item related to that nodal Ministry, except for the list of the item published by the permitting their participation. **34.1.5** In pursuance of the public procurement policy on MSE(Micro & Small Enterprises) vide notification of Government of India dated 23.03.2012 (as notified in the Gazetted of India Notification No. 503 dated 26.03.2012 (clarified vide Office of Development (Commissioner), MSME's OM dated 15.02.2016 as amended on 04.10.2019 by Ministry of MSME), the following conditions are applicable for eligible MSEs : (a) Participating MSEs quoting a price within price band of L1 +15% shall be

	allowed to supply a portion of the requirement by bringing down their price to L1 price in a situation where L1 price is from someone other than a MSE and such MSEs can be together ordered up to 25% of the total tendered value. (b) The sub-target for procurement from MSEs owned by SC/ST shall remain at 4% and MSEs owned by women the sub-target shall be 3%, out of the total 25%. (c) MSEs who are interested in availing themselves of the above benefits will enclose with their offer the proof of their being registered with MSE for tendered item or similar items with any of the following agencies: (i) UDYAM (UDYAM Registration Certificate) (d) All MSE's shall be eligible for benefits of public procurement policy irrespective of product category under with MSEs are registered. Failing (a) to (c) above, such offers will not be eligible for consideration of benefits detailed in MSE notification of Government of India dated 23.03.2012 (as amended by the Ministry of MSME on 04.10.2019).
ITB 42	Gurugram, Haryana

Section 3 – Evaluation and Qualification Criteria

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Section 3 – Evaluation and Qualification Criteria

1. General Provisions

1.1 Evaluation Sequence

Bids will be evaluated through the following four stages:

(i) Stage 1: Evaluation of Administrative Requirements

(ii) Stage 2: Evaluation of Compliance with the Qualification Requirements

(iii) Stage 3: Technical Evaluation

(iv) Stage 4: Financial Evaluation

1.2 Clarification from Bidders

The Employer may request clarification of any Bid in accordance with the provisions of the Bid Documents (Part 1, Section-1: Instructions to Bidders, Clause 27).

1.3 Bidding Forms

(a) Bidders should note that the information required to be inserted into the Bidding Forms shall be comprehensive and detailed. The technical information shall be furnished in line with the requirements of Part 1, Part 2 and Part 3 of the BidDocuments.

(b) All Forms contained in the Bid Documents must be fully and properly completed and all the forms must be returned duly signed by Authorised Representative of the Bidders, as they will be reviewed exactly as submitted and errors or omissions may count against the Bidder.

(c) Any Bidder who is found to have intentionally submitted false or inaccurate statements/information shall be disqualified from the Bidding process.

1.4 Joint venture/Consortium

Joint venture/Consortium is **not permitted** to participate in this Bid.

2. Stages of Evaluation

2.1 Stage 1: Evaluation of Administrative Requirements

The Stage 1 Evaluation will consist of checking the Bids to confirm whether they are substantially responsive to the administrative requirements of the Bid Documents. The following administrative items will be checked:

(i) Whether the Tender submission is in accordance with ITB 11.4;

(ii) Whether the Power of Attorney (POA) for the Authorised signatory is in the correct form [Ref. ITB 20.3 and ITB 20.4]. If during technical evaluation stage, POA submitted by the Bidder is not found in the correct format, Employer will send written (Courier/email with PDF attachment) request to the Authorized Representative for rectification of POA in accordance with format prescribed in Section 4, Bidding Forms, specifying the deadline for receipt of Power of Attorney in correct form. If a Bidder does not provide the Power of Attorney in correct form within the stated date and time set in the Employer's request for correction of Power of Attorney, its Bid is liable to be rejected.

3. Stage 2: Evaluation of Compliance with the Qualification Requirements

If the Bidder fails to comply with any item of Qualification requirements given below, the Bidder shall be disqualified.

3.1 Eligibility

Criteria	Compliance Requirements	Documents Submission Requirements
	Single Entity	
3.1.1 Nationality		
Nationality in accordance with ITB Sub-Clause 4.1	Must meet requirement	Form ELI-1.1
3.1.2 Conflict of Interest		
No Conflict of interest in accordance with ITB Sub-Clause 4.3.	Must meet requirement	Letter of Technical Bid (Form PS 1)
3.1.3 Disqualification of Bidder		
Not Disqualified under Clause 4.4 of ITB.	Must Meet Requirement	Letter of Technical Bid (Form PS 1) & Affidavit (Form PS 3)

3.2 Financial Situation and Performance

Criteria	Compliance Requirements	Documents Submission Requirements
Requirement	Single Entity	
3.2.1 Historical Financial Performance		
(i) Minimum average Net-Worth (Total Assets – Total Liabilities) should be **positive** during the last three financial years (refer note below the table) and (ii) Net Worth in the last financial year (i.e. 2023-24) should be also Positive.	Must meet requirement of (i) and (ii)	Form FIN – 1
3.2.2 Average Annual Construction Turnover		
Minimum average annual construction turnover in equivalent **INR 40 Cr** calculated as total certified payments received for contracts in progress or completed, within the last **three** financial years (i.e. **2021-22** , **2022-23** and **2023-24** (refer note below the table).	Must meet requirement	Form FIN – 2
3.2.3 Financial Resources		
The Bidder shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow requirements estimated as **INR 6.50 Cr** for the subject contract **(i.e. MNS-01).**	Must meet requirement	Form FIN – 3
3.2.4 Bid Capacity		
The available Bid capacity should be equal to or more than **INR 40.00 crores.** The available Bid capacity will be calculated as per Item No. 1 of Form FIN- 4.	Must meet requirement	Form FIN – 4

Notes: -

(i) In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the Bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

(ii) In case audited balance sheet of the last financial year is not available with the Bidder, he will declare the same vide item (l) prescribed in the Letter of Technical Bid.

3.3 Experience

Criteria	Compliance Requirements	Documents Submission Requirements
Requirement	**Single Entity**	
3.3.1 Specific Construction Experience		
(a) Execution as a Contractor/ JV member / Subcontractor in at least **One "Similar Work"** having minimum value of **INR 24.00 Crores.** **OR** (b) Execution as a Contractor/ JV member/ Subcontractor in at least **two "Similar Works"**, each having minimum value of **INR 16.00 Crores.** **OR** (c) Execution as a Contractor, JV member in at least **three "Similar Works"**, each having minimum value of **INR 12.00 Crores.** **"Similar Work"** here shall be civil work involving construction of minimum G+3 building. The **"Similar Work"** in (a) or (b) or (c) above must have been **successfully or substantially completed** within the last Seven years before the deadline for submission of the Bids.	Must meet requirement of either (a) or (b) or (c)	Form EXP – 3.3.1 along with documentary evidence issued by the Employer (Owner of the Work) / Concessionaire
3.3.1 (B) Execution as a Contractor/JV member/Subcontractor one work involving General Electrical services. The minimum value of General Electrical Services pertaining to building works should be **INR 3.00 Crores**. The work should have been **successfully or substantially completed** within the last Seven years before the deadline for submission of the Bids	Must meet requirement	Form EXP – 3.3.2 along with documentary evidence issued by the Employer (Owner of the Work) / Concessionaire

Notes:

1. Substantial completion shall be based on 80% or more of the original or revised value (whichever is lower) of works completed under the contract. Completion or substantial completion of work shall be based on completion/substantial completion certificate issued by the Employer (Owner of the Work) / Concessionaire.
2. Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for purpose of satisfying his/her experience criteria mentioned in Sub-Clause 3.3.1 . For the purpose of value of similar work and General Electrical Services works for the past experience of a Bidder in a JV, credit shall be given in proportion of the percentage share of the Bidder in that JV certified by the Employer (Owner of the Work)/Concessionaire.

(a) If the Employer's Certificate does not indicate the percentage share of Bidder, in such a case value of Bidder's share in JV shall be as per details given in JV agreement forming part of the relevant Contract Agreement. Bidder should submit JV agreement with their Bid if the Bidder's share is not mentioned in Employer (Owner of the Work)/Concessionaire.

3. The Bidder shall submit copy of completion certificate/experience certificate issued by the Employer (Owner of the Work) / Concessionaire clearly indicating the similarity of work, actual completion Date/substantial completion Date, Value of Work executed by the Bidder. Bid submitted without this documentary proof shall be liable to be rejected.

4. In case Bidder submits **work experience certificate issued by other than Govt. / Public Sector undertakings**, the Bidder shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate. Work experience certificate without these supporting documents will be liable to be rejected.

5. If a Bidder has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (Owner of the work) / Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Bids submitted without this documentary proof is liable to be rejected.

   For example: Entity **'A'** is the owner of the work and awards a contract for execution of work to Contractor **'X'**. Thereafter, Contractor **'X'** sublets part of the work to Sub-Contractor **'Y'**. In this case, experience certificate of Sub-Contractor **'Y'** issued only by Entity **'A'** / Concessionaire shall be considered for the purpose of evaluation of the Bid. Experience certificate issued by Contractor **'X'** to Sub-Contractor **'Y'** shall not be considered and the offer submitted based on such certificate is liable to be rejected.

6. The completion certificate/experience certificate and supporting documents submitted by the Bidder shall be in the name of Bidder. The credentials of the other firms such as the Bidder's subsidiaries, parent entities, affiliates, subcontractors or any other firm(s) different from the Bidder shall not be considered towards Bidder's qualification.

7. Bidder must note that the completion certificate/experience certificate issued by the Independent Engineer shall not be considered for evaluation of Bidder's qualification towards meeting the requirements of Sub-Clause 3.3.1 above.

8. Exchange Rate for Qualification Criteria

Wherever a Form in Section 4, Bidding Forms, requires a Bidder to state a monetary amount, Bidder shall indicate the INR equivalent as indicated in the respective form using the rate of exchange determined as follows:

(a) For Construction turnover or financial data required for each year – Exchange rate prevailing on the last day of the respective financial year.

(b) Value of single contract - Exchange rate prevailing on the date of the Contract Award i.e. the date of issue of Letter of Acceptance.

(c) *Exchange rates shall be taken from reference rate published by the Reserve Bank of India (RBI) on its website https://www.rbi.org.in. In case the exchange rate of particular currency on given date is not available on RBI web site, it will be as per the web site https://www.fbil.org.in of Financial Benchmark India Private Limited (FBIL). Any error in determining the exchange rates may be corrected by the Employer. In the case, where a Bidder is required to convert a monetary amount from a currency other than those currencies for which the RBI/FBIL reference rate is not published, the INR equivalent shall be worked out using the rate of exchange as published by the central bank of the country issuing the said currency. In case the exchange rate of that currency is not directly available in INR on the website of the central bank of the country issuing the said currency then the currency will be first converted to USD as per that web site and then converted from USD to INR as Per RBI or FBIL reference rates*

4. Stage 3: Evaluation of Technical Proposal

(a) The Stage 3 Evaluation will consist of checking the technical aspects of the Bidders to confirm whether they substantially conform to the requirements of the Bid Document.

(b) In order to determine whether the Bidder substantially conforms to the technical requirements of the Bid Document, the technical proposal shall broadly cover the following items in relevant Forms:

S. No.	Technical Evaluation Items	Relevant Forms
1.	Site Organization	Form TP-1, Technical Proposal, Section 4 Bidding Forms
2.	Outline Method Statement	Form TP-2, Technical Proposal, Section 4 Bidding Forms
3.	Works Execution Programme	Form TP-3, Technical Proposal, Section 4 Bidding Forms

(i) Site Organization

The Bidder must submit Site Organization in the Form TP-1 given in Section 4 Bidding Forms.

(ii) Outline Method Statement

The Bidder must submit Outline Method Statement in the Form TP-2 given in Section 4 Bidding Forms.

(iii) Works Execution Programme

The Tenderer must submit Works Execution Programme in the Form TP-3 given in Section 4 Bidding Forms.

Note: Bidder must visit the site and should be fully aware of all the Works requirements under this Bid and then prepare and submit their Bid.

All Bids which are found substantially responsive after Stage 3 evaluation will proceed to the Stage 4: Financial Bid Evaluation.

5. Stage 4: Financial Bid Evaluation

The activities in this Stage 4 will be in two (2) parts.

A. Evaluation of Compliance and Responsiveness

Under this Stage the following items will be checked:

(i) Whether the Letter of Financial Bid is compliant (i.e. does not include any alteration to the basic terms and does not constitute an alternative offer).

(ii) Whether all Forms and Bill of Quantities (words and figures) have not been altered and are correctly completed and signed.

B. Detailed Financial Bid Evaluation

After passing the above requirements, the Price Bid will then proceed for detailed financial evaluation in accordance with ITB 35.

C. Award of Contract

Bid with the lowest Bid price from above shall move to next stage as per ITB “F. Award of Contract”.

Section 4: Bidding Forms

This Section contains the forms which are to be completed by the Bidder and submitted as part of his Bid

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Form: PS 1

Letter of Technical Bid

Date: …….
Bid No.: HORC/HRIDC/MNS-01/STN/2025

To,

Chief Project Manager/West
Haryana Rail Infrastructure Development Corporation Limited (HRIDC),
IRCON Tower-2, 3r Floor,
Plot No. 16, Sector-32,
Gurugram – 122018
Tel: 0124 2979623

We, the undersigned, hereby submit our Bid, in two parts separately, namely: (a) the Technical Bid; and (b) the Financial Bid.

In submitting our Bid, We declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda/Corrigenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute the Works in conformity with the Bidding Documents;

(c) Our bid shall be valid for a period of **180 days** after the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) If our bid is accepted, we commit to obtain a performance security in accordance with the Bidding Documents;

(e) If our bid is accepted, we commit to deploy Key Equipment and Key Personnel consistent with the requirements stipulated in Section 5: Works Requirements;

(f) If our bid is accepted, we commit to submit work method statements for all major activities and get these approved from the Engineer prior to commencing work on such activities. We also understand that the work shall be executed as per the approved method statements without any deviations;

(g) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;

(h) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;

(i) If our bid is accepted, we will not sub-contract any work to a Sub-Contractor from a Bidder of a country which share a land border {Details in clause ITB 4.1 (d)} with India unless such contractor is registered with the Competent Authority.

(j) We declare that we are not liable to be disqualified in accordance with ITB 4.4, and we are enclosing the affidavit for the same as per the Performa given in the bid document.

(k) We understand that if at the time of evaluation of the Bid or during execution of the Contract, the declaration regarding local content, submitted thorough the relevant form provided in Section 4 Bidding Forms, is found to be false, it will be treated as breach of Code of Integrity under Rule 175(1)(i)(h) of the General Financial Rules for which the Bidder or its successors can be debarred up to two years along with such other actions as may be permitted by law.

We have also enclosed declaration in Form-MII and also a certificate, in case the estimated cost of the work is more than ₹10 Cr, from statutory auditor or cost auditor of the company or from practicing cost accountant or chartered accountant.

We also undertake that the 'Local Content' added in the entire work will have to be submitted along with the final bill.

(l) ***[select the appropriate option and <u>delete whichever is not applicable]</u>*** [We declare and certify that financial data as per the balance sheets for last three financial years including that for the latest concluded financial year are being submitted] **OR** [We declare and certify that balance sheet for the latest concluded financial year has not been finalized till date and that is why we are furnishing financial data for last three financial years ignoring the latest concluded financial year.]

(m) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

(n) We have not made any deviations from the requirement of the bidding document and we have also not made any tampering or changes in the bidding documents on which the bid is being submitted and if any tampering or changes are detected at any stage, we understand the bid will invite summary rejection and forfeiture of bid security/the contract will be liable to be terminated along with forfeiture of performance security, even if LOA has been issued.

(o) If our bid is accepted, we opt to take payment into the bank account, nominated by us.

(p) We declare that the submission of this bid confirms that no agent, middleman or any intermediary has been, or will be engaged to provide any services or any other item of work related to the award and performance of this contract. We further confirm and declare that no agency commission or any payment which may be construed as an agency commission has been, or will be, paid and that the bid price does not include any such amount. We acknowledge the right of the Employer, if he finds to the contrary, to declare our bid to be noncompliant and if the contract has been awarded to declare the contract null and void

(q) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Name of the Bidder: * [*insert complete name of the Bidder*]

Name of the person duly authorized to sign the Bid on behalf of the Bidder: **[*insert complete name of person duly authorized to sign the Bid*]

Title of the person signing the Bid: [*insert complete title of the person signing the Bid*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*]

Date signed [*insert date of signing*] **day of** [*insert month*], [*insert year*]

****: Person signing the Bid shall have the power of attorney given by the Bidder. The power of attorney shall be submitted in Form ELI-1.2.**

Form: PS 2

FORMAT FOR AFFIDAVIT TO BE SUBMITTED BY BIDDER ALONGWITH THE BID

*(To be executed in presence of Public Notary on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper has to be in the name of the bidder)***

Bid No.: HORC/HRIDC/MNS-01/STN/2025

I **…….** ***(Name and designation)*******…….** appointed as the attorney/authorized signatory of the bidder (including its constituents), M/s. _____ (hereinafter called the bidder) for the purpose of the Bid for the work of _____ as per the bid No._____ of HORCL/HRIDC, do hereby solemnly affirm and state on behalf of the bidder including its constituents as under:

*1. That the bidder or any of its constituents has not been Blacklisted/ banned for business dealings for all Government Departments or by Ministry of Railways or by HORCL/HRIDC at any time and/or no such blacklisting is in force as on the deadline for submission of bids.

*2. That none of the previous contracts of the bidder or any of its constituents had been terminated/rescinded for Contractor's failure or part terminated for its failure as a JV partner with forfeiture of its full Performance Security, by Haryana Rail Infrastructure Development Corporation Limited during the period of last 3 years before the deadline for submission of bids.

(Add Proviso of Clause 4.4(b) (ITB) suitably, if any Contract was so terminated).

*3. The bidder or any of its constituents has not been imposed liquidated damages of 5% or more of contract value by HORCL/HRIDC due to delay in the implementation of any previous contract (either in the capacity of a single entity or as constituent of any other JV) within the period of last 2 years before the deadline for submission of bid [*2 years shall be reckoned from the date on which imposed L.D. has exceeded 5% of the contract price]*and there are no such accrued delay damages which has not been fully recovered before the deadline for submission of bids on account of contractor's request for deferring recovery to maintain cash flow and HORCL/HRIDC has acceded to the same in the interest of the project and the work under the previous contract in question has been completed before the deadline for submission of bid, unless imposition of such delay damages has been set aside by the Competent Authority.

4. That the Bidder or any of its constituents is neither Bankrupt/Insolvent nor is in the process of winding-up nor such a case is pending before any Court on the deadline of submission of the bid.

*5. That the name of the Bidder or any of its constituents is not on the list of "Poor Performer" of HORCL/HRIDC as on the deadline for submission of bid.

6. We declare that the bidder or any of its constituents have not either changed their name or created a new business entity as covered by the definition of "Allied Firm" under para 1102 (iii) of chapter XI of Vigilance manual of Indian Railways

with latest amendments and corrections (available on website of Indian Railways), consequent to having been banned business dealings for specified period which is not over or suspended business dealings or having been declared as poor performer.

7.[#] We declare and certify that balance sheets for last three financial years including that for the latest concluded financial year are being submitted.

OR

We declare and certify that balance sheet for the latest concluded financial year has not been finalized till date and that is why we are furnishing financial data for last three financial years ignoring the latest concluded financial year.

*(# - Delete whichever is not applicable)***.

8. That the bidder or any of its constituents is not an Entity of such countries, which have been identified by the Railway Ministry as not allowing Indian Companies to participate in their Government procurements for any item related to Railway Ministry, except for the list of items published by the Railway Ministry permitting their participation.

9. That the bidder or any of its constituents has not committed any previous transgressions in respect of Code of Integrity [Rule 175 (1) of General Financial Rules 2017] with any entity in any country during the last three years or of being debarred by any other procuring entity.

10. We declare and certify that we have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

11. We declare that the information and documents submitted along with the Bid by us are correct and we are fully responsible for the correctness of the information and documents, submitted by us.

12. "We have read the clause regarding restrictions on procurement from a bidder of a country which share a land border with India and I certify that :

@ This Bidder is not from such a country

OR

This Bidder is from such a country and the bidder has been registered with the Competent Authority.

13. We understand that in case we cease to fulfill the requirements of qualifying and eligibility criteria at any time after opening of bids and till finalization of bids, it will be our bounden duty to inform the Employer of our changed status immediately and in case of our failure to do so, our bid shall be rejected and bid security shall be forfeited. In case such failure comes to the notice of Employer at any time after award of the contract, it will lead to termination of the contract and forfeiture of Bid or Performance Security. We shall also be liable for Banning of Business dealings upto a period of five years.

14. We understand that if the contents of the affidavit are found to be false at any stage during bid evaluation, it will lead to rejection of our bid and forfeiture of the bid security. Further, we ***[insert name of the bidder]*****_____ and all our constituents understand that we shall be liable for banning of business dealings upto a period of five years.

15. We also understand that if the contents of the affidavit are found to be false at any time after the award of the contract it will lead to termination of the contract, forfeiture of Bid or Performance Security and Banning of Business dealings of the Bidder and all its constituents for a period of upto five years.

SEAL AND SIGNATURE OF THE BIDDER

Verification:

Verified on _____ day of _____ at _____ that the contents of the above mentioned affidavit are true and correct and nothing material has been concealed there from.

SEAL AND SIGNATURE OF THE BIDDER

**Modify the contents wherever necessary, in terms of sub-clause 4.4 ITB.*
*** The contents in Italics are only for guidance purpose and details as appropriate, are to be filled in suitably by Bidder.*

Attestation before Magistrate/Public Notary

@ Strike out whichever is not applicable. In case the bidder is from a country which share a land border with India, evidence of valid registration by the Competent Authority shall be attached.

Form: BDF/1

Bid Security

The amount for Bid Security will only be paid online by eligible Bidders on eProcurement Portal of Government of Haryana.

Form : BDF/2

Bid Security Declaration Form

DELETED

Form TP-1

Site Organisation

(To be submitted by the Bidder)

Form TP-2

Outline Method Statement

(To be submitted by the Bidder)

Form TP-3

Work Execution Programme

(To be submitted by the Bidder)

Bill of Quantities (BOQ)

For Bill of Quantities, Please refer Volume-II

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

Bidder's Information	
Bidder's legal name	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's legal address for Communication:	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	Name: _____ Designation: _____ Address: _____ Telephone/Fax numbers: _____ Mobile number: _____ E-mail address: _____

The Bidder shall attach copies of the following original documents with the form:

1. Articles of incorporation or constitution, and/or documents of registration of the legal entity named above, in accordance with ITB 4.1 and 4.2.
2. Authorization to represent the firm named in above, in accordance with ITB 20.2.

SIGNATURE OF AUTHORIZED SIGNATORY
ON BEHALF OF BIDDER

Company stamp: ……..…..

Form: ELI - 2
Format for Power of Attorney for Authorised Signatory of Bidder
(Ref. Sub-Clause: ITB 20.2)

POWER OF ATTORNEY*

(*To be executed on non-judicial stamp paper of the appropriate value in accordance with relevant stamp Act. The stamp paper to be in the name of the company who is issuing the Power of Attorney*)

Know all men by these presents, we…..…….. (name and address of the registered office) do hereby constitute, appoint and authorise Mr/Ms…….. (name and residential address) who is presently employed with us and holding the position of ……..as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our Bid for "**Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.**", including signing and submission of all documents and providing information/ responses to Haryana Rail Infrastructure Development Corporation Ltd (HRIDC), representing us in all matters before HRIDC, and generally dealing with HRIDC in all matters in connection with our Bid for the said project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

……. (Signature)

(Name, Title and address) of the **Person Accepting the POA.**

……. (Signature)

(Name, Title and address) of the **Person issuing the POA**

Notes:

i. The Bidder should submit the notarised Power of Attorney.
ii. The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.
iii. The Bidder should submit following additional document in support of the POA as case to case basis:
    a) Notary certified copy of Proprietorship Affidavit in case of Proprietary Bidder.
    b) Notary certified copy of Partnership Deed in case of Partnership Firms.
    c) Board Resolution in case of a Public/Private limited company/LLP.
    d) Incorporation Certificate and Memorandum & Article of Association in case of a Public/Private limited company.

e) Incorporation Certificate and Limited Liability Membership Agreement in case of Limited Liability Membership firms.

Form FIN-1: Financial Situation and Performance

[Ref. ITB Sub-Clause 17.2 & EQC Sub-Clause 3.2.1]
[The following table shall be filled in for the Bidder]

Bid No.: HORC/HRIDC/MNS-01/STN/2025

Bidder's Name: _____

Page _____of _____pages

(All amounts in Lacs)

Type of Financial information	**Historic information for Financial Years, (Amount in INR)**		
	Year 1: 2021-22	**Year 2: 2022-23**	**Year 3: 2023-24**
	Statement of Financial Position (Information from Audited Balance Sheet)		
Total Assets (TA)			
Total Liabilities (TL)			
Total Equity/Net Worth (NW) = TA-TL			

Notes:

(i) In case, the Financial Year is the same as the Calendar Year, the turnover for the year 2021, 2022 and 2023 shall be furnished.

(ii) The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.

(iii) The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Bidder's Authorized representative.

(iv) The above documents shall reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.

(v) In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the Bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

(vi) In case audited balance sheet of the last financial year is not available with the Bidder, he will declare the same vide item (l) prescribed in the Letter of Technical Bid.

(vii) If the value of Net Worth is not submitted for any of the last three years, the Bidder shall be considered nonresponsive and shall be summarily rejected.

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct as per the audited balance sheets of the entity.

Signature: ……..

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-2: Average Annual Construction Turnover

[Ref. ITB Sub-Clause 17.2 & EQC Sub-Clause 3.2.2]

[The following table shall be filled in for the Bidder]

Bid No.: HORC/HRIDC/MNS/STN/2025

Bidder's Name: _____

Page _____of _____pages

(All amounts in Lacs)

Annual Construction Turnover Data for the Last Three (03) Financial Years)			
Year	**Amount Currency**	***Exchange Rate**	**INR Equivalent**
2021-22	*[insert amount and indicate currency]*		
2022-23			
2023-24			
Average Annual Consultancy Turnover			

Notes:

(i) In case, the Financial Year is the same as the Calendar Year, the turnover for the year 2021,2022 and 2023 shall be furnished.

(ii) The Average Annual Construction Turnover shall be calculated by adding the turnover amount of last three financial years divided by three.

(iii) The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.

(iv) The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Bidder's Authorized representative.

(v) The above documents shall reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.

(vi) In the event that the audited accounts for the latest concluded Financial Year are not available, the Bidder shall furnish information pertaining to the last three financial years after ignoring the latest concluded financial year. In case, the Bidder submits audited financial information for the last four or more years, only the figures for the latest three years shall be considered for evaluation.

*(vii) In case audited balance sheet of the last financial year is not available with the Bidder, he will declare the same vide item (*l*) prescribed in the Letter of Technical Bid.*

(viii) If the value of Annual Construction Turnover is not submitted for any of the last three years prescribed in Financial Data, the Bid shall be evaluated by considering "NIL" Turnover for that year(s).

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct as per the audited balance sheets of the entity.

Signature: ……..

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-3
Sources of Finance for the Subject Contract

[Ref. ITB Sub-Clause 17.2 and Section 3, Evaluation and Qualification Criteria, Sub-Clause 3.2.3]

Bid No.: HORC/HRIDC/MNS/STN/2025

Bidder's Name: _____

Page _____of _____pages

Bidder should specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current contract commitments, available to meet the total construction cash flow demands of the subject contract **i.e. Package MNS.**

(*All amounts in Lakhs*)

Financial Resources for Subject Contract Package MNS		
No.	**Source of financing**	**Amount (INR equivalent)**
1		
2		
3		
	Total Sources of Finance for the subject Contract MNS	

(i) The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.

(ii) The Form duly certified by a Chartered Accountant/Company Auditor/Statutory Auditor shall also be signed by Bidder's Authorized representative.

(iii) The above documents shall reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Chartered Accountant/Company Auditor/Statutory Auditor

Certified that the information furnished above is correct.

Signature: ……..

Name:

Position:

Date:

Company:

Company stamp:

Membership No:

Address:

Contact No:

Email ID:

Form FIN-4: Bid Capacity

[Ref. ITB Sub-Clause 17.2 and Section 3, Evaluation and Qualification Criteria, Sub-Clause 3.2.4]

Bid No.: HORC/HRIDC/MNS/STN/2025

Bidder's Name: _____

Page _____of _____pages

1.0 Bid Capacity:

The available bid capacity shall be calculated as under:
Available Bid Capacity = [A x N x 2] – 0.33xNxB
Where,

A = Maximum value of construction works executed and payment received in any one of the previous three financial years, taking into account the completed as well as works in progress.

N= Number of years prescribed for completion of work for which Bid has been invited

B = Existing commitments and balance amount of ongoing works with Bidder and also the works which are awarded to Bidder but yet not started upto the date of inviting the Bid.

Note:

(a) The Bidder (s) shall furnish the details of :

(i) Maximum value of construction works executed and payment received in any one of the previous three financial years for calculating **'A'**, and

(ii) Existing commitments and balance amount of ongoing works with Bidder and also the works which are awarded to Bidder but yet not started upto the date of inviting the Bid for calculating **'B'**. The details shall be submitted in the prescribed proforma given under **2.0 below.** In case of no works in hand, a 'NIL' statement should be furnished.

The submitted details for (i) and (ii) above should be duly verified by Chartered Accountant.

(b) In case, the Bidder/s failed to submit the above statement along with offer, their/his offer shall be considered as incomplete and will be rejected **summarily**.

(c) The Available Bid Capacity of Bidder shall be assessed based on the details submitted by the Bidder. In case, the available bid capacity is less than that prescribed in Sub-Clause 3.3.1 (ii), Section III, EQC, then the offer shall not be considered even if the Bidder has been found eligible in other eligibility criteria/ Bidder requirement**.**

2.0 Bidder should provide information on their current commitments on all contract that have been awarded, or for which a letter of intent or acceptance has been received, or

for contracts approaching completion, but for which an unqualified, full completion certificate is yet to be issued.

Current Contract Commitments /Works in Progress

(All amounts in INR)

S. No.	Name and Brief particulars of contract (Clearly indicate the part of the work assigned to the applicant)	Contract No. & Date	Name of client with telephone number	Contract Value in INR Equivalent (Give only the value of work assigned to the	Stipulated Period of completion	Value of balance work yet to be done in INR equivalent upto the date of inviting the Bid
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Total value of balance work yet to be done in INR equivalent upto the date of inviting the Bid						**B=**

Notes:

(i) Where a work is undertaken by a JV/Consortium, only that portion of the contract which is undertaken by the concerned applicant/member should be indicated and the remaining done by the other members of the JV/Consortium be excluded.

*(ii) The Bidder is not required to submit any document as documentary evidence along with the Bid Documents. **All information furnished in this Form shall be certified by a Chartered Accountant/Company Auditor/Statutory Auditor.***

(iii) The above documents shall reflect the financial situation of the legal entity or entities comprising the Bidder and not the Bidder's parent companies, subsidiaries, or affiliates.

"Certified that current commitments on all the contracts that have been awarded or for which a letter of intent or acceptance has been received or for the works in progress or the works approaching completion, value of outstanding work has been indicated in the above table correctly. It is further certified that if later on the Employer discovers that information provided in the table is incorrect then the Employer will treat our Bid invalid and it will be liable for rejection"

3.0 Calculation of Available Bid Capacity

Description	**Value**
A= Maximum value of construction works executed and payment received in any one of the previous three financial years, taking into account the completed as well as works in progress as per Form **FIN 3** (in INR Equivalent)	
N= Number of years prescribed for completion of work for which Bid has been invited (in years)	**1.5**
B= Existing commitments and balance amount of ongoing works	

Description	Value
with Bidder and also the works which are awarded to Bidder but yet not started upto the date of inviting the Bid (in INR Equivalent)	
Bid Capacity (in INR Equivalent) = [A x N x 2] – 0.33xNxB	

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Certified that all figures and facts submitted in this form have been furnished after full consideration of all observations/notes in Auditor's reports.

_____

(Signature of CA/Auditor)

Name of CA/Auditor:_____

Registration No:_____

_____

(Seal)

Form EXP-3.3.1: Specific Construction Experience

[Ref. ITB Sub-Clause 17.2 and Section 3, Evaluation and Qualification Criteria, Sub-Clause 3.3.1(A)]

Bid No.: HORC/HRIDC/MNS/STN/2025
Bidder's Name: _____
Page _____of _____pages

Fill up one form per Contract

Similar Contract No.	**Information**		
Contract Identification			
Award date			
Completion date			
Role in Contract as Contractor or Member in JV or Sub-Contractor	**[insert the role in Contract]**		
Total Contract Amount	*[insert Contract amount(s) and currency(ies)]*		INR [insert * *Exchange rate prevailing on the date of the Contract Award i.e. the* ***date of issue of Letter of Acceptance*** and total Contract amount in INR equivalent]
If member in a JV or sub-contractor, specify participation in total Contract amount	*[insert Percentage participation]*	*[insert amount(s) and currency) of participation]*	*INR [insert Exchange rate prevailing on the date of the Contract Award i.e. the date of* ***issue of Letter of Acceptance*** *and amount of participation in INR equivalent]*
Employer's (Owner of Work) Name:			
Address: Mobile: Telephone/fax number E-mail:			
Description of the similarity in accordance with Sub-Clause 3.3.1 (A) of Section III:			
1. Amount in (INR)			
2. Civil Works involving: G+3 building	*(i) No. of Storeys*		
3. Certificate issuing Authority	*Govt/Public Sector Undertakings /other than* **Govt. / Public Sector undertakings** *[Select the appropriate one as applicable]*		
4. Whether copy of experience certificates issued by the Employer (Owner of the Work) / Concessionaire attached or Not	*Copy of experience certificates issued by:* *[Select the appropriate one as applicable]* *The Employer (Owner of the Work)* *OR* *Concessionaire.*		

<table>
<tr>
<td>5. Documents submitted in support of experience certificate issued by other than Govt. / Public Sector undertakings</td>
<td>Documents Submitted
<table>
<tr><th>Supporting Documents</th><th>Yes/No</th></tr>
<tr><td>(a) the relevant copy of work order</td><td></td></tr>
<tr><td>(b) bill of quantities,</td><td></td></tr>
<tr><td>(c) bill wise details of payment received duly certified by Chartered Accountant</td><td></td></tr>
<tr><td>(d) TDS certificates for all payments received and</td><td></td></tr>
<tr><td>(e) copy of final/last bill paid by company</td><td></td></tr>
</table>
</td>
</tr>
</table>

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Notes:

1. Substantial completion shall be based on 80% or more of the original or revised value (whichever is lower) of works completed under the contract. Completion or substantial completion of work shall be based on completion/substantial completion certificate issued by the Employer (Owner of the Work) / Concessionaire.
2. Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for purpose of satisfying his/her experience criteria mentioned in Sub-Clause 3.3.1 . For the purpose of value of similar work for the past experience of a Bidder in a JV, credit shall be given in proportion of the percentage share of the Bidder in that JV certified by the Employer (Owner of the Work)/Concessionaire.
   (a) If the Employer's Certificate does not indicate the percentage share of Bidder, in such a case value of Bidder's share in JV shall be as per details given in JV agreement forming part of the relevant Contract Agreement. Bidder should submit JV agreement with their Bid if the Bidder's share is not mentioned in Employer (Owner of the Work)/Concessionaire.
3. The Bidder shall submit copy of completion certificate/experience certificate issued by the Employer (Owner of the Work) / Concessionaire clearly indicating the similarity of work, actual completion Date/substantial completion Date, Value of Work executed by the Bidder. Bid submitted without this documentary proof shall be liable to be rejected.
4. In case Bidder submits work **experience certificate issued by other than Govt. / Public Sector undertakings**, the Bidder shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate. Work experience certificate without these supporting documents will be liable to be rejected.
5. If a Bidder has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (Owner of the work) / Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Bids submitted without this documentary proof is liable to be rejected.

For example: Entity **'A'** is the owner of the work and awards a contract for execution of work to Contractor **'X'**. Thereafter, Contractor **'X'** sublets part of the work to Sub-Contractor **'Y'**. In this case, experience certificate of Sub-Contractor **'Y'** issued only by Entity **'A'** / Concessionaire shall be considered for the purpose of evaluation of the Bid. Experience certificate issued by Contractor **'X'** to Sub-Contractor **'Y'** shall not be considered and the offer submitted based on such certificate is liable to be rejected.

6. The completion certificate/experience certificate and supporting documents submitted by the Bidder shall be in the name of the Bidder. The credentials of the other firms such as the Bidder's subsidiaries, parent entities, affiliates, subcontractors or any other firm(s) different from the Bidder shall not be considered towards Bidder's qualification.
7. Bidder must note that the completion certificate/experience certificate issued by the Independent Engineer shall not be considered for evaluation of Bidder's qualification towards meeting the requirements of Sub-Clause 3.3.1 above.

Form EXP-3.3.2: General Electrical Services Experience

[Ref. ITB Sub-Clause 17.2 and Section 3, Evaluation and Qualification Criteria, Sub-Clause 3.3.1 (B)]

Bid No.: HORC/HRIDC/MNS/STN/2025
Bidder's Name: _____
Page _____of _____pages

Fill up one form per Contract

Similar Contract No.	**Information**		
Contract Identification			
Award date			
Completion date			
Role in Contract as Contractor or Member in JV or Sub-Contractor	**[insert the role in Contract]**		
Total Contract Amount	*[insert Contract amount(s) and currency(ies)]*		INR [insert * *Exchange rate prevailing on the date of the Contract Award i.e. the* ***date of issue of Letter of Acceptance*** and total Contract amount in INR equivalent]
If member in a JV or sub-contractor, specify participation in total Contract amount	*[insert Percentage participation]*	*[insert amount(s) and currency) of participation]*	*INR [insert Exchange rate prevailing on the date of the Contract Award i.e. the date of* ***issue of Letter of Acceptance*** *and amount of participation in INR equivalent]*
Employer's (Owner of Work) Name:			
Address: Mobile: Telephone/fax number E-mail:			
Description of General Electrical Services in accordance with Sub-Clause 3.3.1 (B) of Section III:			
6. Amount in (INR)			
7. General Electrical Services pertaining to building works	*(Provide brief description of items of General electrical services executed for building works)*		
8. Certificate issuing Authority	*Govt/Public Sector Undertakings /other than* **Govt. / Public Sector undertakings** *[Select the appropriate one as applicable]*		
9. Whether copy of experience certificates issued by the Employer (Owner of the Work) / Concessionaire attached or Not	*Copy of experience certificates issued by:* *[Select the appropriate one as applicable]* *The Employer (Owner of the Work)* *OR* *Concessionaire.*		

<table>
<tr>
<td>10. Documents submitted in support of experience certificate issued by other than Govt. / Public Sector undertakings</td>
<td>Documents Submitted
<table>
<tr><th>Supporting Documents</th><th>Yes/No</th></tr>
<tr><td>(a) the relevant copy of work order</td><td></td></tr>
<tr><td>(b) bill of quantities,</td><td></td></tr>
<tr><td>(c) bill wise details of payment received duly certified by Chartered Accountant</td><td></td></tr>
<tr><td>(d) TDS certificates for all payments received and</td><td></td></tr>
<tr><td>(e) copy of final/last bill paid by company</td><td></td></tr>
</table>
</td>
</tr>
</table>

Bidder's Authorized Representative

Signature: ……..

Date: ……..……..

Company stamp: ……..…..

Notes:

8. Substantial completion shall be based on 80% or more of the original or revised value (whichever is lower) of works completed under the contract. Completion or substantial completion of work shall be based on completion/substantial completion certificate issued by the Employer (Owner of the Work) / Concessionaire.
9. Value of completed work done by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for purpose of satisfying his/her experience criteria mentioned in Sub-Clause 3.3.1 . For the purpose of value of General Electrical Services work for the past experience of a Bidder in a JV, credit shall be given in proportion of the percentage share of the Bidder in that JV certified by the Employer (Owner of the Work)/Concessionaire.
   (b) If the Employer's Certificate does not indicate the percentage share of Bidder, in such a case value of Bidder's share in JV shall be as per details given in JV agreement forming part of the relevant Contract Agreement. Bidder should submit JV agreement with their Bid if the Bidder's share is not mentioned in Employer (Owner of the Work)/Concessionaire.
10. The Bidder shall submit copy of completion certificate/experience certificate issued by the Employer (Owner of the Work) / Concessionaire clearly indicating the similarity of work, actual completion Date/substantial completion Date, Value of Work executed by the Bidder. Bid submitted without this documentary proof shall be liable to be rejected.
11. In case Bidder submits work **experience certificate issued by other than Govt. / Public Sector undertakings**, the Bidder shall also submit along with work experience certificate, the relevant copy of work order, bill of quantities, bill wise details of payment received duly certified by Chartered Accountant, TDS certificates for all payments received and copy of final/last bill paid by company in support of above work experience certificate. Work experience certificate without these supporting documents will be liable to be rejected.
12. If a Bidder has successfully completed a work as Sub-Contractor, the work experience certificate issued only by the Employer (Owner of the work) / Concessionaire for such work to Sub-Contractor shall be considered for the purpose of fulfillment of credentials. Bids submitted without this documentary proof is liable to be rejected.

For example: Entity **'A'** is the owner of the work and awards a contract for execution of work to Contractor **'X'**. Thereafter, Contractor **'X'** sublets part of the work to Sub-Contractor **'Y'**. In this case, experience certificate of Sub-Contractor **'Y'** issued only by Entity **'A'** / Concessionaire shall be considered for the purpose of evaluation of the Bid. Experience certificate issued by Contractor **'X'** to Sub-Contractor **'Y'** shall not be considered and the offer submitted based on such certificate is liable to be rejected.

13. The completion certificate/experience certificate and supporting documents submitted by the Bidder shall be in the name of the Bidder. The credentials of the other firms such as the Bidder's subsidiaries, parent entities, affiliates, subcontractors or any other firm(s) different from the Bidder shall not be considered towards Bidder's qualification.

    Bidder must note that the completion certificate/experience certificate issued by the Independent Engineer shall not be considered for evaluation of Bidder's qualification towards meeting the requirements of Sub-Clause 3.3.1 above

Form-MII

Declaration for 'Local content' in terms of 'Public Procurement (Preference to Make in India) Order 2017', as amended up to 28 days prior to deadline for submission of bids, issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry

Ref: Bid Notice No……

I / We declare that:

1. The offer submitted against the meets the 'Local Content' requirement as prescribed vide clause ITB 4.1 e and ITB 43.2.
2. The details of the local content and location(s) where local value addition is made in case of imported items, are as below:

BOQ Item no	Description in brief	BOQ Amount	Made in India Items: Amount of local content	Imported Items: Value added in India	Imported Items: Location of Value added in India
1					
2					
….					
Total		**A**	**B**	**C**	

Total Local Content: B + C
% of local content in total BOQ cost: …..%

3. Fulfilment of the aforesaid requirements shall also be ensured from the subcontractors and that the above statement contains information for the entire contract.

SEAL AND SIGNATURE OF THE BIDDER

Note: Form MII- Declaration for 'Local content'

As para 9(b) of Make in Indian Policy letter dt.19.07.2024, if procurement value is in excess of Rs. 10 Crore. The Class-I local supplier/Class-II local supplier are required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accounts (in respect of suppliers other than companies) giving the percentage of local content.

FORM CL

Checklist of submission of Documents/Forms online, duly filled

(Reference to ITB 11.4 & 11.5)

Bid No: HORC/HRIDC/MNS-01/STN/2025

Name of Work:

A. TECHNICAL BID

S. No.	Requirement of Bid Document	Ref. Clause of Bid Document	Bidder's Name:	
			Whether submitted (Yes/No/NA)	Ref. Pg. No. in the Technical Bid
1.	Letter of Technical Bid	ITB 11.4 and Section 4		
2.	Technical Bid signed by authorized representative of Bidder	ITB 20.2		
3.	Bid Security/Online Bid Security payment Receipt (copy of online payment receipt on ePortal)	ITB 19.1		
4.	Cost of Bid Document (copy of online payment receipt on ePortal)			
5.	Form PS-1: Affidavit to be submitted by Bidder	ITB 4.4 and Section 4		
6.	Form ELI – 1: Bidder's Information Form	ITB 4.1 and Section 4		
7.	Form ELI-2: Power of Attorney (POA) for submitting Bid	ITB 20.2 and Section 4		
8.	Board Resolution in case of a Public/Private limited company/LLP	ITB 20.2 and Form ELI -2		
9.	Incorporation Certificate and Memorandum and Articles of Association (MOA & AOA) (in case of Private/Public Limited Company)	Note (iii) (d) of Form ELI-2		
10.	Incorporation Certificate and Limited Liability Membership Agreement in case of Limited Liability Membership firms.	Note (iii) (e) of Form ELI-2		
11.	Notarised Copy of Proprietorship Affidavit (in case the Bidder is Proprietorship Bidder)	Note (iii) (a) of Form ELI-2		
12.	Notarised copy of Partnership Deed (in case the Bidder is Partnership Firm)	Note (iii) (b) of Form ELI-2		
13.	Form FIN-1: Financial Situation and Performance	ITB 17.2 and EQC 3.2.1		
14.	Form FIN-2: Average Annual Construction Turnover	ITB 17.2 and EQC 3.2.2		
15.	Form FIN-3: Sources of Finance for the Subject Contract	ITB 17.2 and EQC 3.2.3		
16.	Form FIN-4: Bid Capacity	ITB 17.2 and EQC 3.2.4		

S. No.	Requirement of Bid Document	Ref. Clause of Bid Document	Bidder's Name:	
			Whether submitted (Yes/No/NA)	Ref. Pg. No. in the Technical Bid
17.	Form EXP-3.3.1: Specific Construction Experience	ITB 17.2 and EQC 3.3.1 (A)		
18.	Form EXP-3.3.2: Specific Construction Experience	ITB 17.2 and EQC 3.3.1 (B)		
19.	In case Bidder submits work experience certificate issued by other than Govt. / Public Sector undertakings: (a) the relevant copy of work order, (b) bill of quantities, (c) bill wise details of payment received duly certified by Chartered Accountant, (d) TDS certificates for all payments received and (e) copy of final/last bill paid by company	ITB 17.2 and EQC 3.3.1 and Note 4 under Sub-Clause 3.3.1 (A) and 3.3.1 (B) of Section 3, EQC		
20.	Form MII- Declaration for 'Local content'	ITB 4.1 e and ITB 43.2		
21.	As para 9(b) of Make in Indian Policy letter dt.19.07.2024, if procurement value is in excess of Rs. 10 Crore. The Class-I local supplier/Class-II local supplier are required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accounts (in respect of suppliers other than companies) giving the percentage of local content	ITT and ITB 34.1		

Notes:

(i) **The check list is indicative and not exhaustive. The Bidder must go through the complete Bid documents and submit the required document accordingly.**

(ii) **If any of the above form or criteria is not applicable to the Bidder, then they can simply indicate N.A. against the relevant column**

B. FINANCIAL BID

The Financial Bid is provided in the Bid Document in the form of:

(i) MS-Excel file and

(ii) Pdf File

The Bid Price shall be quoted at the prescribed place in the Bill of Quantities (MS-Excel Sheet) provided with the Bid Document. These prices should include all costs associated with the contract including GST. The Bid price shall not be offered/quoted elsewhere in the Technical Bid submission/Bid submission. The Bidder shall download the MS-EXCEL file and after quoting their Contract Price, upload the completed MS-EXCEL file along with duly signed PDF documents of Financial Bid mentioned in (a) below on eProcurement portal. The quoted Contract Price shall not be offered/quoted elsewhere in the Technical Bid submission/ Tender submission. The Bidder shall complete the Financial Bid in accordance with the instructions given in the Financial Bid.

a) Following duly signed documents are required to be submitted by the Bidder in their Financial Bid**:**

(i) Letter of Financial Bid,
(ii) Preamble,
(iii) Bill of Quantities ,
(iv) Bill of Quantities (MS-Excel File) with quoted percentage rate against Schedule 'A' and Schedule 'B'

I hereby confirm that:

(i) I have checked the above list with our submittal. I am also aware that if our Bid is not containing the above documents, the Employer has the right to reject our Bid.

(ii) All the pages of Bid submission are properly signed, indexed and numbered.

Seal:
Date:
(Signature of Authorized Representative of the Bidder)

Bid Document

(Two-Envelope Bidding Process)

Name of work: MNS-01: Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.

Bid No: HORC/HRIDC/MNS-01/STN/2025

Contract title: Composite Works Contract (Civil, Electrical, Road works and other associated works)

Project: Haryana Orbital Rail Corridor Project

Employer: Haryana Orbital Rail Corporation Limited

Country: INDIA

Issued on: 06.02.2025

Summary

Specific Procurement Notice (SPN)

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Section 5: Works Requirements

Section 5I: General

WORKS REQUIREMENTS

1 Project Profile and Background.

1.1 General

State of Haryana is strategically located bordering the National capital of Delhi. NCT, Delhi shares three fourth of its border with Haryana alone and remaining with Uttar Pradesh. The development of Haryana region, bordering Delhi is very important for balanced growth of NCR as it acts as buffer zone against rampant migration and other support infrastructure. At present on account of growth of Metro network in Delhi & NCR, there is radial movement of commuters to and from, Delhi being in centre. This "Hub and Spoke" traffic planning has resulted in rapid growth of Noida, Greater Noida, Faridabad and Gurugram. However, for hub and spoke concept to sustain it is necessary to link the ends of spoke by ring connectivity. There will be natural demand for commuter movement within these towns like Gurugram, Faridabad, Ballabhgarh, Palwal, Sohna, Manesar etc. Peripheral roads have been commissioned recently, linking these towns around Delhi but Rail link provides economical, sustainable, eco-friendly and bulk freight transport option. The peripheral Rail link will also help in growth of other cities within the same distance from Delhi like Sonipat, Panipat, and Rohtak. Western DFC originating from Dadri station is passing through Asaoti Station on Delhi- Mathura route, providing connectivity to Haryana Orbital Rail Corridor (HORC). This will also help in easing the pressure on the transport network of Delhi as some of the commuter traffic moving on the radials will get shifted to HORC. Apart from passenger traffic, substantial amount of freight traffic, which is entering the Delhi area of rail network but is not meant to be consumed in Delhi, will also get diverted via this corridor. Apart from this, there are major goods sheds in the heart of Delhi causing endless avoidable traffic jams. The goods sheds in west Delhi are Azadpur, Shakurbasti, Dayabasti, Sabzi Mandi which are located on prime commercial land and are black spots of the urban planning. Previously moving out commercial activity to other states had interstate taxation issues but now with GST in place, there is no reason of not shifting these activities to the peripheral region. In any case, if freight traffic movement through Delhi is restricted, then these goods sheds or alternatives will be serviced via the proposed HORC. Haryana Orbital Rail Corridor (HORC) from Palwal to Sonipat Via Sohna, Manesar, Kharkhoda and Harsana Kalan is to be constructed as an Electrified (1X25kV AC-50Hz) double line track, capable of operating at a maximum train speed of 160 kmph.

1.2 Forest and Environmental Clearance

It is mentioned that for Railway projects no prior environmental clearance is required as per Environment Impact Assessment (EIA) Notification, 2006. However, as per Ministry of Environment, Forest and Climate Change (MoEF&CC) clarification dated 19.10.2023, forest clearance is required for the Protected Forest portion of Project. In this Package there is no Protected Forest.

Permission for cutting of trees (within ROW) wherever required will be obtained by the

Employer. Cutting of trees within ROW wherever required for execution of the Works shall be done by the Contractor. In case cutting of trees are required outside the ROW necessary clearances and permissions will be obtained by the Contractor from the concerned authorities. However, the Employer will facilitate in getting the clearance on specific request made by the Contractor. Compensatory plantation is not included in the Scope of the Works.

2 DEFINITIONS AND INTERPRETATIONS

In addition to the words and expressions defined in the General Conditions of Contract, further following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

- **"As-Built Drawings"** means those drawings produced by the Contractor and endorsed by its true records of construction of the Permanent Works and which have been given a consent from the Engineer.

- **"As-Built Documents"** mean the set of drawings and documents which are a true record of the construction of the Permanent Works prepared by the Contractor.

- **"CAD Standards"** means requirements for CAD, as specified in the Appendix 9 of Works Requirements.

- **"Charted Utilities"** mean identified Utilities listed in Works Requirements-Tender Drawings and Documents, which may be affected by the execution of the Works under the Contract.

- **"Cold Joint"** means a joint or discontinuity formed when a concrete surface hardens before the next batch is placed against it, characterised by poor bond unless necessary procedures are observed.

- **Combined Services Drawings" (CSD):** means drawings showing the locations, layouts and sizes of all services including those of other contractors co-ordinated so as to eliminate all clashes.

- **"Construction Phase":** has the meaning identified in the Works Requirements - General.

- **"Construction Reference Drawings":** means those drawings referred in the Works Requirements - Design in respect of which a Notice has been issued.

- **"Construction Reference Drawings Submission":** means the submission of Construction Reference Drawings representing elements of the Permanent Works and for which the Contractor seeks a Notice.

- **"Contract Spares"** means any Spare Parts recommended by the Contractor for the operation and maintenance of the Permanent Works following the Taking Over of the Works.

- **"Consumables"** means those parts that are not repairable and usually have a relatively short life span.

- **"Critical Path Method"** means a schedule network analysis technique used to determine the amount of scheduling flexibility (the amount of float) on various logical network paths in the project schedule network, and to determine the minimum total project duration.

- **"Definitive Design Submission":** means the submission of documents which comprise the whole or parts of the proposed Definitive Design and for which the Contractor seeks a Notice.

- **"Design Criteria":** means the criteria defined in Works Requirements-Design and Outline Design Specifications.

- **"Design Manual":** means the manual to be prepared and submitted by The Contractor as part of the Definitive Design and as described in the Works Requirements - Design.

- **"DN Line"** means the down line of the HORC double line track route from Sonipat to Palwal.

- "**Final Design":** has the meaning identified in the Works Requirements – Design.

- **"Fixed Structure Gauge":** means the profile related to the designed normal co-ordinated axis of the track into which no part of any structures or fixed equipment may penetrate.

- **"Good For Construction Drawings (GFC)":** Construction Reference Drawings or Working Drawings which have received Notice from the Engineer, shall be endorsed as "Good For Construction Drawings" and will be issued to the Site. Execution of work shall be carried out only as per drawings which have been endorsed as GFC.

- **"Interface Management Plan"** means the plan for all interface issues that may arise during the design, construction, testing and commissioning of the Works, in consultation with the Interfacing Contractors/ Interfacing Parties and the Engineer.

- **"Independent Laboratory"** means a laboratory, submitted by the Contractor to the Engineer for approval, that is free from outside control and not subject to direct or indirect influence or authority of the Employer, the Engineer, or the Contractor

- **"Inspection and Test Plan"** means a document that states inspection and testing requirements and actions provisioned for the Works, related process, Plant, or Materials. It is used to control, check, monitor and record; testing procedures that are required for quality assurance and to achieve the agreed quality requirements for the Works.

- **"Installation Tests"** means the tests to be performed to verify the conformity of completion of an installation/assembly to the design documents approved by the Engineer prior to the start of Commissioning, and they must be successfully completed before the Tests on Completion.

- **"Interface Coordinator"** means the person who has the responsibility, and authority with substantial experience to resolve interface matters to the satisfaction of the Engineer and provide the necessary support team for the Interface Management System as specified in Appendix 5

- **"Interfacing Contractor"** means the Contractor engaged by the Employer or other agencies having an interface issue with the Contractor for the Works.

- **"Interfacing Parties"** comprises the interfacing contractors / consultants / service providers, who are engaged in part of the works, relevant authorities and public utility agency.

- **"Interface Table"** means the table that describes the relationships between the Contractor and Interfacing Contractors / Interfacing Parties and their roles and responsibilities is a key document.

- **"Kick-Off Meeting"** means the meeting held by the Engineer to formally notify all parties concerned under the Contract that the project has commenced and to ensure that every party has a common understanding of their role from the Commencement Date up until issuance of the Performance Certificate.

- **"Maintenance Manuals"** means the manuals providing detailed instructions for the maintenance of infrastructure and maintenance facilities.

- **"Method Statement"** means a document that states the way a particular work, task, or process along with various associated aspects such as quality, safety, environment protection, time and resources; are planned to be directly controlled by the Contractor or its Subcontractor.

- **"Monthly Progress Meeting"** means the meeting specified under Appendix 7 of the Works Requirements.

- **"Monthly Progress Report"** means the report that the Contractor shall prepare and submit to the Engineer.

- **"Nonconformity Report"** means a report documenting non-fulfilment of a requirement, with objective evidence, the location and time of occurrence or detection, and provision for its proper resolution by the concerned responsible.

- **"Notice":** means a Notice of No Objection.

- **"Notice of Objection"** means a category of Engineer's response, issued by the Engineer to the Contractor.

- **"Not Reviewed"** means a category of Engineer's response, issued by the Engineer to the Contractor.

- **"On-Site Laboratory"** means Contractor's own laboratory submitted by the Contractor to the Engineer for approval as specified in Appendix 12 of the Works Requirements.

- **"Operation and Maintenance Manuals (O&M Manuals)"** means the manual that will be indicating the provisions which are required for maintenance of various assets created under the Contract by the Employer under their operation phase.

- **"Priority Section"** means the section from Km 49.7 to Km 55.6 of HORC Main line and connectivity line from Manesar station on HORC and Patli station on Delhi-Rewari section of Indian Railway Network.

- **"Programme Analysis Report"** means the report submitted to the Engineer that shall, in narrative format, describe the basis and assumptions used to develop each programme.

- **"Project"** means the project named as "Haryana Orbital Rail Corridor (HORC)".

- **"Project Management Plan"** refers to the plan that will be established by the Contractor for the management of activities related to design, procurement, manufacture, execution/construction, delivery, installation, testing and commissioning.

- **"Project Management Information System"** means a document, information and communication technology system (platform) that is to be implemented by the Contractor so that the management of information between the Contractor, the Employer and the Engineer is efficient, reliable, and secure.

- **"Preliminary Design":** means the submission of documents which comprise the initial stage of the design phase.

- **"Indian Railway"** means the rail tracks of the Indian Railway or any other organization and any ancillary areas of Indian Railway such as the depots, sidings, stations, terminus, traction power stations, etc.

- "**Request for Inspection"** means the form used to give notice by the Contractor to the Engineer.

- **"Railway Representative"** means a person, or persons, nominated by the Employer / Engineer to liaise with the Contractor and the Engineer on matters affecting the operation of Indian Railway.

- **"Tender drawings and Documents"** means the drawings and documents prepared by the Employer for reference purposes only and included in the Tender Documents.

- **"Right of Way"** means the land area of the Project, either acquired by the Employer or for which the Employer has the permission of the Stakeholder to construct the embankment & bridges, etc. over their area.

- **"Environmental, Social, Health and Safety Management Plan"** means the plan in accordance with the requirements of Appendix 13 of the Works Requirements.

- "**Safety**" freedom from unacceptable risk of harm.

- **"Site Office"** means Site Office for Employer's/Engineer's Personnel constructed by the Contractor.

- **"Spare Parts"** means those parts which are generally repairable and have normally a service life of several years.

- **"Specification"** has the meaning identified in the Works Requirements - General.

- **"Station Yard"** is defined as the section between points at either end of the station which are located 50 m from the outermost points away from the station.

- **"Tertiary Control Points (TCP)"** means the benchmarks provided by the Employer, used to locate & confirm the Right of Way (ROW) and its co-ordinates including levels for the purpose of execution of works.

- **"Three Months Rolling Programme"** means the programme which the Contractor shall prepare and update monthly as per Appendix 6 of the Works Requirements.

- **"Three Weeks Rolling Programme"** means the programme which the Contractor shall prepare and update weekly as per Appendix 6 of the Works Requirements.

- **"Time Bar Chart",** known as "Gantt Chart" too is a type of bar chart which illustrates a project schedule. i.e. the start and finish dates of the activities and summary elements of a project

- **"Uncharted Utilities"** mean Utilities other than Charted Utilities which are identified during a survey conducted by the Contractor or encountered during excavation/ other works.

- **"UP Line"** means the up line of the HORC double line track route from Palwal to Sonipat.

- **"Utilities"** means the electricity, lighting, traffic control, telephone and/or communication cables, gas, water, sewage and drainage pipes, including all associated protection, supports, ancillary structures, fittings and equipment.

- **"Working Drawing"** means additional drawings developed by the Contractor as necessary to supplement the Construction Reference Drawings and to specify additional details and procedures for construction of the Works, such as shop drawings, fabrication drawings, erection drawings, Temporary Works drawings, bar bending schedules, bar reference drawings, embankment/cutting cross sections. All such drawings shall comply with the requirements of the Contract.

- **"Works Areas"** means the areas of the Site within the Right of Way of HORC including land in KMP ROW, land in DFC ROW and land in ROW of Road Authority for the Work of construction/ regrading of road of RUB and any additional areas which may be obtained by the Contractor and agreed by the Engineer as additional working area.

- **"Works Programme"** means the time-scaled and resource-loaded critical path network, updated from time to time in accordance with the General Conditions of Contract and Works Requirements, depicting activities, durations, sequences and interrelationships that represent the Contractor's work plan, work breakdown, schedule structure for constructing and completing the Works, distributed over the Time for Completion of the Contract.

- **Abbreviations**

AC	**:**	**Alternating Current**
ACB	**:**	**Air Circuit Breaker**
AIIB	**:**	**Asian Infrastructure Investment Bank**
ALARP	**:**	**As Low As Reasonably Practicable**
ASLI	**:**	**Automatic Safe Load Indicator**
BG	**:**	**Broad Gauge**

BIS	**:**	**Bureau Of Indian Standards**
BOCW	**:**	**Building Or Other Construction Work**
BS	**:**	**British Standards**
CAD	**:**	**Computer Aided Design**
CCTV	**:**	**Closed Circuit Television**
CP	**:**	**Contract Package**
CPCB	**:**	**Centre Pollution Control Board**
CPM	**:**	**Critical Path Method**
CRS	**:**	**Commissioner Of Railway Safety**
CSD	**:**	**Combined Service Drawings**
CV	**:**	**Curriculum Vitae**
DB	**:**	**Distribution Box**
DCN	**:**	**Design Change Notice**
DFC	**:**	**Dedicated Freight Corridor**
DFCCIL	**:**	**Dedicated Freight Corridor Corporation Of India Limited**
DG	**:**	**Diesel Generator**
DGPS	**:**	**Differential Global Positioning System**
DIN	**:**	**Deutsche Industrial Norms**
DL	**:**	**Double Line**
DNP	**:**	**Defect Notification Period**
DPR	**:**	**Daily Progress Report**
DT	**:**	**Down Time**
E&M	**:**	**Electrical & Mechanical**
EIA	**:**	**Environmental Impact Assessment**

ELCB	**:**	**Earth Leakage Circuit Breaker**
EMC	**:**	**Electro Magnetic Compatibility**
EMI	**:**	**Electro Magnetic Interference**
ESHS	**:**	**Environmental, Social, Health And Safety**
FAT	**:**	**Factory Acceptance Test(S)**
FCN	**:**	**Field Change Notice**
FFL	**:**	**Finished Floor Level**
FL	**:**	**Formation Level**
GAD	**:**	**General Arrangement Drawing**
GCC	**:**	**General Conditions Of Contract**
GE	**:**	**Geotechnical Engineering**
GFL	**:**	**Ground Floor Level**
GIS	**:**	**Geographical Information System**
GL	**:**	**Ground Level**
GNSS	**:**	**Global Navigation Satellite System**
GOI	**:**	**Government Of India**
GPS	**:**	**Global Positioning System**
GRC	**:**	**Grievance Redress Committee**
GRM	**:**	**Grievance Redress Mechanism**
HDPE	**:**	**High Density Polyethylene**
HFL	**:**	**Highest Flood Level**
HORC	**:**	**Haryana Orbital Rail Corridor**
HT	**:**	**High Tension**
HV	**:**	**High Voltage**

HVAC	**:**	**Heating, Ventilation And Air Conditioning**
Hz	**:**	**Hertz**
IC	**:**	**Integrated Circuit**
ID	**:**	**Identification**
IMD	**:**	**Integrated Maintenance Depot**
IMP	**:**	**Interface Management Plan**
INR	**:**	**Indian Rupee**
IP	**:**	**Point Of Intersection**
IPS	**:**	**Integrated Power Supply**
IR	**:**	**Indian Railways**
IRC	**:**	**Indian Road Congress**
IRS	**:**	**Indian Railway Standards**
IS	**:**	**Indian Standards**
ISO	**:**	**International Organization For Standardization**
IT	**:**	**Information Technology**
ITP	**:**	**Inspection And Test Plan**
Km	**:**	**Kilometre**
kV	**:**	**Kilo Volt**
LAN	**:**	**Local Area Network**
LCD	**:**	**Liquid Crystal Display**
LCX	**:**	**Leaky Coaxial Cable**
LED	**:**	**Light Emitting Diode**
LT	**:**	**Low Tension**

LV	**:**	**Low Voltage**
LWL	**:**	**Lowest Water Level**
MC	**:**	**Municipal Corporation**
MCB/LV	**:**	**Miniature Circuit Breaker / Low Voltage**
MCCB	**:**	**Moulded Case Circuit Breaker**
MDR	**:**	**Major District Roads**
MOR	**:**	**Ministry Of Railway**
MPR	**:**	**Monthly Progress Report**
MQR	**:**	**Monthly Quality Report**
MS	**:**	**Method Statement**
MSDS	**:**	**Material Safety Data Sheet**
MSL	**:**	**Mean Sea Level**
NABL	**:**	**National Accreditation Board For Testing And Calibration Laboratories**
NCR	**:**	**Nonconformity Report**
NFPA	**:**	**National Fire Protection Association**
NGO	**:**	**Non-Governmental Organization**
NH	**:**	**National Highway**
NHAI	**:**	**National Highway Authority Of India**
NOC	**:**	**No Objection Certificate**
NONO	**:**	**Notice Of No Objection**
NONOC	**:**	**Notice Of No Objection With Comments**
NOO	**:**	**Notice Of Objection**
NR	**:**	**Not Reviewed**
O&M	**:**	**Operation And Maintenance**

OCS	**:**	**Overhead Catenary System**
ODR	**:**	**Other District Roads**
OEM	**:**	**Original Equipment Manufacturer**
OFC	**:**	**Optical Fibre Cable**
OHE	**:**	**Over Head Electrification**
OHSAS	**:**	**Occupational Health And Safety Assessment Series**
OHTL	**:**	**Over Head Transmission Lines**
PDF	**:**	**Portable Document Format**
PHA	**:**	**Preliminary Hazard Analysis**
PMIS	**:**	**Project Management Information System**
PPE	**:**	**Personal Protective Equipment**
PR	**:**	**Public Relation**
PS	**:**	**Particular Specifications**
PVC	**:**	**Polyvinyl Chloride**
PWD	**:**	**Public Works Department**
QA	**:**	**Quality Assurance**
RAMS	**:**	**Reliability, Availability, Maintainability And Safety**
RAP	**:**	**Resettlement Action Plan**
RCC	**:**	**Reinforced Cement Concrete**
RDSO	**:**	**Research Designs And Standards Organization**
RFI	**:**	**Request For Inspection**
RFO	**:**	**Rail Fly Over**
RINL	**:**	**Rashtriya Ispat Nigam Limited**

RL	**:**	**Reduced Level**
ROB	**:**	**Road Over Bridge**
ROW	**:**	**Right Of Way**
RUB	**:**	**Road Under Bridge**
S&T	**:**	**Signalling And Telecommunication**
SAIL	**:**	**Steel Authority Of India Limited**
SAT	**:**	**System Acceptance Test**
SCADA	**:**	**Supervisory Control And Data Acquisition**
SCC	**:**	**Special Conditions of Contract**
SH	**:**	**State Highway**
SI	**:**	**International System Of Units**
SL	**:**	**Single Line**
SM	**:**	**Station Master**
SOD	**:**	**Schedule Of Dimensions**
SP	**:**	**Sectioning Post**
SRR	**:**	**Submission Review Request**
SSP	**:**	**Sub-Sectioning Post**
TSS	**:**	**Traction Substation**
UG	**:**	**Under Ground**
UPS	**:**	**Uninterrupted Power Supply**
USB	**:**	**Universal Serial Bus**
UTM	**:**	**Universal Transverse Mercator**
VN	**:**	**Variation Notice**
WGS84	**:**	**World Geodetic System 84**

WHO	**:**	**World Health Organization**
WQMP	**:**	**Works Quality Management Plan**

3 RELEVANT DOCUMENTS

The Design Criteria shall be read in conjunction with the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), the Works Requirements, the drawings and any other document forming part of the Contract.

In case of conflict in Design Criteria in various Sub-Sections of Section 5, Works Requirements the order of precedence shall be as follows:

CIVIL

- Outline Design Specifications (ODS)-Civil,
- Outline Construction Specification (OCS)-Civil,
- Bid drawings,
- Works Requirements -Scope of the Works,
- Works Requirements- General,
- Works Requirements- Appendices,
- Indian and other International Standards referenced herein,
- Indian and other International Standards.

4 PHASES (DESIGN AND CONSTRUCTION)

a) The Contractor shall execute the Works in two phases, the Design Phase and the Construction Phase.

b) The Design Phase shall commence upon the date of Letter of Acceptance (LOA). This phase shall include the preparation and submission of:

   i. the Preliminary Design,

   ii. the Definitive Design;

   iii. The Construction Reference Drawings.

   iv. The Design Phase will be complete upon the issue of a Notice in respect of the comprehensive and complete Construction Reference Drawings Submission for the whole of the Permanent Works.

c) The requirements for the Preliminary Design, Definitive Design and Construction Reference Drawings are stated in Clause 2 of the Works Requirements -Design.

d) The Construction Phase for the whole or a part of the Permanent Works shall commence immediately upon the issue of a Notice by the Engineer/Employer in respect of the relevant Construction Reference Drawings Submission. Such Notice may be issued by the Engineer in respect of a Construction Reference Drawing Submission

covering a major and distinctive part of the Permanent Works. However, construction shall not be commenced until the appropriate Working Drawings have been endorsed:

(a) by the Contractor as "Good for Construction"; and

(b) by the Engineer that he has no objections to the drawing.

The Construction Phase shall include the completion and submission of the Final Design and the preparation and submission of the As Built Drawings and other records as specified.

e) Notwithstanding Clause 4 (b) (iv) above, for those elements identified under Clause *2.6* of the Works Requirements - Design, the Construction Phase may commence immediately upon the issue of the Notice in respect of the Definitive Design Submission in respect of each such element subject to availability of the site in accordance with agreed programme.

f) The Contractor shall furnish Contractor's Warranty in the format approved by the Employer given in Section 8 – Contract Forms.

5 SPECIFICATIONS

In accordance with the provisions of these Works Requirements, the Contract Specifications contained in the Contract shall be followed during the design and construction stage.

6 SPECIFICATIONS IN METRIC AND IMPERIAL UNITS

a) The Contract shall utilise the SI system of units. Codes and Standards in imperial units shall not be used unless the Engineer has given his consent.

b) Conversion between metric units and imperial units shall be in accordance with the relevant Indian Standards.

7 WORKS PROGRAMME

a) The Key Dates are defined in Appendix 2 to these Works Requirements.

b) The Contractor shall prepare and submit its Works Programme and three-month rolling programmes and the detailed requirements contained in Appendix 6 to these Works Requirements.

c) In compiling its Works Programme and in all subsequent updating and reporting, the Contractor shall make provision for the time required for co-ordinating and completing the design, testing, commissioning and integrated testing of the Works, including, inter alia, design co-ordination periods during which the Contractor shall co-ordinate its design with those of Interfacing Contractors, the review procedures, determining and complying with the requirements of all Government Departments and all others whose consent, permissions, authority or licence is required prior to the execution of any work.

d) The Works Programme shall take full account of the Design Submission Programme.

8 MONITORING OF PROGRESS

a) Project Monitoring shall be done by Project Monitoring and Information System (PMIS). The contractor has to prepare Primavera P6 schedule as per the Programme Requirements provided in Appendix 6.

b) The Contractor shall submit to the Engineer three copies (along with an additional copy in digital format) of a Monthly Progress Report (MPR), as described in Appendix 7 to these Works Requirements, describing the progress and current status of the Works. The MPR shall address the matters set out in the Works Programme.

c) The MPR shall be submitted by the end of each calendar month. It shall account for all works actually performed in the current month.

d) The MPR shall be divided into two sections. The first section shall cover progress and current status relating to design and the second section shall cover progress and current status relating to construction.

e) A monthly meeting to monitor & review the progress of the project shall be convened by the Engineer. Contractor's site Representative & Designer Representative of Contractor and site representative of all Interfacing Contractors shall also attend the meeting. The Employer may also be present in the meeting.

f) The Engineer or Employer may also conduct progress review meetings and Interface meetings on weekly /bi-weekly intervals depending upon the requirements or urgency of works. In these review meetings Engineer may call Contractor's Supplier/Sub-Contractor/Designer etc. as per the requirements.

9 QUALITY ASSURANCE

The Contractor shall establish and maintain a Quality Assurance System in accordance with Appendix 11 to these Works Requirements for design and construction procedures and the interfaces between them. This Quality Assurance system shall be applied without prejudice to, or without in any way limiting, any Quality Assurance Systems that the Contractor already maintains.

10 DELETED

11 CO-ORDINATION WITH INTERFACTING CONTRACTORS

11.1 General

a) The Contractor is responsible for detailed co-ordination of his design and construction activities with Interfacing Contractors. Such co-ordination responsibilities of the Contractor shall include the following:

i. To provide all information reasonably required by the Interfacing Contractors in a timely and professional manner to allow them to proceed with their design or construction activities, and specifically to meet their contractual obligations.

ii. To ensure that the Contractor's requirements are provided to all other Interfacing Contractors before the cut-off dates to be identified in the Interface Management Plan (IMP).

iii. To obtain from the Interfacing Contractors information reasonably required to enable the Contractor to meet the design submission dates as identified in Appendix 2.

iv. Where the execution of the work of the Interfacing Contractors depends upon the site management or information to be given by the Contractor, the Contractor shall provide to such Interfacing Contractors the services or correct and accurate information required to enable them to meet their own programme or construct their work.

v. To attend regular co-ordination meetings convened by the Engineer with the Interfacing Contractors. The Contractor shall conduct separate meetings with the Interfacing Contractors as necessary to clarify particular aspects of the interfacing requirements of the Works. The party who convenes the meeting shall prepare minutes recording all matters discussed and agreed at the meeting.

vi. To ensure that copies of all correspondence, drawings, meeting minutes, programmes, etc. relating to the Contractor's co-ordination with the Interfacing Contractors are issued to all concerned parties and the Engineer no later than two (2) calendar days from the date of such correspondence and meetings.

b) The Contractor, shall in carrying out his co-ordination responsibilities, raise in good time and provide sufficient information for the Engineer to decide on any disagreement between the Contractor and the Interfacing Contractors as to the extent of services or information required to pass between them. If such disagreement cannot be resolved by the Contractor despite having taken all reasonable efforts, then the decision of the Engineer shall be final and binding on the Contractor.

c) Where an Interfacing Contract is yet to be awarded the Contractor shall proceed with the co-ordination activities with the Engineer until such time when the Interfacing Contractor is available. The Contractor shall provide the Interfacing Contractor with all information necessary to enable the Interfacing Contractor to follow-on and proceed with their co-ordination.

d) The cut-off dates to be identified in the IMP are the latest dates. Any claim of additional costs by the Interfacing Contractors as a result of the Contractor's failure in adhering to these dates shall be borne by the Contractor. The Contractor shall note that the information exchange is an iterative process requiring the exchange and update of information at the earliest opportunity and shall be carried out on a regular and progressive basis so that the process is completed for each design stage by the cut-off dates.

e) The Contractor shall co-ordinate with the Engineer on all matters relating to works that may affect the Operation & Maintenance of the already operational Section corridor of the of Employer in general. Such work shall be subject to the rules and regulations imposed by the Employer.

11.2 Design Interface

a) The dates shown in Works Requirements Appendix 2 are critical to the timely completion of the project. The Contractor shall commence design interface with the Interfacing Contractors as soon as he has been notified by the Engineer that such Interfacing Contract has been awarded. In the case of utility agencies and other statutory boards, interface shall commence as soon as it is practicable. Where no design

interface date has been established whether because the Interfacing Contractor(s) have not been identified or for whatever reason, the Contractor shall liaise with such Interfacing Contractor/s as soon as they have been awarded.

b) The Contractor shall immediately upon award of the Contract gather all necessary information and develop his design to a level where meaningful interaction can take place as soon as the Interfacing Contracts are available. The Contractor shall submit together with each of his Design Submissions a joint statement from the Contractor and the relevant Interfacing Contractor confirming that design co-ordination has been completed and that they have jointly reviewed the appropriate document to ensure that a consistent design is being presented.

c) The design interface is an iterative process requiring regular exchange and update of interfacing information. The Contractor shall ensure that the information he requires from the Interfacing Contractors is made known at the outset of each design interface and vice versa so that the information can be provided in time for the Contractor and the Interfacing Contractors to complete their design to meet their various design submission stages.

11.3 Construction Interface

a) Construction interface will be necessary throughout the duration of the Works commencing from the time the Contractor mobilises to the Site to the completion of the Works. Construction interface will overlap design interface, involving cast-in and buried items such as pipes for electrical and mechanical services, supports, brackets, plinths, ducts, service buildings, openings, cableways, trenches etc. that are to be incorporated at the early stage of the construction up to provision of attendance during the testing and commissioning stage.

b) The Contractor shall ensure that there is no interference with the Works of the Interfacing Contractors and shall maintain close co-ordination with them to ensure that his work progresses in a smooth and orderly manner. The Contractor shall carry out and complete the Works, or any part thereof, in such order as may be agreed by the Engineer or in such revised order as may be requested by the Engineer from time to time. The Contractor shall, unless otherwise provided, be liable for and shall indemnify the Employer against all costs, charges, expenses and the like resulting from failure of the Contractor to co-ordinate the Works as specified.

12 SURVEY AND SITE INVESTIGATIONS

a) The datum used for the Contract shall be Mean Sea Level Datum.

b) The Contractor shall carry out all further site investigations (such as detailed utility identification, detailed geo technical investigation) necessary for the design of the Permanent Works and to enable the determination of the methods of construction and the nature, extent and design of the Temporary Works.

c) The Contractor shall carry out geotechnical investigation using conventional method of boreholes and geo-physical methods for the entire alignment.

13 CLIMATIC CONDITIONS

a) The entire section of HORC with connecting IR Station is situated in the state of Haryana. During summer months the temperature can be as high as 45°C with a high level of humidity, nights can be relatively cool with temperatures dipping to 30°C. Torrential rains and high humidity accompany the monsoon in late June to early September. In the winter months temperatures can vary from a high of 21°C during day to a low of 2°C during night.

b) The information given above is only indicative. The contractor shall obtain detailed climatic data in respect of minimum & maximum temperatures, rain, relative humidity, sunshine, and wind velocity/pressure etc. from "India Meteorological Department publications" and the same shall be taken into account by the Contractor when designing any part of the Permanent Works. The Contractor shall ensure that due allowance is made for more severe local conditions when Permanent Works are required to operate, for example, with restricted ventilation that may lead to higher local ambient temperatures, and any other factors that may affect the operating environment in any way.

c) Unless specific figures are provided elsewhere, the Permanent Works will generally be required to function at its rated value with the values of ambient temperature and relative humidity appropriate to the location of the equipment within the classifications shown in Table given below. Certain parts of the Permanent Works may need to be rated for more or less onerous conditions as required by the PS.

d) The Contractor's attention is drawn to the more severe environmental conditions that may exist during the construction/installation period and shall take adequate measures to protect the Permanent works against any deleterious effects of such conditions during the time between installation and final completion of the project. Also, Air throughout the project will contain considerable moisture content, hence the permanent works shall be tropicalized and vermin proof.

14 PROJECT MANAGEMENT INFORMATION SYSTEM (PMIS)

The Employer is using SPEED (Systematic Program Evaluation for Efficient Delivery of Project) software for Project Management. The Contractor shall use the SPEED Software for Project Management for which access will be made available by the Employer to the Contractor free of cost. Necessary Training in software for Contractor's staff will be arranged by the Employer.

The Contractor shall develop Work Breakdown Structure of the Works Programme specified in Appendix 6 of Section 5: Works Requirements in Primavera suiting to the Work Breakdown Structure of SPEED.

The Contractor's application for payment shall be submitted through Billing module of SPEED Software.

The Contractor shall process and update all data related to Project and progress monitoring viz., Progress updates, RFI(s), NCR and NCN compliances etc. through SPEED Software.

15 CONTRACTOR'S PROJECT ORGANISATION

a) The Contractor shall have a competent team of Managers, Engineers, Technical staff etc so as to complete the work satisfactory as per various requirements of the Contract.

b) The designations of the various project organisations team members shall be got approved by the Engineer before adoption so as to avoid any duplication of the designations with those of the Employer or the Engineer.

16 CONTRACTOR'S CERTIFICATE

The Contractor shall provide his registration details for GST Registration, EPF registration, ESI registration, Statutory Certificate, Certificate as per ESHS Manual etc. as required for the execution and completion of the Works.

17 CONTRACTOR'S SUPERINTENDENCE

The Contractor shall submit a Staff Organization Plan in accordance with the Attachment C-1

This plan shall be updated and resubmitted whenever there are changes to the staff. The plan shall show the management structure and state clearly the duties, responsibilities and authority of each staff member.

The Contractor's Representative and his associates/supervisors shall have experience and qualification appropriate to the type and magnitude of the Works as per Attachment C-2. Full details shall be submitted of the qualifications and experience of all proposed staff to the Engineer for his approval.

18 CONTRACTOR'S TEMPORARY WORKS DESIGN

The Contractor shall, prior to commencing the construction of the Temporary Works, submit a certificate to the Engineer signed by him certifying that the Temporary Works have been properly and safely designed and checked and that the Contractor has checked the effect of the Temporary Works on the Permanent Works and has found this to be satisfactory.

19 SUB-CONTRACTOR

The Contractor shall appoint sub-Contractor with the approval of the Engineer.

The Contractor is required to enter into a legally enforceable agreement with the Sub-Contractor approved by the Engineer within 60 days of approval of Sub-Contractor and submit a copy of the agreement to the Engineer. The agreement must specify the specific role and responsibility of the Sub-Contractor.

20 Detailed Design Consultant (DDC)

The Contractor shall appoint Detailed Design Consultant with the approval of the Engineer.

Detailed Design Consultant to be engaged shall have experience of design of minimum four storied residential/Office /Commercial/Institutional Buildings project in last seven years prior to the deadline of submission of Bids. The Contractor shall enter into a legally enforceable agreement with the DDC approved by the Engineer within 21 days of approval of DDC and

submit a copy of the agreement to the Engineer. The agreement must specify the specific role and responsibility of the DDC.

21 CONTRACTOR'S PERSONNEL AND KEY EQUIPMENT

The Contractor shall deploy minimum Contractor's Personnel and Key Equipment as per the Attachment C-1, C-2 and C-3 given hereunder.

ATTACHMENT - C-1

MINIMUM ORGANISATION STRUCTURE REQUIRED *& PENALTY FOR NON-DEPLOYMENT*

The figures indicated in Table below are the minimum number of Project-Personnel required which are to be deployed as per the minimum level of supervision. The qualification/experience of such Project personnel is given under Attachment-C-2.

S. No.	Designation of Project Personnel	Minimum no. of Project-Personnel required	Penalty for Non-deployment per week or part thereof per person
1.	Contractor's Representative/ Project Manager	1	Rs 1,00,000/-
2.	Planning Engineer	1	Rs 40,000/- for first 3 months and Rs. 80,000/- thereafter
3.	Quality Assurance /Quality Control Expert	1	Rs 40,000/- for first 3 months and Rs. 80,000/- thereafter
4.	Civil Engineer	1	-
5.	Electrical Engineer	1	
6.	Health & Safety Expert	1	Rs 40,000/- for first 3 months and Rs. 80,000/- thereafter
7.	Surveyor	1	-

NOTES:-

i. The Contractor shall deploy resources as per the above-mentioned table. The Contractor shall also confirm to deploy manpower over and above the minimum numbers indicated above, if the work so requires.

ii. The performance of project personnel deployed will be evaluated periodically by the Engineer during the contract period. In case the performance of any of the project personnel is not satisfactory, the Contractor shall replace them with good personnel immediately as per directions of the Engineer.

iii. The personnel at Sr.No.1, must be deployed by Commencement Date. Balance Personnel in the above table must be deployed within 60 days of Commencement Date. Non adherence to these provisions shall attract penalty as indicated in the table above.

iv. The resources indicated in the table above are for peak requirement. All resources need not be mobilized simultaneously for the entire duration of the contract. The Contractor shall mobilize the resources as per the deployment programme approved by the Engineer.

vi. In case of non-deployment of project personnel, the penalty shall be imposed as indicated above and deducted from Contractor's running / final bills. The decision of the Engineer in this regard shall be final and binding.

ATTACHMENT C-2

Minimum level of supervision & qualification/ experience of Project Personnel is as follows:

S. No.	*DESIGNATION*	*QUALIFICATION*	*EXPERIENCE LEVEL*
1.	Contractor's Representative/ Project Manager	Graduate in Civil Engineering	Minimum total experience of 10 years out of which, minimum 2 years as In-charge in projects of Railway/ DFC/ Metro/ RRTS/ Highway /Expressways/Building projects.
2.	Planning Engineer	Graduate in Civil Engineering	Minimum total experience of 05 years out of which minimum 01 years in relevant field in planning of Infrastructure projects/ Building projects.
3.	Quality Assurance /Quality Control Expert	Graduate / Diploma in Civil Engineering	Minimum total experience of 05/07 years out of which minimum 02/04 years in QA (Field) in Infrastructure Projects/ Building projects.
4.	Civil Engineer	Graduate / Diploma in Civil Engineering	Minimum total experience of 03/05 years out of which 2 year experience in relevant field in projects of Railway/ DFC/ Metro/ RRTS/ Highway /Expressways/ Building projects.
5.	Electrical Engineer	Graduate / Diploma in Civil Engineering	Minimum total experience of 03/05 years out of which 2 year experience in relevant field in projects of Railway/ DFC/ Metro/ RRTS/ Highway /Expressways/ Building projects.
6.	Health & Safety Expert	Bachelor degree in any science stream with one-year full time Diploma in Industrial Safety. (Or) Diploma in Engineering with one year full time Diploma in Industrial Safety. (Or)	Minimum total experience of 05 years with relevant experience of 02 years in infrastructure projects/ Building projects. (Or) Minimum total experience of 05 years with relevant experience of 02 years in infrastructure projects/ Building projects. (Or)

S. No.	*DESIGNATION*	*QUALIFICATION*	*EXPERIENCE LEVEL*
		Graduate in Engineering with one year full time Diploma in Industrial Safety	Minimum total experience of 04 years with relevant experience of 02 years in infrastructure projects/ Building projects.
7.	Surveyor	Diploma in Civil Engineering / ITI	Minimum total Experience of 01/02 years in survey work for building/linear Infrastructure projects/ Building projects

NOTES:

1. The CVs of concerned personnel shall be submitted to the Engineer for approval. No person mentioned in table above shall be deployed in the project without Engineer's approval.

2. Relaxation in qualification / experience can be given by the Engineer in exceptional cases where candidates have got high level of professional competency. Decision of the Engineer in such cases shall be final and binding.

3. The candidates must have obtained Degree/Diploma as full-time regular candidates.

ATTACHMENT C-3

MINIMUM REQUIREMENT OF THE DDC'S ORGANIZATIONAL STRUCTURE

The DDC shall submit an Organisation Chart together with clear description of the responsibilities of each member within the overall works programme.

S. No	Designation	Numbers	Experience
1	Team Leader	01	Graduate degree in Civil Engineering having experience not less than *12* years and would have handled minimum 01 project as Team Leader of similar nature & complexity.
2	Building/other Structural Engineer	01	Graduate degree in Civil Engineering with total experience of 05 years and minimum 03 years experience of multistoried building design.
3	Architect	*01*	Graduate degree in Architecture with total experience of 05 years and minimum 03 years experience of architectural design of multistoried buildings.
4	Electrical Design Engineer	*01*	Graduate degree in Electrical Engineering with total experience of 05 years and minimum 03 years experience of building design/other structure design.

NOTES:

1. Sufficient documentary proof to substantiate the qualification and work experience shall be submitted. The Contractor shall submit proposal of DDC experts having experience as mentioned above to the Engineer for approval before deployment.

2. The requirement given above is minimum. The Contractor shall be required to supplement the above mentioned design team as per requirement of the Works so as to adhere to the timelines given in Appendix-2- Contract Key Dates and Completion Date, Section 5VII: Appendices, Part 2- Works Requirements under the Contract.

3. Relaxation in qualification / experience can be given by the Engineer in exceptional cases where candidates have got high level of professional competency. Decision of the Engineer in such cases shall be final and binding.

ATTACHMENT C-4

MINIMUM RESOURCES PROPOSED FOR THE PROJECT- PLANTS & EQUIPMENTS

The figures indicated below are the minimum number of equipment required.

S. No.	Types of Equipment Required for the Work	Minimum No. of Unit of Equipment Required for the Work
1.	Concrete Batching Plant	1 (Minimum Capacity of 30 cum/hr.)
2.	Concrete Boom Placer	1
3.	Stationary Concrete Pumps (36 cum/hr)	1
4.	Survey Instruments (Total Station)	1
5.	Lab Testing equipment- fully equipped for site tests.	As per Appendix 12 of Section 5 - Works Requirements
6.	Digital Level (Leica, Sokia)	1

Notes:

1. These resources are for peak period of each activity. All plants and equipment need not be mobilized simultaneously. Plants and equipment as required as per the progress of the work shall be brought at site in advance as directed by the Engineer.

2. Concrete Batching Plant may either be installed at site by the contractor or RMC may be procured from an approved source.

Section VII: Works Requirements

Section 5II: Functional

WORKS REQUIREMENTS – FUNCTIONAL

Objective

The objective of the Contract is the design, construction, testing and commissioning of the permanent works by the Contractor (including without limitation, the design, construction and removal of the Temporary Works) and the rectification of defects appearing in Permanent Works in the manner and to the standards and within the time obligations, liabilities and risks which may be involved, the Contractor shall undertake the execution of the Works.

1. GENERAL

1.1 The Works to be executed under Package MNS- 01 is for design and construction of civil works and General Electrical Services work as per Works Requirements on BOQ basis. All information available with the Employer has been furnished in Part 2, Works Requirements. The Works are to be designed by the Contractor and payment for design/drawing shall be made to the Contractor under relevant item of BOQ. Geo-technical site data required for design of the Works shall be collected by the Contractor and payment for GT investigations shall be made to the Contractor under relevant schedule of BOQ. The design and performance of the Permanent Works shall comply with the specific core requirements contained in the Works Requirements.

1.2 The design of the Permanent Works shall be developed in accordance with these Works Requirements – Functional and other requirements of the Contract.

1.3 The Permanent Works shall be designed and constructed to the highest standards available using proven up-to-date good engineering practices. The Specifications shall in no case specify standards which, in the Engineer's opinion, are less than or inferior to those described in the Outline Design Specifications (ODS) and Outline Construction Specifications (OCS). Construction shall be carried out employing the procedures established by the Contractor as per approved Quality Assurance and Quality Control plan and Environmental, Social, Health and Safety (ESHS) Plan.

1.4 The Contractor shall be responsible for obtaining all necessary approvals from the relevant Public/Government/Local/Statutory or any agencies in the design and construction of the Works at his own cost.

1.5 Works Requirements- Functional shall be read in conjunction with Employer's Requirements-General, Outline Design specifications (ODS), Outline Construction Specifications (OCS), Particular Specifications -General Electrical Services, Bid drawings and documents, Appendices, Conditions of Contract, Vol II Bill of Quantities and other requirements of the Contract. The price quoted by the Contractor shall be deemed to have included cost of Works as per Part 2-Works Requirements (General, Functional, Outline Design specifications (ODS), Outline Construction Specifications (OCS), Particular Specifications-General Electrical Services, Bid drawings and Documents and Appendices).

2. SCOPE OF WORK

2.1.1 Scope under BOQ Schedule 'A'

2.1.2 Design of the Works

i. Schedule 'A'

a) Design and drawings of all items of the Works under Schedule 'A' shall be carried out by the Contractor and the payment for the same shall be made under relevant item of BOQ under Schedule 'A'.

b) Design and drawings of all the temporary works shall also be carried out by the Contractor and the payment for the same is included in the cost of permanent works of Schedule 'A'.

2.1.3 Design and construction of balance works of IMD building at Manesar

The building shall house maintenance and operational officials, control office & rest house facilities. It is a G+5 building. Structural RCC works have already been completed by the other contractor. The contractor shall design and construct finishing works including plumbing, sanatory works, drainage, firefighting arrangements, ground water storage tank, rainwater harvesting system etc. as shown Tender drawings.

2.1.4 Design and construction Station building Manesar

Manesar is one of the major stations on HORC network with immense potential for future growth. Station building shall be designed for G+4. However, in the present contract building shall be constructed up to 3 storeys as shown in the Bid drawings. Station building has been sited along the platform No. 1, adjacent to one of the subways being constructed by C-1 Contractor. Two storeys of the building are below Platform level and one story is above the platform level.

2.1.5 Design and construction of Electrical, S&T and Track maintenance offices and Resting facility for Track Machine staff

The building shall be designed for 3 storeys. However, in the present contract building shall be constructed up to 2 storeys as shown in Bid drawings. Each maintenance office shall have two rooms, one store room and one toilet block. In addition, the building shall house resting accommodation for track machine staff.

2.1.6 S&T huts near both ends of Manesar Yard

The contractor shall construct 2 No. S&T huts, one each on either end of Manesar yard as shown in the Tender drawings. Plinth level of building shall be minimum 300 mm above formation level.

2.1.7 Road work and other miscellaneous structures

The Contractor shall construct Vacuum Dewatered Concrete (VDC) station approach roads with foot path & drainage arrangement as shown in Tender drawings. In addition, the Contractor shall design & construct some minor structures such as ground water storage tank for firefighting & drinking water requirement, pump house, boar well, rain water harvesting system, Electrical sub-station building, canteen building etc.

1.1.1 The work content of Items under Schedule 'A' shall also include, but not be limited to, the following:

a) Site clearance and dismantling of obstructions etc., before commencement of work as specified or as directed by the Engineer;

b) True and proper setting out and layout of the Works, benchmarks and provision of all necessary labour, instruments and appliances in connection therewith as specified or as directed by the Engineer;

c) All aspects of quality assurance, including testing of materials as per the approved Inspection and Test Plan and other components of the work, as specified or as directed by the Engineer;

d) Day to day cleaning of worksite throughout the execution period.

e) Maintenance of the completed Works during the period as specified or as directed by the Engineer.

f) Submission of completion (i.e., 'As-Built') drawings 06 (Six) sets in A-1 size and all other related documents as specified including scanned (in .pdf) and AutoCAD copy with soft copies in both formats of all As-built drawings & documents.

g) Compliance of requirements of Environmental, Social, Health and Safety (ESHS) Manual as per Appendix 13, Section 5VII-Appendices of Part 2-Works Requirements.

h) The Interface Management Document as per Appendix- 5 of Works Requirements shall also be complied with**.**

1.1.2 Associated Works

Works to be performed shall also include all general works, preparatory works for the construction and works of any kind necessary for the design and satisfactory construction, completion and maintenance of the works to the intent and meaning of the drawings adopted and Outline Construction Specifications , to best Engineering standards and orders that may be issued by the Engineer from time to time, compliance with all Conditions of Contract, supply of all materials, apparatus, plants, equipment, tools, fuel, water, strutting, timbering, transport, offices, stores, workshop, staff, labour and the provision of proper and sufficient protective works, diversion, temporary fencing, lighting and watching required for the safety of the public and protection of works on adjoining land; first-aid equipment, sanitary accommodation for the staff and workmen, effecting and maintenance of all insurances, the payment of all wages, salaries, fees, royalties, duties or the other charges arising out of the execution of works and the regular clearance of rubbish, clearing up, leaving the site perfect and tidy on completion.

1.1.3 Land for Contractor's Facilities & Site Office

For batching plants, field quality control laboratories, site offices and other activities (excluding labour camps), land total measuring approx. 5,000 Sq. m will be made available by the Employer on 'as is where is basis' free of cost. This land shall be made good for such offsite activities as needed by the Contractor at no extra cost to the Employer. Any land

required beyond the above area will have to be arranged by the Contractor at his own cost. The land shall be cleared from debris, all structures made by the Contractor including RCC footings and rafts etc. and reinstated to the line, level and to the same conditions as existed before the work started before handing over back to the Employer within 91 days after Taking over Certificate. The final bill shall be released to the Contractor after all structures from the Contractor facility and site office are removed & clearance of site. The cost of setting up of all the above-mentioned facilities & the office and reinstatement of site is deemed to be included in quoted price of items of Schedule 'A'.

1.2 Scope under Schedule 'B' (General Electrical Services works)

Under this Schedule, the Contractor is required to carry out General Electrical Services works. Detailed Scope of Works is given in Section 5-VII: General Electrical Services, Part 2- Works Requirements.

1.3 REFERENCE TO THE STANDARD CODES OF PRACTICE

1.3.1 All Standards, Outline Construction Specifications, Technical Specifications and Codes of Practice referred to shall be latest editions including all applicable official amendments and revisions. The Contractor shall make available at site all relevant Indian Standard Codes of practice, IRS, IS, IRC, UIC, as applicable.

1.3.2 Wherever Indian Standards do not cover some particular aspects of design/ construction, relevant International Standards will be referred to. The Contractor shall make available at site such standard codes of practice.

1.3.3 In case of discrepancy among Standard codes of practice and Section 5IV: Outline Construction Specifications-Civil (OCS), the order of precedence shall be as given below:

a. Outline Design Specifications-Civil

b. Outline Construction Specifications-Civil.

c. Standard Codes of Practice. In case of discrepancy among Standard Codes of Practice, the order of precedence will be

   i. IRS,

   ii. IS,

   iii. IRC,

   iv. other International codes

d. Indian Railway Unified Standard Specifications,

e. CPWD specifications,

f. NBC 2016,

g. MORTH Specification for Road & Bridges,

1.4 DIMENSIONS

As regards errors, omissions and discrepancies in Specifications and Drawings, relevant clause of Particular Specification will apply. The levels, measurements and other information

concerning the existing site as shown on the conceptual / layout drawings are believed to be correct, but the Contractor shall verify them for himself and examine the nature of the ground as no claim or allowance whatsoever shall be entertained on account of any errors or omissions in the levels or strata turning out different from what is shown on the drawings.

1.5 INSPECTION

The Employer may appoint an independent agency to ensure the quality checking of design, supply, fabrication, erection and construction of all works under scope of work. Payment to the independent agency shall be made by the Employer separately. The Contractor shall ensure complete co-operation with the agency to perform their work satisfactorily. In addition, the Employer also reserves right to undertake quality check and inspection directly by itself.

1.6 DURABILITY AND MAINTENANCE

The Permanent Works shall be designed and constructed such that, if maintained reasonably, they shall endure in a serviceable condition throughout their minimum lives as described in Section 5III, Outline Design Specifications-Civil. The Permanent Works shall be designed and constructed so as to minimise the cost of maintenance whilst not compromising the performance characteristics and ride quality of the railway.

1.7 OPERATIONAL REQUIREMENTS

During construction the Contractor shall be responsible for providing and maintaining adequate flood protection to ensure protection of the works.

1.8 ENVIRONMENTAL CONSIDERATIONS

All provisions and conditions contained in the Environmental, Social, Health and Safety (ESHS) Manual as per Appendix 13 of Part 2-Works Requirements shall be strictly complied with.

1.9 STANDARDS

Works, Equipment, materials and systems shall be designed, manufactured and tested in accordance with the latest issue of National and/or International codes and standards. The Contractor shall submit hard copies in original to the Engineer of all codes and standards used for the work.

Reference to standards or to materials and equipment of a particular manufacturer shall be regarded as followed by the words “or equivalent”. The Contractor may propose alternative standard materials, or equipment that shall be equal to or better than those specified. If the Contractor for any reason proposes alternatives to or deviations from the specified standards, or desires to use materials or equipment not covered by the specified standards, the Contractor shall apply for the consent of the Engineer. The Contractor shall state the exact nature of the change, the reason for making the change and relevant specifications of the materials and equipment in the English language. The decision of the Engineer in the matter of quality will be final.

Part 2-Works Requirements

Section 5III: Works Requirements -Outline Design Specifications (ODS) – Civil

Section 5III: Works Requirements -Outline Design Specifications (ODS) – Civil

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1 OUTLINE DESIGN SPECIFICATIONS

1.1 General

Concept Plan of the station and other building has been provided in the Bid drawings. The Contractor shall prepare the detailed architectural design and drawings of the various building. The structural design of building and other works as mentioned in the Design Requirement Criteria shall be done by the Contractor as per the requirements briefed hereunder.

This Outline Design Specification (ODS) is applicable for station building and other Civil works.

1.2 Details of Structures to be designed

The Contractor shall prepare and submit architectural drawings of IMD building, station building and maintenance building at Manesar station. Various architectural alternatives shall be prepared for the station building with better aesthetics, pleasing appearance, durability and environment friendliness.

The Contractor shall design station building and structures at *Manesar*.

The design shall include, but not limited to, the following -

i. Station cum S&T and Electrical Service Building
ii. Water supply system
iii. RCC retaining wall at station adjacent to platform fill
iv. Bore well, pump house, pipe connections, underground & overhead water storage tanks
v. Septic tank and soak pits for toilets of station building and platforms
vi. RCC portico
vii. Approach road to station
viii. Signal hut and other service buildings
ix. Circulating area and landscaping

The design and drawings of buildings shall include, but not limited to, the following:

i. Architectural and structural design and drawings
ii. Plumbing arrangement design and drawings
iii. Ventilation design and drawings
iv. All other building services as necessary for functioning of the station as per NBC 2016

1.3 Design Requirements

1.3.1 Layout Criteria

i. The layout of the station, as prepared & provided by the Employer are indicative. The Contractor shall develop the layout so as to comply with the Employer's Requirements.

ii. Architecture and profile of all buildings shall conform to local aesthetics, cultural ethos, local architecture and environment and shall be subject to consent and approval of the Engineer.

iii. The functional and structural design of the station building shall be carried out as per provisions of National Building Code 2016 and the by-laws of the local authorities to the extent of their applicability.

iv. Method of structural analysis shall be appropriate for the structure or component to be analysed and shall be carried out by the Contractor using well established software duly consented by the Engineer. However, critical designs shall be supported by manual checks.

v. Dynamic analysis shall be performed to obtain the design seismic force by Response Spectrum Method as per latest IS 1893. Analysis of framed structure shall be carried out considering fixed support at top of pile cap / Open foundation. Structural design of building shall conform to codal provisions of IS 456, IS 4326 and IS 13920. Design of water retaining structure shall conform to codal provisions of IS 3370.

vi. Loading due to earthquake shall be assessed based on the provisions of IS: 1893 (Part I) and IRS seismic code, with latest revision.

vii. Loads and load combinations shall be for most unfavourable effects and shall comply with relevant Indian Standards including IS: 456 and IS:800.

viii. Overall stability and serviceability requirements shall be checked in accordance with the provisions of relevant Indian Standards.

ix. All the buildings shall have provision for concealed ducts/pipes for wiring of telecom facilities in addition to the wiring for power supply and distribution. Concealed ducts/pipes for wiring of telecom & power supply facilities shall be provided in consultation with the Engineer.

x. False ceiling shall be proposed at a clear height of about 3m in the rooms with air-conditioning facilities with a view to help in energy conservation.

1.3.2 VAC Requirements for Station Building

Ventilation of station building shall be provided as per provisions of ISHARE / National building Code except for Signalling/ Telecommunication / UPS/ IPS/ Battery Rooms.

1.3.3 Other requirements

The minimum requirement of the facilities for Operation and Maintenance shall be as specified below: -

i. In stairs, riser shall be kept maximum as 150mm (net height) and tread minimum as 300 mm (clear width).

ii. Approach road shall be designed for 450 commercial vehicle /day & for a design period of 30 years or more as per IRC:58-2015. Approach road shall have VDC of minimum thickness 250 mm.

iii. Covered underground RCC water storage tank shall be provided at the station having minimum capacity of 2 X 1,50,000 litres. Effective depth of tank shall be kept about 1.5 m to 2.0 m.

iv. RCC overhead water storage tank shall be provided for a capacity of 20,000 litres at the stations over RCC staging of suitable height as per requirements.

1.4 Outline Design Criteria

1.4.1 Objective

The objective is to lay down the structural analysis & design of the proposed buildings. It also incorporates the design process to establish the overall design philosophy to be adopted in the Analysis and design.

1.4.2 Statutory Requirements

The design of the Civil Structure will comply with the requirements of the following:

i. National Building Code.

ii. Local Building Regulations.

iii. Bureau of Indian standard codes.

iv. Indian Railway Standard

v. International codes as applicable.

vi. Any other regulation as per requirements.

1.4.3 Structural Design Requirement

The main considerations followed for the design of structure are:

i. Structure safety and stability.

ii. Functional suitability

iii. To meet the demands of aesthetics conceived by the architect.

iv. Availability of material, equipment and expertise.

v. Constructability and ease of maintenance.

vi. Durability.

vii. Economy

1.4.4 Structural Arrangement

The proposed building is considered to be of RCC frame structure with Isolated/ Strip /Raft/Pile foundations.

1.4.5 Loads

The structural members are loaded with various loads combinations during its services conditions. The loads on the structure are taken for analysis and design as per the relevant latest IS codes of practice.

i. Dead load as per IS: 875 (Part-1)

ii. Imposed live load as per IS: 875(Part-2)

iii. Wind loads as per IS: 875(Part 3)

iv. Seismic Loads as per IS: 1893

Dead loads comprise of the self-weight of all permanent construction including walls, slabs, beams, columns, water proofing treatment, water tanks, staircase, floor finish etc. Other super imposed loads shall be considered. The structure would be designed for earthquake resistance as per IS 1893, with due consideration for the structural detailing as per provisions of IS 13920 and SP 34.

(a) Dead Load (DL)

Dead load shall be based on the actual cross-sectional area and unit weights of materials and shall include the weight of structural members of the station building.

(b) Super Imposed Dead Load For NON-TRACK Area (SIDL)

For platform slabs, the following loads in SIDL shall be taken:

i. Floor finishes load shall be assumed minimum 3.6kN/m^2 uniform load as per architectural requirement.

ii. Suspension load shall be assumed minimum 2.0kN/m^2 uniform load (Suspension load will be considered as the load of false ceiling and services etc. This load will be considered wherever is applicable.

iii. Light partition wall load shall be assumed minimum 1.0kN/m^2 uniform load.

For concourse area, the following loads in SIDL will be considered:

i. Floor finishes load shall be assumed minimum 3.6kN/m^2 uniform load as per architectural requirement.

ii. Load due to additional fill in the toilets (brick bat) shall be considered as per architectural drawing.

iii. Suspension load shall be assumed minimum 2.0kN/m^2 uniform load (Suspension load will be considered as the load of false ceiling and services etc. This load will be considered wherever is applicable.

iv. Loads due to escalator / lift will be considered as per manufacturer's detail.

v. Light partition wall load shall be assumed minimum 1.0kN/m^2 uniform load.

vi. Loads due to solar panel shall be considered as 0.30kN/m^2.

Notes:

The walls loading will be taken based on actual location shown in architectural drawings. External wall load/glazing load will be taken as per details provided in architectural drawings. It is proposed to take 230 mm thick brick wall with 20 mm thick plaster on either side. However, the same shall not be taken less than 24kN/m^2.

Above loads intensities are minimum loads to be considered in design, Actual load may be higher as per detailed architectural drawings.

(c) Live loads (LL)

Live loads shall generally follow the requirements of National Building Code and IS 875:(Part 2), except where the loadings given below are more severe:

(d) Earthquake Loads (EQ)

Location of proposal site lies in Zone IV. The design parameters shall be taken as per IS-1893.

Seismic Ductile detailing for RCC structures as per IS: 13920

(e) Wind Loads (WL)

Wind Loads (longitudinal & transverse) shall be calculated in accordance with IS 875: Part 3.

Design wind speed Vz(m/s) = 50m/s (As per NBC)

(f) Construction and Erection Loads (ER)

The weight of all temporary and permanent materials together with all other forces and effects which can operate on any part of structure during erection shall be taken into account. Allowances shall be made in the permanent design for any locked in stresses caused in any member during erection.

(g) Temperature Load (TL)

As per IS: 456. Temperature gradient shall be considered as per IRC-6, if applicable.

(h) Shrinkage & creep

Shrinkage & creep strain shall be evaluated as per IS: 456 for plain and RCC

structures and IS: 1343 for prestressed concrete structures.

(i) Earth Pressure (EP) & Water pressure (WP)

In the design of structures or part of structures below ground level, such as retaining walls and underground pump room/ water tanks etc. the pressure exerted by soil or water or both shall be duly accounted for. When a portion or whole of the soil is below the free water surface, the lateral earth pressure shall be evaluated for weight of soil diminished by buoyancy and the full hydrostatic pressure. (As per IS: 875-part 5).

All foundation slabs / footings subjected to water pressure shall be designed to resist a uniformly distributed uplift equal to the full hydrostatic pressure. Checking of overturning of foundation under submerged condition shall be done considering buoyant weight of foundation.

If any of the structure supporting railway loading is subjected to earth pressure, the loads and effects shall be calculated in accordance with IRS substructure code.

(j) Surcharge Load (SL)

In the design of structures or the parts of the structures below ground level, such as retaining walls & underground pump room/ water tank etc. the pressure exerted by surcharge from stationary or moving load, shall be duly accounted for. For the area approachable by road traffic, the minimum live load surcharge shall be taken as 24 kN/m^2.

(k) Other Forces and Effects

As per IS: 456.

1.4.6 Deflection Criteria

The deflection limitations as per IS: 456 for Plain and RCC Structures.

1.4.7 Settlement (DS)

Maximum and differential settlement shall not exceed, as provided in Table 1 of IS: 1904. The allowable settlement for pile group is 25mm (as per IS 2911-part 4).

1.4.8 Lateral Sway

The lateral sway at the top of the building due to wind loads should not exceeds H/500, where 'H' is the height of the building.

1.4.9 Load combinations

For loadings, load combinations, analysis, and design of structures, all relevant IRS, IS, IRC and other relevant codes shall be followed.

i. For steel structures, the load combinations shall be as per IS: 800.

ii. For RCC structures / elements, shall be as per Table 18 of IS: 456.

1.4.10 Materials

i. Cement

For plain and reinforced concrete structures cement shall be used according to IS: 456. For PSC structures IS: 1343 shall be used.

ii. Concrete

The minimum grade of concrete shall be as per IS: 456 for Plain and RCC structures and IS: 1343 for PSC structures.

Concrete & Short term modulus of elasticity (Ec) shall be as per IS: 456 in case of Plain and Reinforced Concrete structures and as per IS: 1343 for Pre-stressed concrete structures.

The modular ratio for concrete grades shall be taken as per Annex B of IS: 456.

iii. Density

(a) 25 kN/m^3 for Reinforced concrete & Prestressed concrete

(b) 25 kN/m^3 for Plain concrete

(c) 26 kN/m^3 for wet concrete

For density of strands and all other materials, the densities shall be considered as per IS Codes.

iv. Structural Steel

Structural steel used shall conform to following:

(a) Hollow steel sections as per IS: 4923

(b) Steel for general Structural Purpose as per IS: 2062

(c) Steel tubes for structural purpose as per IS: 1161

(d) Design of steel structure will be governed by IS 800. In case of composite (steel- concrete) structure it will be governed by IS: 11384 & IS: 3935

(e) Fabrication shall be done in accordance with IS: 800

v. Reinforcement Steel (Rebars)

High strength deformed (HYSD) reinforcement bars of Fe-500D grade, conforming to IS 1786 and Clause 4.5 & 7.1.5 of IRS-CBC shall be used.

Young's Modulus = 200,000 Mpa

Yield Stress(fy)	=	500 MPa.
Density	=	78.5 kN/m3

1.4.11 Reinforcement Detailing

All reinforcement shall be detailed in accordance with IS: 456 & SP: 34 for plain and reinforced concrete structures and IS: 1343 for PSC structures.

The ductile detailing of seismic resisting RC elements shall comply with ductile requirements of IS: 13920.

1.4.12 Durability

Durability of concrete shall be as per IS: 456 for Plain & RCC, as per IS: 1343 for PSC elements and as per IS: 800 for steel structures.

1.4.13 Cover to Reinforcement

From durability consideration, exposure condition is assumed to be moderate. The clear cover to main reinforcement shall be considered in the design, satisfying durability & 2 hrs. fire rating requirement, which shall be as follows (clause No. 26.4.2, Clauses 21.4-,26.4.3 and Fig 1 of IS 456-2000)

A	Footing	50 mm
B	Columns	40 mm
C	Floor/Roof Beams	30 mm
D	Floor /Roof Slab	25 mm
E	Lintel Beams, Chajja & Loft	15 mm
F	Staircase Waist Slab & Landing	25 mm
G	Plinth Beam	40 mm
H	Walls	25 mm

1.4.14 Fire Resistance Period

All the structural elements shall be designed for a minimum period of fire resistant of 2 hour. The minimum element thickness for fire resistance shall be as per IS: 456 for concrete structures and as per IS: 800 for steel structures.

1.4.15 Crack width Check

All structural concrete elements shall be designed to prevent excessive cracking due to flexure, early age thermal and shrinkage. Flexural crack width shall be checked in accordance with IS: 456 for Plain and RCC structures and IS: 1343 for PSC

structures. Crack width should not exceed 0.25 mm unless otherwise specified. Crack width for water retaining structure 0.2 mm as IS 3370.

1.4.16 Computation Methods – Modelling, Analysis, Design & Detailing

i. Modelling

The structure is idealized as a 3-D space frame model using the software packages STAAD pro/ Midas. The masonry wall is used as filler wall and not cast monolithically with structure. Hence this is not modelled in the analysis. In this package slab loads are applied as a floor loads. Wall loads are applied as UDL on beams. Self – weight is added in the software to have member loads.

The analysis of the proposed structure would be carried to

(a) Analyse to ensure elastic behaviour and fulfilment of serviceability criteria for un-factored load combination.

(b) Analyse to ensure adequate structural integrity for factored load combinations

(c) Obtain static displacements and rotations at various nodes.

(d) Obtain resultant member forces like bending moments, shear forces and axial forces.

(e) Support reactions (axial force and moment) coming on foundations.

ii. Control of Deflection (Vertical)

The deflections of a structure or part thereof shall not adversely affect the appearance or efficiency of the structure or finishes or partitions. The deflections shall generally be limited to the following (Clause 23.2 of IS 456-2000):

(a) The final deflections due to all loads including heat effects of temperature, creep and shrinkage and measured from the as-cast level of the supports of floors, and all other horizontal members, should not normally exceed span/250.

(b) The deflection including the effects of temperature, creep and shrinkage occurring after erection of partitions and applications of finishes should not normally exceed span/350 or 20 mm whichever is less. When deflections are required to be calculated, the method given in Appendix – B of IS: 456-2000 will be used.

1.4.17 Design Philosophy

To meet the design life and durability requirements, codal provisions specified in clause 8.0 and table 5 of IS: 456- 2000 will be followed for reinforced Concrete Elements. All structural elements would be designed according to the Limit State Method as specified in IS: 456: 2000. M 35 grade of concrete shall be considered for design of all structural member. Along with specified analysis package, design sheets in MS Excel format shall be submitted as per Employer's requirement.

i. Design OF FLOOR / ROOF SLAB

All floor/roof slabs be designed in accordance with Annex- D of IS: 456-2000 with corners held down. Cranking of reinforcement at the support will be provided. Torsion reinforcement will be provided at corners of the slab as per clause D-1.8 of Annex-D of IS: 456-2000.

The beams shall be designed for the envelopes of maximum bending moment and shear force for the load combination that gives the maximum stresses using the latest STAAD Pro software as per the requirements of IS 456-2000. The critical members would be check manually also. Main reinforcement will not be bent-up and hence shear reinforcement shall be in the form vertical stirrups only.

ii. Design Of Columns:

The columns shall be designed for vertical load (reduced in accordance with clause 3.2 of IS: 875 (part-2-1987) and uniaxial or biaxial bending depending on its location. Effective length of the column will be in accordance with Annex- E of IS: 456-2000, considering fixed end on both ends. Minimum diameter of longitudinal steel is 12mm and that for ties is 8mm. The columns shall be designed for the envelopes of maximum value as per STAAD Pro/Etab. The critical members would be check manually also.

iii. Design Of Footings

Assume 10% of the vertical load from the column as the self-weight of the footing a preliminary step for the design. The same shall be checked after designing the footing dimensions. The plan size of the footing will be determined on the basis of the SBC of the soil. The design pressure at the base of the footing shall be determined by algebraic addition of the pressure due to vertical load and that the due to moment at the base of the column. The design pressure shall be less than SBC of soil except when seismic load are considered, Where SBC can be increased as per Table-1 of IS: 1893-2016.

Base pressure = (P/A)+/-(Mx/Zx) +/- (My/Zy)

Where,

P = Vertical load on the footing;

A = Plan area of the footing;

Mx and My = Bending moment at the base of the column along the X and Y directions;

Zx and Zy = Sectional modules of the footing along the X and Y directions = $ab^2/6$ or $ba^2/6$; and

a & b are the dimensions of the footing.

The footing shall be designed in accordance with clause 34 of IS:456-2000. The footing will be checked for the following:

(a) Bending moment at a section on the face of the column /pedestal

(b) Shear force at a section at a distance equal to effective depth of the footing from the face of the column or pedestal.

(c) Bearing stress on the footing due vertical load of the column.

(d) Punching shear on the footing due to vertical load of the column.

The reinforcement will be determined as a rectangular section in accordance with Annex-G of IS:456-2000 and SP-16.

iv. Design Of Lintel Beams, Chajja & Loft

The lintel beams will be designed for:

(a) Weight of brick masonry above the lintel level

(b) Load from RCC Chajja attached to the lintel.

(c) Torsion moment due to eccentricity of the Chajja/loft.

Lintel beam shall have a minimum bearing equal to the thickness of the wall on which it is supported or the depth of the lintel beam, whichever is greater. It shall be designed as a simply supported rectangular section. Chajja/loft will be designed as a cantilever slab.

v. Design Of Staircase

The Internal staircase shall be designed in accordance with clause 33 of IS: 456-2000. The Staircase is slab type without stringer beam. The waist slab shall be designed as a simply supported rectangular section. The size of main

reinforcement steel shall not be less than 12mm. The staircase would be analysed, designed & detailed as per the provisions of SP-34.

vi. Design Of Overhead Water Storage Tanks

Overhead water storage tanks shall be designed to sustain the water load at full tank condition as per the provisions of IS: 3370 (Part 1- Part4).

vii. Expansion & Construction Joints:

Seismic Expansion joints are recommended when structure exceeds 45m length. The width of the joints is being calculated as per Clause7.11.3 of IS-1893.

viii. Detailing

The reinforcement layout should take into account the strength requirements as well as the economy of construction.

Following are the requirements of good detailing:

(a) Reinforcement detailing should be simple for fabrication and placing.

(b) Cracking of concrete should be within the permissible limits

(c) There should not be any free paths for propagation of cracks without being traversed by reinforcement

(d) Joints and discontinuities should be capable of withstanding the same forces as the adjoining sections

(e) Reinforcement should not deviate excessively from the direction of tensile stresses

(f) Reinforcement steel of same type and grade shall be used as main reinforcement in a structural member.

(g) Provisions of IS: 456, IS 13920 and IS: SP 34 will be followed for the purpose of detailing of reinforcement.

1.4.18 Design of Underground water storage tanks

Underground water storage tanks at stations shall be designed as a water retaining structure based on IS: 3370. Underground water tank would be designed to sustain the following two cases-

(a) Tank full and No earth fill

(b) Tank empty and active earth pressure acting from outside.

Various types of loadings shall be considered in the design of the underground tank. The side walls shall be subjected to earth pressure. Wherever encountered,

horizontal pressure due to water table shall also be considered. Stability of water tank shall be checked against buoyancy and foundation raft shall be designed for the worst of buoyant force and soil pressure.

The tank shall also be designed for surcharge loading if any. Water proofing treatment shall be done on the external surface as well as in the internal surface.

1.4.19 Masonry Walls

All Masonry walls shall be treated as non-structural infill panels and shall be treated as one way / two way slab panels spanning between adjoining beams and columns to check structural safety. Masonry walls shall be designed as un-reinforced masonry as per IS: 1905 and IS: 4326. Shear connector reinforcement between walls & beams and walls & columns shall be provided for external wall while the internal partition walls shall be connected with roof slabs/beams using dry packing mortar between top of walls and soffit of slab / beam.

1.5 Codal Preference

The design shall be carried out as per provision of these design specifications. Reference shall be made to the following codes for any additional information:

Order of preferences of codes shall be as follows:

(a) Bureau of Indian Standard codes

(b) Indian Railway standard

(c) National Building Code

(d) IRC

(e) BS or Euro Codes

(f) AASHTO

(g) Any international code with approval of HRIDC.

2 CODES & STANDARDS

2.1 General

The Contractor shall carry out the design on the basis of the codes and specifications given below. The list of codes mentioned herein is only for guidance. The Contractor may supplement these codes and standards with the consent of the Engineer if in his opinion it is essential to do so to comply with the Employer's Requirements.

The Contractor shall be responsible for detailing in his design report and specifications the standards on which his materials and workmanship will be based and these will be of similar or higher standard than those listed below.

The Contractor shall also be responsible for getting the approval from the Engineer for the standards which he intends to apply for the detailing of his design and specifications additionally.

Apart from the basic data and specific requirements listed in the Employer's Requirement, all items of the Works shall be governed by the latest versions of the following codes and specifications as revised/corrected/amended (with latest correction slip) till the date of opening of the Bid. In case of contradiction in various codal provisions, the order of precedence shall be as follows: -

i. Specific provisions in the Employer's Requirements.
ii. IS Codes
iii. IRS Codes and specifications
iv. IRC Codes and specifications
v. International Codes

However, in case of structure near railway track, loadings shall be taken as per IRS Codal provisions. Notwithstanding the precedence specified above, the Contractor shall always seek advice from the Engineer in the event of any conflict for a final decision.

Part 2: Employer's Requirements
Section 5IV: Outline Construction Specifications (OCS) -Civil

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1.1 General

Specification for various activities involved in buildings & other structures shall generally be in accordance with CPWD specifications-2019 for Civil Works Volume 1 & 2, as amended up to date unless stated otherwise in these specifications. In case of any contradictory instruction in the specification, Engineer's decision shall be final & binding.

1.1.1 Earthwork

Earthwork in excavation and filling/backfilling in buildings & other structures shall be carried out as per CPWD specifications. Soil for filling shall be arranged by the Contractor from outside the ROW. No Earth is to be taken from the Railway/HORC premises except surplus earth from excavation for the building.

1.1.2 Concrete Work

All plain and reinforced concrete works shall be carried out as per IS 456:2000 and Annexure OCS-1 and 2. Design Mix concrete as approved by the Engineer shall only be used.

1.1.3 Anti-Termite Treatment

Pre-Construction Anti-Termite Treatment shall be done as per clause 2.28 of CPWD specification 2019 Vol.-1. The chemical shall be approved by the Engineer and used as per the manufacturer's instructions/specification.

1.1.4 Plinth Protection

Plinth protection shall be 1000 mm wide all around the building, it comprises of 50mm thick M-25 concrete over 75 mm thick bed of dry brick aggregate of 40mm nominal size, grouted with fine sand. The outer edge or face edge shall be lined with with 2^{nd} class bricks laid on the edge and joints laid in cement mortar 1:4. It shall be laid to the required width and slope in outward direction.

1.1.5 Damp Proof Course (DPC)

Unless otherwise mentioned in the drawings, DPC will consist of 40 mm thick M25 CC with two coats of bitumen over it shall be provided as per clause 4.4 of CPWD Specification 2019 Volume-1.

1.1.6 Masonry Work

In IMD building AAC blocks and in other buildings AAC blocks/ Clay bricks confirming to the BIS shall be used. All outer and load bearing walls shall be of minimum 225 mm thickness or more as per design, in cement mortar 1:6, all partition walls shall be minimum 115 mm thick in cement mortar 1:4 as per Clause 6 of CPWD Specification Volume-I 2019.

1.1.7 Plaster

Plaster of 15-19mm thick in cement mortar 1:4 on all outer and inner walls except in ceiling. Inner walls shall be finally finished with POP. The underside of slabs shall be

rendered smooth wherever required and finished with POP as per Clause 3 of CPWD Specification Volume-I 2019.

1.1.8 **Painting**

Two coats of synthetic enamel paint of 1st quality over a priming coat of Asian, Berger, Nerolac or equivalent brand and shade as approved by the Engineer, on all exposed steel and wooden surfaces.

1.2 Sanitary fittings/sewerage system:

1.2.1 Manholes

Manholes and junction chambers to be constructed by Contractor as per the design by the Contractor & approved by the Engineer and to be connected with RCC pipes of 150/200 mm dia. with each other and to septic tank or to existing sewerage arrangement. In case sewage system is not be connected with trunk sewer, contractor will furnish appropriate design of septic tank for required number of users to be approved by the Engineer and will construct the Septic Tank accordingly.

1.2.2 Rainwater pipes

Adequate number of rainwater pipes of min 110 mm dia, uPVC of approved quality and make as approved by the Engineer to be provided. Inlet of the rainwater pipe to be provided with shoe and CI gratings and at the outlets necessary protection to be done to prevent erosion of soil.

1.2.3 Soil and vent pipes

uPVC pipes/cast iron of min 75 mm dia to be provided for soil and vent pipes including all fittings and other accessories as necessary for laying the pipes of approved quality and make as approved by the Engineer to be provided. Before embedding the pipes under the floor/platform the same will have to be tested against any leakage. Necessary floor traps, gully traps as essential will be provided. Storm water drain of suitable size to be provided as approved by the engineer.

1.2.4 Wash Basins, Sink and Water closet

Wash basins (Ceramic) of approved size, colour and make as per IS: 2556 (Part 1) and IS: 2556 (Part 4) shall be provided in ladies and gents toilet. Urinal in gent's toilet shall be of Bowl type with flushing rim & partition slab and in lady's toilet Squatting plate type (ceramic) of approved size and make as per IS: 2556 (Part 6) with ceramic flushing cisterns as shown in tender drawings. Water closet shall be Indian (Orissa type) as per IS: 2556 (Part3) / European type as per IS: 2556 (Part1) and IS: 2556 (Part2) with ceramic flushing cisterns as shown in tender drawings. Stainless steel/Ceramic sinks as per IS: 771 (Part2) of approved size and makes to be provided in battery rooms, pantry. All water services and sinks will be connected through bottle traps to concealed outlet pipes.

1.2.5 Water supply

a) Bore well shall be constructed as per IS 2800 Part 1 & Part 2. Chlorinators using common salt shall be provided at tube well for chlorination of water.

b) Necessary layout for water supply distribution in the water booth, toilets and bathroom to be designed by the contractor and submitted for approval of the Engineer. All internal pipes shall be laid concealed in walls and tested for leakage for a minimum of 12m head of water. All GI pipes shall be of minimum class 'B.' All necessary taps, stop valve etc. of approved size and make to be provided by Contractor to make the toilets and kitchens functional including provision of RCC underground & overhead water tanks of designed capacity. This will include provision of float valve, copper/brass rod and plastic ball with inlet, outlet, overflow, washout connections etc. for the water tank complete in all respect. Taps in platform toilets & water booths shall be self-closing type.

1.2.6 Water proofing of roofs:

Waterproofing of roof shall be carried out by the Contractor as approved by the Engineer.

1.2.7 Drip courses

Drip course of approved design shall be provided all around the building, chajjas etc.

1.3 Station, S&T hut and Maintenance office:

1.3.1 Finishes

a) **Interior finish**

Two or more coats of 1st quality acrylic distemper of approved shade over POP coating to make the surface smooth. Final coat to be done before handing over of assets.

b) Exterior finish

Two or more coats of water proofing cement paint of approved shade over POP coating to make the surface smooth. Final coat shall be done before handing over of assets.

1.3.2 **Flooring**

a) **Substation room, Electrical room, Genset room, Store room etc.**

40mm thick, cement concreate flooring with M-25 CC laid in one layer finished with cement slurry to a true smooth surface with joints provided with glass strips of 4mm thick to form panels not exceeding 1200x1200mm, laid over 100mm thick CC M-10 over 100mm thick sand filling over well rammed and consolidated earth filling as per Clause 11.2 of CPWD Specification Volume-I 2019.

b) **Battery Room**

Acid proof tiles of size 198.5x198.5 mm & 10 mm thick conforming to IS 4457-1967 as approved by the Engineer over 10 mm thick cement sand mortar 1:4(1 acid proof cement: 4 coarse sand). Acid proof tiles shall also be provided in dado as per requirement up to minimum 1.5 m height as per Clause 11.14 of CPWD Specification Volume-I 2019.

c) **Staircase**

In maintenance office, Kota Stone 25 mm thick to be provided in risers, treads and landings of steps laid on with neat cement slurry mixed with pigment to match the shade of kota stone including rubbing polishing complete on 20mm thick cement sand mortar 1:4. Skirting of same Kota Stone shall be provided upto minimum150 mm height. The work shall be done as per Clause 11.22 of CPWD Specification Volume-I 2019. Kota stone provided on riser & tread of steps shall be minimum 1.8 m long & shall cover full height/width of the step. Exposed end of kota stone on treads shall be rounded to provide nosing. Kota stone tile at other places shall be of minimum 600 mm x 600 mm size. Stone at edges can be cut in smaller sizes to fill up the residual areas.

In station building, Granite 18 mm thick to be provided in risers, treads and landings of steps. Skirting of same granite Stone shall be provided upto minimum150 mm height as per Clause 8.1.3 of CPWD Specification Volume-I 2019. Granite stone provided on riser & tread of steps shall be minimum 1.8 m long & shall cover full height/width of the step. Exposed end of granite stone on treads shall be rounded to provide nosing. Antiskid recess to be provided on steps as approved by the Engineer.

d) **Verandah Flooring**

Kota Stone 25 mm thick flooring and 150 mm height skirting laid on with neat cement slurry mixed with pigment to match the shade of kota stone including rubbing polishing complete on 20mm thick cement sand mortar 1:4 as per Clause 11.21 of CPWD Specification Volume-I 2019. Kota stone tiles shall be of minimum 600 mm x 600 mm size. Stone at edges can be cut in smaller sizes to fill up the residual areas.

e) **Toilets**:

Finished floor to be kept 25mm below the normal floor of the building. Minimum 300x300 mm size ceramic anti-skid floor tiles of minimum 12 mm thickness, 1st quality conforming to IS 13630-1993 of make and shade and approved by Engineer laid over 20mm thick bed of cement sand mortar 1:4 using neat cement slurry and pointing of joints done with white cement mixed with pigment to match the shade of tiles as per Clause 11.15 of CPWD Specifications Volume-I 2019. Glazed tiles of suitable size (300mmx300mm or 300mmx450mm) and minimum 06mm thickness confirming to IS 13630-1993 of make, quality and shade as approved by the engineer to be provided on wall for full height up to ceilings over 12 mm thick cement mortar 1:3. All the tiles to be laid with zero gap between them.

f) **Rooms**

Relay room, Panel Room, IPS room, Tele-equipment room, restroom etc. 1st quality 600 x 600 mm vitrified floor tiles of minimum 12 mm thickness conforming to IS 15622 of make and shade as approved by Engineer laid over 20 mm thick bed of cement sand mortar 1:4 using neat cement slurry and pointing of joints done with white cement mixed with pigment to match the shades of tiles over a base of 100mm thick CC M-10 over 100 mm thick sand filling on well rammed and consolidated earth filling for ground floor. On subsequent floors tiles shall be laid directly on mortar bed. In skirting/dado also vitrified tiles shall be provided. All the tiles are to

be laid with zero gap between them as per Clause 11.15 & 11.16 of CPWD Specification Volume-I 2019.

Note:-

Color and make of all the flooring shall be as per the direction of the Engineer.

g) **Booking Office & Waiting Hall**

18 mm thick Granite flooring of approved shade and colour shall be provided as per CPWD Specification Volume-I 2019. Same granite shall be provided in skirting.

1.3.3 **Door, Windows and Ventilation**

I. Station Building

a) **Door frames:**

Door frame shall be pressed steel door frames manufactured from mild steel sheets of specified thickness conforming to IS:2062 & 4351. Each frame shall consist of hinge jamb, lock jamb, head and angle threshold of size 50 x 25mm as per Clause 10.12 of CPWD Specification Volume-I 2019.

In toilets uPVC door frames of section of size 65 mm x 55 mm with wall thickness of 2 mm shall be provided as per CPWD Specification Volume-I 2019

b) **Door Shutter**:

35 mm thick flush door shutter conforming to IS:2202 (Part1), decorative type, core of block board construction with stiles, rails & lipping of hard wood timber and well-matched commercial 3 ply veneering with vertical grains on both faces of shutters as per IS:710 with brass fittings of approved size and make as per requirement.

In toilets PVC door shutter with styles and rails made up of PVC hollow section shall be provided as per CPWD Specification Volume-I 2019

c) **Windows/Ventilators**

The frames of windows and ventilators shall be of powder coated aluminum (coating thickness 60-80 micron) with extruded built up standard tubular sections/ Z sections of approved make conforming to IS: 733 and IS:1285 fixed with dash fasteners of required dia and size with fully glazed shutters of 5 mm thick float glass provided with EPDM rubber/ neoprene gasket with complete fittings as per CPWD specifications Vol.-II.

d) Anodised aluminium grills (minimum anodic coating of grade AC 15 as per IS:1868) of approved design/pattern, manufactured from standard sections shall be provided in the windows and ventilators. The grill shall be fixed to the window/ventilator frame with C.P brass/ stainless steel screws.

e) Necessary exhaust fan opening to be provided as required.

f) Toughened Glass door shutter, 12mm thick including all fitting & fixing in ticket booking office as per Clause 21.14 of CPWD specifications Vol.-II.

II. **S&T hut and Maintenance office**

a) **Door frames:**

Door frame shall be pressed steel door frames manufactured from mild steel sheets of specified thickness conforming to IS:2062 & 4351. Each frame shall consist of hinge jamb, lock jamb, head and angle threshold of size 50 x 25mm as per Clause 10.12 of CPWD Specification Volume-I 2019.

In toilets uPVC door frames of section of size 65 mm x 55 mm with wall thickness of 2 mm shall be provided as per CPWD Specification Volume-I 2019

b) **Door Shutter**:

35 mm thick flush door shutter conforming to IS:2202 (Part1), decorative type, core of block board construction with stiles, rails & lipping of hard wood timber and well-matched commercial 3 ply veneering with vertical grains on both faces of shutters as per IS:710 with brass fittings of approved size and make as per requirement.

In toilets PVC door shutter with styles and rails made up of PVC hollow section shall be provided as per CPWD Specification Volume-I 2019

g) **Windows/Ventilators**

Windows and ventilators shall be IS marked steel glazed factory made of approved make with complete fittings as per CPWD specifications Vol.-I.

1.4 IMD Building

1.4.1 **Doors, Windows & Ventilators**

a) **Main Entrance Door**

Toughened Glass door shutter, 12mm thick including all fitting & fixing as per Clause 21.14 of CPWD specifications Vol.-II.

b) **Door frames**

Door frames shall be of powder coated aluminum (coating thickness 60-80 micron) with extruded built up standard tubular sections/ Z sections of approved make conforming to IS: 733 and IS:1285 fixed with dash fasteners of required dia and size with fully glazed shutters of 5 mm thick float glass provided with EPDM rubber/ neoprene gasket with complete fittings as per CPWD specifications Vol.-II.

c) **Door Shutter**

35 mm thick flush door shutter conforming to IS:2202 (Part1), decorative type, core of block board construction with frame of 1st class hard wood timber and well-matched teak 3 ply veneering with vertical grains on both faces of shutters with 2nd class teak wood lipping as per IS:710 with complete fittings.

d) **Windows/Ventilators**

The frames of windows and ventilators shall be of powder coated aluminum (coating thickness 60-80 micron) with extruded built up standard tubular sections/ Z sections of approved make conforming to IS: 733 and IS:1285 fixed with dash fasteners of required dia and size with fully glazed shutters of 5 mm thick float glass provided with EPDM rubber/ neoprene gasket with complete fittings as per CPWD specifications Vol.-II. Windows and ventilators shall be provided with anodised aluminium grills (minimum anodic coating of grade AC 15 as per IS:1868) of approved design/pattern & manufactured from standard sections wherever required. The grill shall be fixed to the window/ventilator frame with C.P brass/ stainless steel screws.

e) **Door/Window fittings**:

These shall be of aluminium type, of size and make as approved by the Engineer.

1.4.2 **Finishes**

a) **Interior finish**

Two coats of 1st quality acrylic distemper of approved shade & make over POP coating to make the surface smooth. 3rd coat may be done before handing over of assets.

b) **Exterior finish**

Two coats of textured exterior paint of approved shade & make over POP coating to make the surface smooth. 3rd coat shall be done before handing over of assets.

c) **Structural Glazing**

Structural glazing (in semi unitized system) in framework of extruded aluminium section powder coated of requited colour and shade shall be provided on façade as per architectural drawing and CPWD specifications.

1.4.3 **Flooring and Dado**

a) 1st quality 600 x 600 mm vitrified floor tiles of minimum 12 mm thickness conforming to IS: 15622 of make and shade as approved by Engineer. Same floor tiles shall also be provided on walls in dado up to 200 mm height from floor level. All the tiles to be laid with 3mm gap between them with joints filled with epoxy grout as per CPWD Specification Volume-I 2019.

b) Toilets

Finished floor to be kept 25mm below the normal floor of the building. 300x300mm 1st class ceramic antiskid floor tiles of minimum 12 mm thickness conforming to IS 15622 of make and shade as approved by Engineer. Glazed tiles of suitable size (300mm x 300mm or 300mm x 450mm) and minimum 06mm thickness conforming to IS 15622 of make, quality and shade as approved by the Engineer to be provided on walls for full height up to ceilings. Tiles shall be laid with zero gaps between them as per CPWD Specification Volume-I 2019.

a) **Portico**

18 mm thick Granite flooring of approved shade and colour shall be provided as per CPWD Specification Volume-I 2019.

a) **Stairs**

Granite 18 mm thick to be provided in risers, treads and landings of steps. Skirting of same granite Stone shall be provided upto minimum150 mm height as per Clause 8.1.3 of CPWD Specification Volume-I 2019. Granite stone provided on riser & tread of steps shall be minimum 1.8 m long & shall cover full height/width of the step. Exposed end of granite stone on treads shall be rounded to provide nosing. Antiskid recess to be provided on steps as approved by the Engineer.

b) **Railing**

Assembly and erection as per approved drawing on stairs, ramp & subway of Stainless steel of material grade SS 304 as per CPWD specification Vol.-1 2019.

False Ceiling

1.5 Miscellaneous items shall be as given below-

Item No.	Description of items	Material Spec.
1.	Orissa WC Pan (Indian Style) with low level dual flushing ceramic cistern	Ceramic
2-	European Type Wall Hung/Floor Mounted WC with seat, lid and low level dual flushing ceramic Cistern	Ceramic
3-	Water Jet/Health Faucet with European WC	CP Brass
4-	Ceramic Wash Basin with CP brass pillar Tap / with Quarter Turns Ceramic Cartridges.	Ceramic
5-	Tap (Toilet, Bath & WC) CP Brass/ bib cock provided with quarter turn ceramic cartridges	CP Brass
6-	Mirror (600 x 450mm) with each wash basin with PTMT glass shelf	PTMT
7-	Towel rail	CP Brass
8-	Soap Rack for each wash basin	CP Brass

1.6 Waterproofing At Construction Joints

Construction joints are to be constructed as follows

a. All construction joints in external slab and wall will be provided with PVC water stop located at the center of the element.
b. In the top surface of base and roof slabs at junction with diaphragm walls, a 25x25mm recess will be cast in the slab and subsequently filled with a high-performance water stop grout of the crystalline growth type.
c. All construction joints in external slab and walls will be cast with a 25x25 recess on the outer face (expect the base slab where it will be provided on the upper face). The recess will be filled with a high performance water stop grout of the crystalline growth type.

d. All construction details and material are to be submitted to the Engineer for the approval.

1.6.1 Waterproofing To Base Slab of Underground Structures

a. General
Concrete waterproofing admixture shall of the crystalline growth type. The admixture shall have a proven track record of successful application in similar conditions.
This admixture shall be applied to the full thickness of the base slab and extend to the sidewall of sumps and similar depression of the base slab to form a continuous water light surface.

b. Trials
Prior to construction, trial mixes are to be conducted under the supervision of the Engineer or his Representative and with the manufacturer present to confirm that the proposed mix conforms to strength, w/c ratio, slump, and other requirements. The trial mix concrete shall further have an average water permeability coefficient when tested at 28 days of not greater than 5x10-13 m/s under 5kgf/cm2 and an average penetration depth not greater than 15mm as measured by DIN 1048 Part 5:1991.

1.6.2 Waterproofing To Roof Slabs

The spray applied liquid polymer membrane shall be suitable for use in an ambient temperature range not greater than 40°C. It shall allow diffusion of water vapors to prevent any buildup of pressure between the membrane and substrate. The membrane shall meet or surpass the following requirements:

Total membrane thickness	2.5mm minimum dry film thickness and sprayed in a minimum of two coats of contrasting colors, with the second coat applied to the first coat only after the first coat has cured.
Tensile strength	4.0MPa minimum in any of the three orthogonal planes of the membrane
Membrane elongation at break	130% minimum
Peal adhesion to concrete (ASTMD4541)	2.0MPa minimum
Static crack bridging (tested to recognized international standard acceptable to the Engineer)	2mm minimum

The cured membrane shall be chemically resistant to the effects of hydraulic fluids, diesel fuel and diluted mineral acids etc.
The substrate shall be prepared and primed in strict accordance with the manufacturer's recommendations and requirements. The membrane shall be of a thixotropic nature and cold applied to ensure consistent thickness is achieved over all substrate irregularities.
The materials used must be based upon resin systems that do not react with moisture although the substrate should be dry during application.

The liquid polymer membrane shall be continued 1 meter down the vertical side of the roof slab where the roof is cast by bottom up sequence.

All components of waterproofing system shall be provided by one manufacturer. All materials must be supplied to site in unopened packaging, with batch numbers marked and corresponding manufacturer's certificates of conformity and must be used within the product's shelf life. All components of the system exposed to rain within the curing period shall be replaced unless agreed otherwise by the Engineer.

The membrane wet film thickness should be checked every 10 square meters during application of of each layer, using a pin or comb gauge. Destructive testing to measure dry film thickness shall be carried out on the cured membrane at every 100 square meters or at every working shift, whichever occurs sooner, and shall be made good to the satisfaction of the Engineer.

Tests to the acceptance of the Engineer shall be carried out on the cured membrane to identify any discontinuities in the membrane and to prove the integrity of the membrane.

2.0 PLUMBING AND FIRE FIGHTING

2.1 Water Supply and Plumbing Works

2.1.1 Applicable Standards

The Contractor shall ensure the compliance to the following codes and standards:

IS 458	Specification for Precast Concrete Pipe
IS 783	Code of Practice for Laying of Concrete Pipes
IS 1172	Code of Basic Requirements for Water Supply, Drainage & Sanitation
IS 1239 (Part-1)	Steel Tubes, Tubulars and Other Wrought Steel– 2004 Fittings, Part 1: Steel Tubes
IS 1239 (Part-2)	Steel Tubes, Tubulars and Other Steel Fittings– 2011, Part 2: Steel Pipe Fittings
IS 1726	Specification for Cast Iron Manhole Covers & Frames
IS 3624	Specification for Pressure and Vacuum Gauges
IS 4984	Specification for Water Supply HDPE pipes
IS 7634 (Part 2)	Specification of Installation for Water Supply HDPE Pipes
IS 8110	Well screens and slotted Pipes.
IS 8329	Centrifugally Cast (spun) Ductile Iron Pressure Pipes for Water, Gas and Sewage
IS: 9439	Glossary of terms used in Water-well drilling technology.
IS 9523	Ductile Iron Fittings for Pressure Pipes for Water, Gas and Sewage
IS:11189	Method of Tubewell Development
IS 12288	Specification for Laying Ductile Iron Pipes
IS:12818	Unplasticized polyvinyl chloride (PVC-U) Screen and casing pipes for Borewell/tubewell specification
IS 16098 (Part-2)	Structured-wall Plastics Piping Systems for Non-Pressure Drainage and Sewerage
BIS - SP (QAWSM) 56	Location, operation and Maintenance of tube/bore wells - Guidelines

2.1.2 Storage Tanks for Water Supply

Storage tanks for water supply shall be constructed in accordance with IS 3370 (Part 1 &

Part 2) and as per drawings approved by the Engineer.

2.2 Plumbing and Firefighting

2.2.1 General

a) General Requirements

i. The workmanship shall be as per best industrial practices and shall conform to the specifications and Indian Standard Specifications in every respect and shall be as approved by the Engineer.

ii. All relevant certificates shall be submitted by the Contractor to show that the materials comply with the requirements and technical data specified in this document. The Engineer may require additional testing of materials to verify the compliance as per specifications for which the costs shall be borne by the Contractor.

b) Testing and Commissioning

i. Hydrostatic Pressure Testing of Pressure Pipes

ii. All pressurized pipelines shall be tested as specified in Sub-Clause 4.15, Part 9, Section 1 of NBC 2016.

iii. Testing of Non-Pressure Pipes

iv. All non-pressure pipelines shall be tested as specified in 'Manual on Water Supply and Treatment", CPHEEO.

c) Flushing

The Contractor shall be responsible to check that the water pipework is flushed and chemically cleaned against unwanted substances. Contamination may occur during storage of materials, due to surface oxides and mill scale, or the application of protective grease and oils. During the installation period, the pipework can become further contaminated by construction material debris such as welding and jointing materials, swarf and dust. The Contractor responsible for installing the system shall ensure that care is taken to limit the amount of dirt entering the system during installation.

d) Site Acceptance Test, Commissioning and Inspection

i. The Contractor shall submit the schedule and Method Statements for testing and commissioning of all plumbing & fire-fighting equipment, materials, goods and systems to the Engineer, as soon as possible after the award of the Contract. Tests shall be conducted in the presence of the Engineer to his satisfaction. The Contractor shall submit these to obtain approval from the Engineer.

ii. The Contractor is responsible to ensure that all testing equipment, materials and personnel are available at the appropriate time for testing. The Contractor shall prepare forms to record all test procedures and results for the review of the Engineer. These forms shall constitute a record of testing and they are aimed for assisting the Engineer in giving his review of operations, performances and functions for

equipment, materials, goods and systems.

iii. During the installation phase of the project, the Contractor shall carry out initial testing and pre-commissioning of all plumbing and fire-fighting services and systems, followed by final commissioning. This shall include the pressure testing, flushing and cleaning of pipework,

iv. Method Statements shall be submitted for review to the Engineer allowing enough time for review, comment and re-issue.

v. The Contractor shall be responsible to take date stamped photographic records of testing and commissioning; in case the Engineer is unavailable to attend a test demonstration. These shall be produced by the Contractor and submitted to the Engineer along with testing and commissioning records for review or request to re-demonstrate.

2.2.2 Plumbing

a) Qualification

The plumbing works shall be carried out by the plumbing sub-contractor / plumber who holds a valid plumbing license issued by the Municipal authority or other competent authority as per Clause 3.3 under Section-2 Part -IX of NBC-2016. The Contractor shall keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals related to water supply, sewerage and drainage system. He shall also be responsible for co-ordination with other Interfacing Contractors.

b) Materials

i. Piping Materials

All materials shall comply with the following specifications, unless otherwise specified. If after tests, any materials, work or portions or work are found defective, the Contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Engineer. To prove that the materials used are as specified, the Contractor shall furnish the Engineer with original invoice on demand.

1) Water supply pipes

Pipes for water supply shall be as follows –

(A) Ductile Iron (DI) shall conform to IS 8329 and fittings to IS: 9523. All pipe joints shall be with couplers or jointing fixtures as per respective IS codes and manufacturers recommendations

(B) HDPE pipes shall conform to IS 4984.

(C) GI pipes shall conform to IS 1239.

2) Sewage and drainage pipes

Sewage and drainage pipes shall be as follows –

(A) Non pressure HDPE pipes shall conform to IS 16098 Type B. Typical classification of pipes shall be double wall corrugated (DWC)SN8.

(B) RCC pipes shall be socket & spigot centrifugally spun conforming to IS 458 of NP-3 Class.

ii. Water supply pipeline

The Contractor shall install all piping and fittings in their final position in accordance with approved trial assemblies and as per drawings that have been approved by the Engineer. The installation shall be done as per CPHEEO/CPWD/IS specifications

1) DI pipes shall be laid as per IS 12288.

2) HDPE pipes shall be laid as per IS 7634 Part 2.

3) GI pipes

iii. Sewer and drainage pipeline

1) Structured wall plastic piping system shall be laid as per IS 16098.

2) Concrete pipes shall be laid as per IS 783.

3) Soil, waste water and drainage pipes from buildings shall be connected with sewerage and drainage systems through manholes to be constructed by the Contractor.

iv. Manholes

1) Manholes shall be constructed as specified in Part-9, Section-2 of NBC-2016.

2) Manholes shall be provided with cast iron covers and frames embedded in RCC slab or SFRC precast concrete covers as per drawing approved by the Engineer.

v. Disinfection of Storage Tanks

The Contractor shall arrange to disinfect the water storage tanks before commissioning. The water storage tanks shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Adequate amount of chlorine shall be used to give water a dose of 50 parts of chlorine to one million parts of water

2.2.3 **Sourcing of water**

i. Borewells

1) Location of bore-well shall be proposed by the Contractor for the Engineer's approval.

2) The Contractor shall provide borewells including borewell room, pumps,

pipeline and electric wire rope hoist for lifting and lowering of pumps as per drawings approved by the Engineer. The Contractor shall provide pipe line with valves, fittings and accessories from borewell to storage tank as shown in the drawings. The well screen and slotted pipe shall conform to IS 8110 Type D. Material of wire of screens shall be stainless steel (SS) of designation XO4Cr18Ni10 of IS 6528. The housing and casing pipe shall conform to IS 4270 or IS 12818. Borewell shall be provided with sluice valve, pressure gauge, non-return valve and flow meter. Borewell shall be constructed and tested as per IS 2800 Part 1 and Part 2. The Contractor shall furnish information after completion of the borewell as per IS 2800 Part 2 to the Engineer for approval. Provisions of IS:SP(QAWSM) 56 shall be followed for ground water exploration, siting, construction and development of borewell.

2.2.4 **Storage tanks for water supply**

The Contractor shall construct underground and overhead water storage tanks as per the drawings approved by the Engineer.

2.2.5 Water Supply distribution system

The Contractor shall provide water supply distribution system including piping, pumping, valves and fittings to the required gradients and profiles as the drawings approved by the Engineer. The Contractor shall follow provisions of "Manual on Water Supply and Treatment" published by the Central Public Health and Environment Engineering Organization, Ministry of Urban Development, Govt. of India, (CPHEEO), CPWD Specifications (Vol. 2) and NBC 2016 for carrying out and testing the works of water supply distribution system.

2.2.6 Sewage Disposal System

The Contractor shall provide sewage disposal as per the drawings approved by the Engineer. The Contractor shall follow provisions of "Manual on Sewerage and Sewage Treatment Systems" published by CPHEEO, IS SP-35 "Handbook on Water Supply and Drainage" and NBC 2016 for carrying out and testing the works of sewage disposal system.

2.3 Firefighting System

2.3.1 Handheld Fire Extinguishers

The firefighting extinguishers works shall consist of the following:

i. Distribution or installation of fire extinguisher shall be in accordance with IS 2190 or IS 15683.

ii. Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners by skilled workmen.

iii. Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

iv. The extinguishers shall be treated for anti-corrosion internally and externally and painted with fire red paint. The paint shall be stove enamelled.

v. The description of extinguishers shall be marked with 2.5cm height in block letters within a triangle of 5cm each side.

vi. Fire extinguishers shall be counted in numbers and shall include installation of all necessary items required as given in the specifications.

2.3.2 Clean Agent Extinguisher

i. Clean agent type fire extinguishers i.e. stainless-steel body made shall be placed as per approved drawing.

ii. Clean agent fire extinguishers capacities as per city chief fire officer's recommendations & other suggestions shall be followed as per IS 15683.

iii. Clean agent extinguishers shall cover A, B & C type fire.

2.3.3 Dry Chemical Powder Extinguisher

i. The extinguisher shall be filled with grade 40 Mono Ammonium Phosphate (40%) from any approved manufacturer.

ii. The capacity of the extinguisher when filled with dry chemical powder as first filling as per IS 4308, Part II shall be 5 Kg ±2% or 10 Kg ±3%.

It shall be operated upright with a squeeze grip valve to control discharge. The plunger neck shall have a safety clip fitted with a pin to prevent accidental discharge. It shall be pressurised with dry nitrogen as expellant

and shall be charged at a pressure of 15 Kg/cm^2.

2.3.4 Water Type Extinguisher (Gas Pressure Type)

i. The extinguishing medium shall be primarily water stored under normal pressure, and the discharge shall be by release of carbon dioxide gas from a cylinder.

ii. The capacity of extinguisher when filled up to the indicated level, shall be 9L±5%.

2.3.5 Mechanical Foam Type Fire Extinguisher

Mechanical foam fire extinguisher suitable for Class A and Class B fire shall be used for fire extinguishing. Foam being an effective smothering agent is used for liquid fires mainly. It shall react by flowing over the liquid fuel oil surface and isolating the fire from the air and shall also prevent re-ignition due to the foam stability.

3.0 Non-Schedule Items

3.1 NS-1 Granite work for wall lining

Granite work gang saw cut (polished and machine cut) of thickness 18 mm for wall lining (veneer work), backing filled with a grout of average 12 mm thick in cement mortar 1:3 (1 cement : 3 coarse sand), including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) with an admixture of pigment to match the marble shade (cost of providing and fixing of dowel and cramps is included in the rate).
Granite of any colour and shade
NS-1.1.1 Area of slab upto 0.50 sqm
NS-1.1.2 Area of slab over 0.50 sqm

I. Method Statement

The Contractor shall submit Method Statement for carrying out the work to the Engineer for approval. The work shall be carried out strictly in accordance with the approved Method Statement.

II Execution

The work shall be broadly executed as per specifications given in para 8.6 of CPWD specifications 2019. The granite slabs used for wall lining/veneer work shall be gang saw cut (polished & machine cut). The tolerance in wall lining when straight edge of 3 m length is placed should not be more than 2 mm. The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. The stones shall be secured to the backing by means of gunmetal cramps of suitable size spaced not more than 600 mm apart horizontally. All joints shall be full of

mortar. Special care shall be taken to see that groundings for veneer work are full of mortar. If any hollow groundings are detected by tapping the face stones, these shall be taken out and re-laid. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5 mm and in the face joint, the top 6 mm depth shall be filled with mortar specified for the pointing.

III **Method Measurement**

The length and breadth shall be measured correct to a cm. In case of radially dressed or circular slabs used in the work, the dimensions of the circumscribing rectangles of the dressed stone used in the work, shall be measured & paid for. The area shall be calculated in sqm nearest to two places of decimal. Payment will be made at the Unit Price per square metre, entered in the Priced Bill of Quantities.

3.2 NS-2 Earthwork in Filling

Earthwork in filling with contractor's own earth of approved quality from borrow areas including all lead, lift, ascent, descent, royalty, taxes, cess, compensation, crossing of nallahs /stream and other obstructions including mechanical compaction in layers with watering to 95% of MDD (as per IS 2720 part 8), handling, re-handling, dressing to the final profile with all labour, material, tools, plant, machinery and equipment, taxes, cess etc. as a complete job in accordance with the specification and drawings.

Note- This item will be used for earthwork in filling for other than Railway embankment.

I Method Statement

The Contractor shall submit Method Statement for carrying out the work to the Engineer for approval. The work shall be carried out strictly in accordance with the approved Method Statement.

II. Method of Measurement

Measurement for payment for earthwork in filling will be the in-situ volume as measured in cubic meter (cum) from the levels recorded prior to any filling work and the lines and grades shown on the Drawings or established at the Site by the Engineer. Payment will be made at the Unit Price per cubic metre, entered in the Priced Bill of Quantities. 10% payment shall be withheld till the slopes are dressed to the required profile and compacted mechanically with vibratory rollers.

3.3 **NS-3 Providing & fixing of ovel shaped wash basin**

Providing & fixing in position oval shape (over Counter) model 1005 basin 550x 460 mm Cera or equivalent approved make with fitting with bracket and cutting and making good the wall floor etc. wherever required including making necessary moulding and grooves for fixing wash basin on granite counter as

directed by Engineer-in-charge. The item includes cost of supply and making connection with supply pipe, bottle trap and waste disposal pipe.

I Method Statement

The Contractor shall submit Method Statement for carrying out the work to the Engineer for approval. The work shall be carried out strictly in accordance with the approved Method Statement. Bottle trap shall be deep seal (minimum 60 mm water seal) type cast brass chromium plated of approved make.

II **Method of Measurement**

Measurement for payment of providing & fixing of wash basin shall be done in numbers by the Engineer. Payment will be made at the Unit Price for each unit, entered in the Priced Bill of Quantities.

3.4 NS-4 Design of Station Building

Design of Station building (G+5) building structure as shown in tender drawing and preparation of detailed drawings, showing floor plans, Architectural front, back and side elevation & section, Parking facilities and sectional details showing reinforcement details of RCC footings, columns, beams, slabs, chhajaas etc. complete as per HRIDC requirement including development of room wise material specification, Door-windows, Fittings & fixtures detailing, Plumbing works detailing, Staircase detailing, Internal wall detailing, Toilet detailing etc., interior finishing & design, PHE drawings, HVAC drawings, Rain water harvesting details with contractor's own tools & plan, consumables etc. complete on original re-produceable tracing film of thickness minimum 75 microns double matt type on A1/A0 size as per direction of Engineer-in-charge.

I The Contractor shall submit a design submission programme conforming to the Key dates and Time of completion of the Works.

II Payment Schedule

Payment Schedule shall be as follows:

1. Submission & approval of Architectural drawings - 25%
2. Submission & approval of structural design & drawings - 35%
3. Submission & approval of specifications /detailing of fittings & fixtures and design & drawings of utility/services. -40%

3.5 NS-5 Design of Maintenance Office

Design of Electrical, S&T and Track maintenance offices (G+4) building structure as shown in Tender drawing and preparation of detailed drawings, showing floor plans, Architectural front, back and side elevation & section , Parking facilities and sectional details showing reinforcement details of RCC footings, columns, beams, slabs, chhajaas etc. complete as per HRIDC

requirement including development of room wise material specification, Door-windows, Fittings & fixtures detailing, Plumbing works detailing, Staircase detailing, Internal wall detailing, Toilet detailing etc. interior finishing & design, PHE drawings, Rainwater harvesting details with contractor's own tools & plan, consumables etc. complete on original re-produceable tracing film of thickness minimum 75 microns double matt type on A1/A0 size as per direction of Engineer-in-charge.

I The Contractor shall submit a design submission programme conforming to the Key dates and Time of completion of the Works.

II **Payment Schedule**

Payment Schedule shall be as follows:

1. Submission & approval of Architectural drawings	-	25%
2. Submission & approval of structural design & drawing	-	35%
3. Submission & approval of specifications /detailing of fittings & fixtures and design & drawings of utility/services.		-40%

3.6 NS-6 Land scaping of Manesar station area

Land scaping of Manesar Station area and preparation of drawings showing Traffic flow pattern, parking including horticulture planning etc. complete on original re-produceable tracing film of thickness minimum 75 microns double matt type on A1/A0 size as per direction of Engineer-in-charge.

I The Contractor shall submit a design submission programme conforming to the Key dates and Time of completion of the Works.

II **Payment Schedule**

Payment Schedule shall be as follows:

1. Submission & approval of landscaping plan	-	55%
2. Submission & approval of horticulture plan	-	45%

3.7 **NS-7 Design of IMD building**

Design of interior works of IMD (G+5) building as shown in tender drawing and preparation of detailed drawings of interior works like false ceiling, internal walls & partition walls, Doors & windows, Toilets, Kitchen & Pantry, staircase, other fittings & fixtures etc., Room wise material specifications, preparation of architectural elevation & sections, interior finishes, design of terrace parapet wall, Firefighting system, Plumbing works, PHE drawings, HVAC drawings, Rain water harvesting and other associated works complete with contractor's own tools & plan, consumables etc. complete on original re-produceable tracing film of thickness minimum 75 microns double matt type on A1/A0 size as per direction of Engineer-in-charge.

I The Contractor shall submit a design submission programme conforming to the Key dates and Time of completion of the Works.

II Payment Schedule

Payment Schedule shall be as follows:

1. Submission & approval of architectural drawings	-	20%
2. Submission & approval of internal finish drawings & specifications	-	40%
3. Submission & approval of design & drawings of utilities/services & Associated structures	-	40%

3.8 **NS-8 Design of underground water storage tank**

Design of under-ground water storage tank of 3,00,000liter capacity divided in two equal parts with cover slab & opening for drinking water & fire fighting and preparation of detailed drawings with contractor's own tools & plan, consumables etc. complete on original re-produceable tracing film of thickness minimum 75 microns double matt type on A1/A0 size as per direction of Engineer-in-charge.

I The Contractor shall submit a design submission programme conforming to the Key dates and Time of completion of the Works.

II Payment Schedule

Payment shall be made on submission & approval of detailed design and drawings by the Engineer.

Bid Document for Works

Procurement of:

Contract Package MNS-01: Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.

Part 2- WORKS REQUIREMENTS

SECTION 5V

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CHAPTER-1 – INTRODUCTION AND OBJECTIVE

1.1 INTRODUCTION

(1) Haryana Rail Infrastructure Development Corporation Limited (HRIDC) was Incorporated on 22nd August, 2017 as a Joint Venture between Government of Haryana and Ministry of Railways with equity Participation of 51% and 49% respectively. The Haryana Orbital Rail Corridor (HORC) is the project of HRIDC, from Prithla (near Palwal station of Indian Railways) to New Harsana Kalan (near Sonipat station of Indian Railways).

(2) Haryana Orbital Rail Corridor (HORC) route will be Broad Gauge, Double Line, with High Rise Electrification at 2x25 kV, AC, approximately 145 RKM and 315 TKM from Prithla to New Harsana Kalan including connectivity to Indian Railway (IR) and Dedicated Freight Corridor Corporation of India Limited (DFCCIL) stations.

(3) There are 17 New Stations namely Prithla, Silani, Sohna IMT, Dhulawat, Chandla Dungerwas, Panchgaon, Manesar, New Patli, Badsa, Deverkhana, Badli, Mandothi, New Asaudah, Jasaur Kheri, Kharkhoda, Tarakpur and New Harsana Kalan and details are as under:

SN	Station	Chainage (km)
1	Prithla (crossing)	0.00
2	Silani (halt)	10.40
3	Sohna IMT (crossing)	19.01
4	Dhulawat (crossing)	32.77
5	Chandla Dungerwas (halt)	42.60
6	Panchgaon (halt)	46.29
7	Manesar (junction)	51.89
8	New Patli (junction)	58.00
9	Badsa (junction)	64.75
10	Deverkhana (halt)	71.14
11	Badli (crossing)	76.83
12	Mandothi (junction)	90.45
13	New Asaudah (halt)	94.03
14	Jasaur Kheri (halt)	100.22
15	Kharkhoda (crossing)	108.72
16	Tarakpur (crossing)	114.20
17	New Harsana Kalan (crossing)	125.13

In addition to above 17 stations, there are 3 stations i.e. Sultanpur, Asaudah and Patli of Indian Railway where HORC connectivity shall be made.

(4) The present works are at Integrated Maintenance Depot (IMD) Manesar Building at Manesar (adjoining Manesar Railway station), Manesar station and any other building works. However, the works (except Lift (Elevator), VRV air-conditioning and Fire Suppression system) can be executed anywhere in the section from Prithla to New Harsana Kalan, as per directions of the Engineer.

(5) The objective of the Specifications is to minimize maintenance cost by design and

selection of Maintenance friendly System which have high Availability, low Life Cycle Cost (LCC), higher Meantime between Failure (MTBF) and minimum Maintenance Time to Restore (MTTR).

(6) The objective of the specifications is to minimize energy usage. The requirement is to reduce energy consumption by employing the energy efficient system design and product specification.

(7) The Works shall be designed and executed to achieve an aesthetic character and provide a feeling of design commonality throughout the project.

1.2 SCOPE OF WORK

The scope involves design, supply, manufacture, installation, testing and commissioning of the works. The broad details of the works are given below and shall be for the purpose of general guidance only and is not exhaustive. For complete appreciation of the scope, the specification, drawings and other details and documents mentioned in the tender documents shall be referred. The indicative items of works are as under:

1.2.1 IMD Manesar Building:

(1) Electrification (conduit, wiring, light, fan, cabling, distribution boards etc.) of the IMD building (6 floor i.e. Ground+5 floors) and other buildings (i.e. substation building, pump room etc.) with allied facilities and complete power supply arrangement as per Standard Railway Practice and guidelines issued by Railway Board/ RDSO/ CPWD specification etc.

(2) Conduits already provided in IMD Building (a) from 1st floor to 5th floor for lights, fan and power sockets etc; (b) from 2nd floor to 5th floor for Fire Detection and Alarm (FDA) system. The GI conduits for FDA on 1st floor shall be provided. No conduits have been provided on ground floor and shall be provided for electrification and FDA system. All conduits shall be G.I wherever required.

(3) Provision of two numbers 11 kV/0.44 kV, 250 kVA Compact Substation (CSS) with Dry type transformer with earthing and all protection & safety equipment with complete power supply arrangement at IMD building.

(4) Automatic Power Factor Correction (APFC) Panel of 150 kVAR connected to main LT panel which shall work for the CSS transformers and Gensets.

(5) Provision of one number silent type Genset of 200 kVA capacity (emission CPCB 4-plus norm) with AMF panel and LT Panel including earthing system and all protection & safety equipment with complete power supply arrangement.

(6) Provision of Fire Detection and Alarm system and fire suppression system as per specifications, National Building Code and guidelines issued by RDSO/ Railway Board etc.

(7) Provision of Variable Refrigerant Volume (VRV) based air-conditioning system along with air-conditioning ducts for cooling as well as heating.

(8) Provision of 6 meter high poles (single arm / double arm) with luminaires, with complete cabling arrangement of circulating area and street illumination of IMD building area to meet standard lux level as per specifications and guideline issued by RDSO/ Railway Board.

(9) Provision of Single sided and Double-sided LED signage board with pictogram/ symbol as per specification.

(10) Provision of one number (13 Passenger, 884 Kg) machine-room-less lift with 6 landings at IMD Manesar building (Ground plus 5 floors).

(11) Provision of LT panel for distribution of LT supply for lighting (indoor and outdoor), fans, air conditioners, circulating street light, signalling and telecom load, SCADA RTU load, lift load, air-conditioning system (VRV), fire detection and alarm system, fire suppression system, submersible pump load etc.

(12) Supply and laying of conduits and wherever conduits are concealed, same shall of fire resistant PVC. No surface conduit shall be allowed and if surface conduit is essential then it shall be with GI conduits only and with the approval of Engineer.

(13) Provision of conduits, wiring, lights (indoor and outdoor), fans and power sockets etc. in substation area, pump houses and other service buildings in IMD building premises. The wiring shall be with copper wires and cables.

(14) Provision of lights, fans, exhaust fans in buildings and provision of lights, circulating area, street lighting etc.

(15) Earthing of all equipment and systems.

(16) Lightning protection of IMD building and all service buildings.

(17) Provision of LT cables and HDPE/ GI pipes in IMD area. The cables shall be laid underground, under floor, on wall, on cable trays, in raceways, in shafts etc and cable route markers shall be provided as per specifications and drawings. These cables shall feed 6 m high poles circulating area lighting, control room load, signalling and telecom load, SCADA RTU load, lift load, air-conditioning system (VRV), fire detection and alarm system, fire suppression system, pumps load etc. The maximum voltage drop in cables from source to load point shall not exceed 5%.

(18) Provision of HT cables (from H-pole to metering room and up to CSS input terminal) with all safety equipment.

(19) Provision of submersible pumps and mono-block pumpsets. Provision of pipelines from submersible pump to underground tank and underground tank to overhead tank.

(20) Supply, installation, testing and commissioning of UPS.

(21) All Nuts, bolts, studs, washers, pins etc. shall be of GI or stainless steel. All earthing strips shall be of GI and NO mild steel (MS) material shall be used anywhere in the system. Copper strips shall be used for copper earthing wherever required.

(22) Provision of water cooler, Geyser, RO system etc.

(23) Miscellaneous items e.g. spares, shock treatment charts, sectioning layouts, safety rubber mats, equipment number plates, first aid boxes, indication boards and danger notice plates, fire buckets, etc.

(24) All equipment testing (type test, routine tests and factory acceptance tests etc), system acceptance tests, integrated testing and commissioning of all equipment.

(25) Interface with other Contractors to ensure timely completion of the Works.

(26) Provision of all the construction drawings, design & calculation, documents, and as-built drawings required to supply, install, testing and commissioning of the above works and all other installations, as required for the completion of the works. Operation & Maintenance Manuals, training manual and other related documentation.

(27) Provide support during Defect Notification Period (one year).

(28) The arrangement of 11kV, 3-phase, AC supply, from Power Supply Authority (PSA) substation to HORC point at H-Pole in HORC premises shall be arranged by HRIDC and all coordination with PSA including necessary payments to PSA shall be made by HRIDC.

1.2.2 Manesar station:

(1) Electrification (conduit, wiring, light, fan, cabling, distribution boards etc.) of the Manesar station building (3 floor i.e. Ground+2 floors) and other buildings (i.e. pump room etc.) with allied facilities and complete power supply arrangement as per

Standard Railway Practice and guidelines issued by Railway Board/ RDSO/ CPWD specification etc.

(2) Provision of two numbers 11 kV/0.44 kV, 250 kVA Compact Substation (CSS) with Dry type transformer with earthing and all protection & safety equipment with complete power supply arrangement.

(3) Automatic Power Factor Correction (APFC) Panel of 150 kVAR connected to main LT panel which shall work for the CSS transformer and Genset.

(4) Provision of one number silent type Genset of 200 kVA capacity (emission CPCB 4-plus norm) with AMF panel and LT Panel including earthing system and all protection & safety equipment with complete power supply arrangement.

(5) High Mast Towers (20 meter) with luminaires, with complete cabling arrangement to meet standard lux level as per specifications and guidelines issued be RDSO/ Railway Board.

(6) Provision of 6 meter high poles (single arm / double arm) with luminaires, with complete cabling arrangement for illumination of platform area, circulating area and street illumination to meet standard lux level as per specifications and guideline issued by RDSO/ Railway Board.

(7) Provision of Single sided and Double-sided LED signage board with pictogram/ symbol as per specification.

(8) Provision of LT panel for distribution of LT supply for lighting (indoor and outdoor), fans, air-conditioners, sub way lighting, platform & circulating area street light, signalling and telecom load, SCADA RTU load, submersible pump load etc.

(9) Supply and laying of conduits and wherever conduits are concealed, same shall of fire resistant PVC. No surface conduit shall be allowed and if surface conduit is essential then it shall be with GI conduit only and with the approval of Engineer.

(10) Provision of conduits, wiring, lights, fans, air-conditioners and power sockets etc. at S&T huts (2 nos.) at both ends of Manesar station.

(11) Air-conditioners shall be provided in S&T rooms of the Manesar station.

(12) Provision of conduits, wiring, lights, fans, distribution boards, air-conditioners and power sockets etc. in S&T Auto Location Hut (ALH) (2 nos.) at Manesar station area.

(13) Provision of lights, fans, exhaust fans in buildings and provision of lights in subways, circulating area, street lighting etc.

(14) Earthing of all equipment and systems.

(15) Lightning protection of station building and all service buildings.

(16) Provision of LT cables and HDPE/ GI pipes in station area. The cables shall be laid under the tracks, underground, under floor, on wall, on cable trays etc and cable route markers shall be provided as per specifications and drawings. These cables shall feed 20 m high mast flood light towers, 6 m high poles circulating area lighting, control room load, signalling and telecom load, SCADA RTU load, air-conditioners, pumps load etc. The maximum voltage drop in cables from source to load point shall not exceed 5%.

(17) Provision of HT cables (from H-pole to metering room and up to CSS input terminal) with all safety equipment.

(18) Provision of submersible pumps and mono-block pumpsets. Provision of pipelines from submersible pump to underground tank and underground tank to overhead tank.

(19) Supply, installation, testing and commissioning of UPS.

(20) All Nuts, bolts, studs, washers, pins etc. shall be of GI or stainless steel. All earthing strips shall be of GI and no MS material shall be used anywhere in the system. Copper strips shall be used for copper earthing wherever required.

(21) Provision of water cooler, Geyser, RO system etc.

(22) Miscellaneous items e.g. spares, shock treatment charts, sectioning layouts, safety rubber mats, equipment number plates, first aid boxes, indication boards and danger notice plates, fire buckets, etc.

(23) Electrification (conduit, wiring, light, fan, cabling, distribution boards, LT panel, earthing, etc.) of the any other building with allied facilities as per Standard Railway Practice and guidelines issued by Railway Board/ RDSO/ CPWD specification etc.

(24) All equipment testing (type test, routine tests and factory acceptance tests etc), system acceptance tests, integrated testing and commissioning of all equipment.

(25) Interface with other Contractors to ensure timely completion of the Works.

(26) Provision of all the construction drawings, design & calculation, documents and as-built drawings required to supply, install, testing and commissioning of the above works and all other installations, as required for the completion of the works. Operation & Maintenance Manuals, training manual and other related documentation.

(27) Provide support during Defect Notification Period (one year).

(28) The arrangement of 11kV, 3-phase, AC supply, from Power Supply Authority (PSA) substation to HORC point at H-Pole in HORC premises shall be arranged by HRIDC and all coordination with PSA including necessary payments to PSA shall be made by HRIDC.

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CHAPTER 2 - DESIGN AND PERFORMANCE REQUIREMENTS

2.1 General

2.1.1 The design, supply, installation, testing and commissioning of General Services work including Power supply system etc. shall meet the design and performance requirements within the design environments specified in this Particular Specifications.

2.1.2 Design Environment

Adequate margin shall be built in Design, particularly to take care of Climate Conditions/ Operating Environment. Wherever, the equipment installed in open at the surface level or inside service buildings at surface level, the same shall be designed for working in the existing tropical conditions and the ambient temperature and humidity levels pertaining to HORC Project area. All ferrous components and fittings shall be hot-dip galvanized. All Nuts, bolts, Studs, washers, Pins etc. shall be of GI or stainless steel. All earthing strips shall be of GI except Copper strips for copper earthing.

2.2 Basic Design Philosophy and Requirements

2.2.1 Proven Design

(a) The Contractor shall develop the design based on specification and on proven and reliable Engineering Practices. The design details shall be submitted with technical data and calculations to the Engineer for review. The Design shall include complete Single Line Diagram (SLD) indicating Local, Auxiliary Transformer supply and Genset supply (as applicable).

(b) The Contractor shall submit drawings in such a form as the Engineer will require them for approval, copies as required of all drawings, diagrams, and details of all equipment in part or in whole. Any review shall be done by the Engineer on receipt of drawings in hard copy. The drawings shall be submitted in soft copy (pdf and auto CAD) also along with submissions. The Contractor shall make drawings available to the Engineer at all reasonable times. Wiring diagrams and other drawings as the Engineer deems shall not be finally settled until satisfactory installation and testing has been made, this shall be approved in principle.

(c) The Contractor shall submit a schematic block diagram of the equipment showing the functional requirements of this specification. The Contractor shall submit a schedule including details of numbering, categories and drawing registers / indexes for the production, submission, and approval during the period of the contract of drawings and of any information, required for the Engineer in connection with the design of the contract works.

(d) This schedule shall be suited to the requirements of manufacture, delivery and installation of the contract works to meet the requirements of the contract and shall allow reasonable time (approx. 4 weeks) for study and approval by the Engineer of all drawings, calculations and graphics submitted (and as necessary, resubmitted) by the Contractor.

(e) No approval by the Engineer of any drawing shall relieve the Contractor of any of his obligations of liabilities under the contract or of his responsibility for ensuring that the work is satisfactorily done and that all operational requirements shall be met.

(f) The Contractor shall provide final drawings without undue delay, and in any case within twelve weeks of the award of the contract and these drawings shall include dimensions,

capacity of equipment and complete power supply arrangement with all associated items of each station. Incomplete submission of documents and Drawings shall not be considered as submission by the Contactor.

2.2.2 The design philosophy shall meet the following criteria:

a) Application of state-of-the-art Technology
b) Service proven design
c) Design life 30 years (However, the individual equipment shall have different design life).
d) Minimum life cycle cost
e) Low maintenance cost
f) Use of interchangeable, modular components
g) Extensive and prominent labelling of parts, cables, and wires
h) High reliability
i) Low energy loss
j) System safety
k) Adequate redundancy in system
l) Fire and smoke protection
m) Use of fire-retardant materials and fire survivals cables
n) Environment friendly
o) Adherence to operational performance requirements
p) Maximum utilization of indigenous materials and skills, subject to quality conformity.

Adequate margin shall be built into the design particularly to take care of the higher ambient temperatures, dusty conditions, and high seasonal humidity, etc. prevailing in HORC Project area.

2.2.3 SERVICE LIFE

All equipment, cables and wiring shall be designed, manufactured and installed so as to secure a service life as shown below:

Main switchboards	30 Years
Transformers	30 Years
Sub-main switchboards	30 Years
Cables	30 Years
Fire alarm main panel	30 Years
Luminaires	20 Years
Tray, trunking and supports	30 Years
Lightning protection	30 Years
Capacitor bank	20 years
Internal wiring of buildings	20 years
Electric pumps	20 years
Diesel pumps	15 years
Electrical Lift	20 years
Sub-assemblies and components	30 Years
Earth Mat	30 years
Water cooler, air-conditioner	10 years
All other equipment	minimum 20 Years

2.2.4 Name Plates and Identification

All parts of the installation, which are of relevance for its operation and maintenance, shall be provided with nameplates, tags or other markers/ arrows, especially in enclosed areas, such as ceiling, shafts, and other places accessible for maintenance service.

2.2.5 Corrosion Protection

All ferrous components and fittings shall be hot-dip galvanized. The minimum coating of zinc shall be 1000 gm/m^2 as per RDSO's specifications no. ETI/OHE/13 (4/84 or latest), until and unless specifically mentioned in the specifications.

2.2.6 Acoustic Criteria

Noise emanating from the equipment / service installations shall be within the permissible limit prescribed in the relevant international standards for each of the equipment. In addition, Central Pollution Control Board of India laid down guidelines shall prevail.

2.2.7 Colour Coding

Colour for power cables, bus bars shall be as follows:

Phase R	:	Red
Phase Y	:	Yellow
Phase B	:	Blue
Neutral	:	Black
Ground	:	Green or Green-Yellow Strip

Large wires and cables shall be colour coded with tapes as specific colour. Colour coding for Junction boxes shall be as follow:

Normal power	:	Orange
Essential power	:	Yellow
Telephone system	:	Green
Fire Alarm System	:	Red
Control System	:	Blue

2.3 EARTHING

(1) The Contractor shall prepare an Earthing and Bonding Plan which shall include service buildings, lift, air-conditioning (VRV) system, air-conditioners, fire fighting system, sub-station, LT/HT Panels, High mast towers, light poles, feeder pillars, Genset, pumpsets etc. This shall be submitted to the Engineer for approval. The Contractor shall take all measures as the system will be in the proximity of 11 kV, AC, 3-phase system. Earthing system shall be designed to ensure personnel safety and protection of persons and installations against damage.

(2) The earthing of sub-station, transformers, LT/HT panels, Genset and high mast towers (with 2 independent earth electrodes) shall be done with Copper cladded Steel Earth Electrode of 4-meter length, 19 mm with Exothermically welded busbar with 50 kg Earth

Enhancement Compound in each pit. The pit and covers shall be made up of M-25 grade RCC concrete. The connection between equipment and earth electrode shall be made with 40x6 mm GI flat. The earth resistance of sub-station shall be less than 1 ohm.

(3) The earthing of light poles, Distribution Board etc. shall be done with single Copper cladded Steel Earth Rod of 4-meter length, 19 mm with Exothermically welded busbar buried 500 mm below the ground. Necessary protection shall be provided to avoid damage and rusting of the earthing system. The connection between equipment and earth electrode shall be made with 40x6 mm GI flat. The earthing of light poles at platform and circulating area shall be done on alternate poles. The metallic armour of the cable (incoming and outgoing) shall be connected to each light pole.

(4) The earthing of H-pole of discom (with 2 earth electrodes) shall be done with Copper cladded Steel Earth Rod of 4-meter length, 19 mm with Exothermically welded busbar for connection with 40x6 mm GI flat. The connection between equipment and earth electrode shall be made with 40x6 mm GI flat. RCC chamber with cover (with M-25 grade concrete) shall be provided.

(5) Building Lightning Protection earthing: Protection of building against lightning shall be done in accordance with IS: 2309-2005 as applicable and shall include the provision of a parallel path lighting system complete with air terminal conductors (finials), ground terminals, interconnecting conductors, earthing pits and other fittings required for the complete system. Lightning protection system shall meet the requirements of the National Building Code of India-2016 (latest). All two storey and above buildings including IMD Manesar building shall be provided with lightning protection earthing. GI flat 40x6 mm size shall be laid on all parapet wall top and flat shall be welded to make it one piece and properly secured with GI or non-corrosive fasteners on parapet. The parapet top GI flat shall be connected to two (or more) independent copper cladded Steel Earth Electrode of 4-meter length, 19 mm with Exothermically welded busbar for connection through 40x6 mm GI flat along with earth pits with RCC chamber with cover (with M-25 grade concrete).

(6) RCC chamber and its cover for earthing, wherever provided in the contract, shall be of M-25 grade concrete with steel reinforcement.

(7) The 4 m, 19 mm dia steel earth electrode shall have minimum 250 micron copper cladding. The earth clamp exothermically welded on the top of earth electrode shall be 75x8 mm GI flat 300 mm long with 2 holes of 10 mm dia on either side of the earth electrode centre as per the indicative drawing. All nuts, locknuts, bolts, washers etc shall be of stainless steel or GI. All bolts shall be with washers and locknuts.

(8) The earth resistance of Compact Sub-station (CSS) body and neutral earthing shall be less than 1 ohm and of LT/HT panel, Genset and high mast towers shall be less than 2 ohms. The resistance of all other earth systems shall be less than 5 ohms. Value of each earth (in black paint) shall be measured and marked on G.I plate size 150x100x3mm painted with yellow enamel paint shall be fixed near the earth, and following information shall be indicated: (i) Earth No. (ii) Individual value of earth (iii) Date of testing. Earth resistance at each electrode shall be measured jointly by the Contractor and the Engineer. Complete work shall be as per IS-3043. Normally an earth electrode shall not be located closer than 1.5m from any building. The separation between two earth electrode shall not be less than 2m.

2.4 CLIMATE CONDITIONS:

The traction power system shall be fully operable and maintainable in the following climatic and atmospheric conditions:

Ambient air temperature	(-)5℃ degrees to +50℃
Average ambient temperature for one year	35℃
Maximum solar gain of metallic object under the sun	1kW/sqm.
Maximum relative humidity	100%
Annual Rainfall	Dry Arid regions and also heavy monsoon Affecting regions with rainfall ranging from 1750mm to 6250mm.
Maximum number of thunderstorms days per annum	85
Maximum number of dust storm Days per annum	35
Number of rainy days per annum	120
Basic wind pressure	50m/sec as per wind map based on IS–875.
Creepage distance for (i) Extreme pollution condition (ii) Polluted conditions	As per IEC60815–2008 (31 mm/kV minimum)
Horizontal Seismic Zone	Refer IS 1893 Part1 for earthquake mapping
Creepage distance of Insulators	Minimum nominal creepage distance of insulators shall be 31mm/kV

2.5 CODES & STANDARDS

(1) Equipment, material, and systems/sub-systems shall be designed, manufactured and tested in accordance with the latest issue of approved and recognized codes and standards defined and proposed by the Contractor and approved for the Work. All standards, codes and manuals with correction slips issued up to 28 days prior to last date of Bid submission shall be applicable for this bid. Any other applicable code, circular, instruction of UIC shall be referred with the approval of the Engineer.

(2) The Contractor shall supply to the Engineer, two original full editions of the publications/ technical standards including codes, standards, manuals and other documents that Contractor proposes to use or used for the work. These publications shall be for the sole use of the Engineer and Employer and shall become the property of the Employer.

(3) The Contractor shall ensure that items of equipment and their components are standardized wherever possible throughout the Works where similar requirements and functions exist.

(4) The Contractor shall submit design to the Engineer for review and No Objection. The proposed standards used shall also be referred with the design listed in the Employer's Requirements. The Contractor may propose an alternative equivalent international standard during the design stage, but the acceptance of the alternative standard shall be subject to review by the Engineer.

(5) In case of any conflict or inconsistency between the provision of the codes/ standards as mentioned above and provisions contained in these specifications, the provisions mentioned in these specifications shall prevail. However, the approval of the Engineer shall be obtained to follow the relevant codes/ specifications. The decision of the Engineer shall be final.

(6) (i) Low Tension (LT) voltage, wherever used, shall mean voltage up to & including 1100V and (ii) High Tension (HT) voltage above 1100 V and up to & including 11kV and (iii) Extra High Tension (EHT) voltage above 11 kV.

2.6 AS-BUILT DRAWINGS

(1) Preparation of the As-built drawings shall be part of these specifications. As-built drawings shall be Final Design Drawings of the project showing the actual work done. The as-built drawings shall be prepared after joint survey of the works by the Contractor's and the Engineer's representatives. The Contractor shall provide the as-built drawings in one original and one reproducible negative produced from the original, with the names of the signature authorities of the Engineer and the Contractor, after joint survey. The size of the drawings shall be such that all drawing details are legible. After they are signed for approval, prints shall be taken from the signed original of each drawing. Also, two nos. Hard Disk Drive (1 TB) of all as-built drawings in pdf format shall be supplied to the Engineer. Together with the as-built drawings, the Contractor shall provide reduced size (e.g., A3 size) booklets (2 nos.) of the as-built drawings as per the Employer's Requirements. Combined Service Drawings (CSD) shall also be submitted for the different facilities with all details.

(2) All details, dimensions, texts, etc., on the reduced size drawings shall be clearly recognizable and readable. The Contractor shall complete and obtain the Engineer's approval on the as-built drawings and make the final submission of the as-built drawings together with the A3 size booklets latest within three months following the date of the Certificate of Completion. All costs associated with the provisions mentioned above shall be deemed to be included in the contract price.

(3) As-built drawings shall cover in general (but not limited to):

a) For mechanical equipment:

i. Construction drawings,
ii. Instruction drawings,
iii. Functional block diagrams with set-point range of process parameters depicted thereon.

b) For electrical installation:

i. Installation drawings with circuit numbers and exact type-assignation of all installed equipment,
ii. Distribution diagrams with circuit numbers,
iii. Fault analysis and protection co-ordination settings the of protection system,
iv. Power consumption,
v. Precise type numbering
vi. Earthing systems

c) For distribution panels:

i. Construction drawings,
ii. Circuit drawings as operating diagrams,
iii. Additional current flow-charts where required,
iv. Accurate lists of any installed equipment with precise description of this equipment,
v. Adjustment tolerances of circuit-breakers, switches, etc.

d) For equipment:

i. Construction drawings,
ii. Circuit diagrams,
iii. Functional block diagrams with set-point range of process
iv. parameters depicted thereon,
v. List of quantities with detailed break-down of the bill of materials comprising the equipment.

e) For cabling:

i. Diagrams with dimensions, type of cables and power requirements with regular cross- section area and measured cable values shall be used for these diagrams, Cable route plan.

2.7 SYSTEM REQUIREMENTS:

Conformity with Governing Specifications and other Statutory Requirements:

The work shall be carried out in accordance with the following governing specifications and other statutory rules:

i. Indian Electricity Act 2003 with latest amendment
ii. CEA Regulations, 2010 (latest)
iii. Regulations laid down by Chief Electrical Inspector to the Government.
iv. Regulations laid down by EIG Indian Railways.
v. National Building Code
vi. Rules and Regulations prescribed by local authorities as applicable.
vii. Relevant, Indian Standards, IEC Standards, CENELEC, British Standards and other National/ International standards as applicable.
viii. The Contractor shall furnish information asked for by a statutory body (e.g., Government of India, Ministry of Railways, Commissioner of Railway Safety, Government of Haryana etc.) in particular format as directed by Engineer. Any documents, studies, test reports, compliances required for getting safety clearances from any authority shall be submitted by the Contractor.

2.8 ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
AC	Alternating Current
ACTM	AC Traction Manual
AHRI	Airconditioning, Heating and Refrigeration Institute
AMF	Automatic Mains Failure
ANSI	American National Standards Institute
APFC	Automatic Power Factor Correction
ARD	Automatic Rescue Device (in lift)
ARI	Airconditioning and Refrigeration Institute
ASM	Assistant Station Master
AuxXer	Auxiliary Transformers

AT	Auto Transformer
ALARP	As Low as Reasonably Practicable
APFC Panel	Automatic Power Factor Correction Panel
BDT	Battery Drive Tool
BIS	Bureau of Indian Standards
BS	British Standards
BTS	Base Transceiver Station
CAD	Computer Aided Design
CC	Cement Concrete
CENELEC	European Committee for Electrotechnical Standards
CEA	Central Electricity Authority
CFM	Cubic Feet per Minute
CHC	Chief Controller
CIP	Co-ordinated Installation Plan
CLS	Colour Light Signaling
COP	Coefficient Of Performance
CP	Contract Package
CPCB	Central Pollution Control Board
CPWD	Centre Public Works Department
CPM	Critical Path Method
CRCA	Cold Rolled Close Annealed Steel
CRS	Commissioner for Railway Safety
CSD	Combined Service Drawings
CSS	Compact Sub Station
CST	Civil, Structure and Track
CV	Curriculum-Vitae
DC	Direct Current
DG	Diesel Generator
DDF	Digital Distribution Frame
DB	Dry Bulb
dB	Decibel
DCN	Design Change Notice
DFC	Dedicated Freight Corridor
DFCC	Dedicated Freight Corridor Corporation
DFCCIL	Dedicated Freight Corridor Corporation of India Limited
DIN	Deutsche Industrie Normen
DL	Double Line
DNP	Defect Notification Period
DPR	Detailed Project Report

DT	Down Time
DTN	Data Transmission Network
DVT	Design Verification Table
DVV	Design Verification and Validation
E&M	Electrical and Mechanical
EDFC	Eastern Dedicated Freight Corridor
EEV	Electronic Expansion Valve
EIG	Electrical Inspector to the Government of India
EI	Electronic Interlocking
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
EMP	Environmental Management Plan
EN	Euro Norm
ERP	Enterprise Resource Planning
ERT	Electrical Rescue Tool
EVA	Elevator Vibration Analysis (meter)
Excl.	Excluding
FAT	Factory Acceptance Test
FCN	Field Change Notice
FDT	Firetrace Detection Tubing
FIU	Field Interface Unit
FM Steel	Ferritic Martensitic steel
FMEA	Fault Mode and Effects Analysis
FMECA	Failure Modes Effect and Criticality Analysis
FRCAS	Failure Recording and Corrective Action System
FRLS	Flame Retardant, Low Smoke Low Halogen
FTA	Fault Tree Analysis
GE	Geotechnical Engineering
GENSET	Generator Set
GI	Galvanized Iron
GSM-R	Global System for Mobile Communication–Railway
GWR	Gate Working Rules
G&SR	General and Subsidiary Rules
GAD	General Arrangement Drawing
GCC	General Conditions of Contract
GS	General Specification
GST	Goods and Services Tax
HRIDC	Haryana Rail Infrastructure Development Corporation Limited
HORC	Haryana Orbital Rail Corridor

HT	High Tension
HTML	Hyper Text Markup Language
HAZOP	Hazard and Operability Studies
HF	High Frequency
HDD	Hard Disc Drive
HDPE	High Density Poly Ethylene
Hz	Hertz
ID	Identification
ICD	Interface Co-ordination Document
IEEE	Institute of Electrical and Electronics Engineers
IEC	International Electro–technical Commission
IHA	Interface Hazard Analysis
IMT	Industrial Model Township
IMD	Integrated Maintenance Depot
IMSD	Integrated Maintenance Sub-Depot
IMP	Interface Management Plan
INR	Indian Rupees
IPS	Integrated Power Supply
IR	Indian Railway
IRS	Indian Railway Standards
IRSEM	Indian Railway Signal Engineering Manual
IS	Indian Standard
ISO	International Standards Organization
IT	Information Technology
ITB	Insulated Terminal Block
km/KM	KiloMeter
KMPH	Kilo Meter Per Hour
KV	Kilo Volt
KVAR	Kilo-Volt-Amperes Reactive power
KVA	Kilo Volt Ampere
LED	Light Emitting Diode
LILO	Loop In Loop Out
LT	Low Tension
LC	Level Crossing
LCC	Life Cycle cost
LRU	Line Replaceable Unit
LIU	Line Interface Unit
LPM	Litre per minute
M&P	Machines and Plants

MACLS	Multiple Aspect Colour Light signaling
MAP	Maintenance Access Panel
MCB	Miniature Circuit Breaker
MCIL	Maintainability Critical Items List
MDF	Main Distribution Frame
MDO	Manually operated Draw Out
MDT	Mean Down Time
MTBSAF	Mean Time Between Service Affecting Failure
MMD	Maximum Moving Dimensions
MMI	Man Machine Interface
MOR	Ministry of Railway
MPR	Monthly Progress Report
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MTTR	Mean Time To Restore
NABL	National Accreditation Board for Laboratories
NDT	Non Destructive Test
NEMA	National Electrical Manufacturers Association
NMCP	Noise Monitoring and Control Plan
NOC	No Objection Certificate
NOO	Notice of Objection
NONO	Notice of No Objection
O&M	Operation and Maintenance
O&SHA	Operating and Support Hazard Analysis
OCC	Operations Control Centre
OD	Outer Diameter
ODBC	Open Data Base Connectivity
ODF	Optional Distribution Frame
OEM	Original Equipment Manufacturer
OFC	Optic Fiber Cable
OHE	Over Head Equipment
OHTL	Over Head Transmission Lines
OPM	Other Preventive Measures
PBX	Private Branch Exchange
PC	Personal Computer
PHA	Preliminary Hazard Analysis
PMIS	Project Management Information System
PS	Particular Specifications
PVB	Polyvinyl Butyral

PVC	Poly Vinyl Chloride
QA	Quality Assurance
RAM	Reliability, Availability & Maintainability
RAMS	Reliability, Availability, Maintainability and Safety
RAP	Resettlement Action Plan
RBD	Reliability Block Diagram
RCIL	Reliability Critical Item List
RDSO	Research, Design and Standards Organization
RDT	Reliability Demonstration Testing
RE	Railway Electrification
RKM	Running Kilo meter
ROB	Road Over Bridge
RO	Reverse Osmosis
ROW	Right of Way
RTU	Remote Terminal Unit
RUB	Rail Under Bridge
SAT	System Acceptance Test
SCIL	Safety Critical Items List
SCADA	Supervisory Control and Data Acquisition
SDFU	Switch Disconnector Fuse Unit
SER	Signaling Equipment Room
SHE	Safety, Health and Environment
SIL	Safety Integrity Level
SLD	Single Line Diagram
SM	Station Master
SMACNA	Sheet Metal and Air-Conditioning Contractor's National Association
SOD	Schedule of Dimensions
SOGP	Schedule of Guaranteed Parameters
SP	Sectioning & Paralleling Post
SSP	Sub-Sectioning Post
SPM	Suspended Particulate Matter
SRS	System Requirement Specification
SRR	Submission Response Request
SSHA	Sub-system Hazard Analysis
S&T	Signaling &Telecommunication
SWR	Station Working Rules
TB	Tera Byte
TDC flanges	Transverse Duct Connection flanges
TEFC	Totally Enclosed, Fan-Cooled

TER	Telecommunication Equipment Room
TKM	Track Kilo meter
T&P	Tools & Plants
TMS	Train Management System
TOT	Transfer of Technology
TPC	Traction Power Controller
TPN	Triple Pole and Neutral
TR	Ton of Refrigeration
TSS	Traction Sub-Station
UIC	International Union of Railways
UPS	Uninterruptible Power Supply
VAT	Value Added Tax
VCB	Vacuum Circuit Breaker
VDU	Video Display Unit
VRLA	Valve Regulated Lead Acid
VHF	Very High Frequency
WB	Wet Bulb
WGS	World Geodetic System
WPS	Welding Procedure Specification
XLPE	Cross Linked Polyethylene

2.9 DOCUMENT SUBMISSION PROCEDURE

i. For each stage of submittal, the Contractor shall prepare a Submission Response Request (SRR) carrying the date of submission, the submission reference number, the submission title, the stage of submission (e.g. Inception Report, Simulation Report (if any), Detailed Design, etc.), and the signature of the Contractor's Representative.

ii. The Documents and Drawings shall be submitted under the signatures of Designer and Project Manager of the Contractors to establish proper issue & control of the documents. The authority will not be delegated below the rank of Project Manager.

iii. The submission shall be accompanied with a checklist duly signed (with name) by the Preparer and Checker of the Drawing/ document.

iv. The submission shall be accompanied with Exception Statement on Deviations, if any to the Specifications.

v. Each Document / drawings shall be signed by the Preparer (with name who has prepared the Document/drawing), the Designer (with name who has designed and checked the document/ drawing) for conformance to specifications, and the issuers (who has verified the document for the purpose, and issued after careful examination) to demonstrate that document have gone through the process of quality assurance.

vi. The Contractor shall refer the indicative tender drawings while making submissions.

vii. All the documents, drawings and designs shall be submitted with the endorsement

thereon the Documents as under:

a) Certificate of the Contractor to the effect that "the submission is prepared, checked and issued by the qualified engineers of the Contractor and has been properly reviewed by the Contractor, according to the Contractor's Project Quality Assurance Plan", thereby confirming its completeness, accuracy, adequacy and validity and conformance to the satisfactory, safe and reliable performance,

b) Compliance with all relevant clauses of the Employer's Requirements;

c) Conformance to all interface requirements;

d) Certifying that it is based on auditable and proven or verified calculations or design criteria;

e) Has taken account of all requirements for approval by statutory bodies or similar organizations, and that where required, such approvals have been granted.

viii. The Contractor shall submit hard copies of all drawings, data of the documents and copy of transmittal along with a soft copy transfer electronically in the agreed format. Contractor will share the softcopies as advance information. However, the reviews will only be made on hard copies and shall be preserved in hard copies with endorsed signed copy. The work shall be executed based on the latest hard copies of the drawings and documents.

ix. Errors, omissions, ambiguities, inconsistencies, inadequacies and other defects shall be rectified by the Contractor at his own cost and the acceptance by the Engineer of the Manufacture and Construction Documents shall not amount to any waiver and shall not relieve the Contractor of his obligations under the Contract.

x. After receipt of "Notice of No Objection" from the Engineer, the Contractor shall submit six (6) hard copies (and soft copy) of the Design and / or Drawings for the use of the Engineer***.***

2.10 ENGINEERING REVIEW COORDINATION

2.10.1 Throughout the Design Stage, the Contractor (along with Designer) shall attend monthly (or fortnightly or earlier) design review meetings with the Engineer. At these Engineer's review meetings, the Contractor shall present information, drawings and other documents to the Engineer in respect of all submissions Program to occur during the following four weeks period. The Contractor's presentations shall be in sufficient depth to enable the Engineer to obtain a clear understanding of the Contractor's proposals and to discuss the methodology and process used in reaching the proposed design solutions. Unless otherwise directed by the Engineer, all meetings shall be convened in Engineer's Office or Contractor's Main Office or at the Site Office or at any other location as decided by the Engineer.

2.10.2 The Contractor shall comply all of the Engineer's observations and any agreed actions resulting from the Engineer's review meeting and shall address each of these fully before submission of the respective documents for formal review.

2.11. ENGINEER'S REVIEW

i. The Engineer will complete his review of the submission within 28-days, and communicate review comments in writing or on marked up drawings/ documents.

ii. Within two weeks of the receipt of the Engineer's comments, the Contractor shall resubmit the submittals/ documents to the Engineer for review.

iii. Where the comments are minor, the same may be clarified by calculations, part prints, etc. as acceptable to the Engineer and included in the Contractor's next submission.

iv. Should the Engineer consider the submission to be unacceptable, the Contractor shall revise and re-submit the entire submission within two weeks, for review by the Engineer.

v. The Contractor shall submit hard copies of all drawings, data of the documents and copy of transmittal along with a soft copy transfer electronically in the agreed format. Contractor will share the softcopies as advance information. However, the reviews will only be made on hard copies and shall be preserved in hard copies with endorsed signed copy. The work shall be executed based on the latest hard copies of the drawings and documents.

2.12 ENGINEER'S RESPONSE

1) The Engineer will respond in one of the following three ways:

   a. Notice of No Objection

   b. Notice of Objection

   c. Notice of No Objection with Comments

2) Definition of Engineer's response:

   a. "Notice of No Objection": if following his review of the submission, the Engineer has not discovered any non-compliance with the Contract, the Engineer will issue to the Contractor a formal "Notice of No Objection" (NONO). A "NONO" from the Engineer, irrespective of with or without comments does not in any way imply the Engineer's consent of the submission nor does it remove any responsibility from the Contractor for complying with the Contract. Issue of a "NONO" from the Engineer entitles the Contractor to proceed to the next stage of the Programed work.

   b. "Notice of Objection: if following his review of the submission, the Engineer discovers major non-compliance, discrepancies or omissions etc. that in his opinion are of a critical nature, the Engineer will issue a "Notice of Objection"(NOO). The Contractor shall revise and reissue the submission addressing the Engineer's comments. Following the issue of a NOO by the Engineer, the Contractor is not entitled to proceed to the next Programed stage on the path in the relevant network as previously approved by the Engineer until all of the Engineer's comments have been fully addressed and a NONO is issued.

   c. "Notice of No Objection (With Comments)": if following his review of

the submission, the Engineer discovers discrepancies or omissions etc. that in his opinion are not of a critical nature, the Engineer may issue a “Notice of No Objection with Comments” (NONOC). The Contractor shall respond to the comments, agreed and incorporated prior to inclusion in the “Construction Package” Following the issue of a NONOC by the Engineer, the Contractor is entitled to proceed to the next stage of the Programed work subject to the inclusion of amendments necessary to address the comments.

3 (a) Should it be found at any time after notification of consent / “Notice of No Objection” / “Notice of No objection with Comments” (as the case may be) that the relevant drawings or documents do not comply with the Contract or do not agree with drawings or documents in relation to which the Engineer has previously notified his consent / “Notice of No Objection” / “Notice of No objection with Comments” (as the case may be), the Contractor shall, at his own expense, make such alterations or additions as, in the opinion of the Engineer, are necessary to remedy such non-compliance or non-agreement and shall submit all such varied or amended drawings or documents for the consent of the Engineer.

(b) No examination by the Engineer of the drawings and / or documents submitted by the Contractor, nor any consent / “Notice of No Objection” / “Notice of No objection with Comments” (as the case may be) of the Engineer in relation to the same, with or without amendment, shall absolve the Contractor from any of his obligations under the Contract or any liability for or arising from such drawings or documents.

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CHAPTER 3–EXPLANATORY NOTES FOR BOOK OF QUANTITIES (BOQ) ITEMS

3.1 EXPLANATORY NOTES FOR BOQ ITEMS:

The explanatory notes to the BOQ are as under and shall be read in conjunction with Tender drawings, specifications and Employer's Requirements.

S.No.	Description for BOQ Items
1 CONDUITS, WIRING, PLUGS, FAN AND DISTRIBUTION BOARDS ETC.	
1.1	**Point Wiring By 3x2.5 sqmm Copper Cable (With Modular Switches & Socket) in laid Conduits:** Supply of material and wiring of Light point/ Fan point/ Exhaust-Fan point. Wiring shall be done by 3x2.5 sqmm multi stranded copper flexible FRLS PVC insulated ISI marked, 1100 volts grade cable, confirming to IS: 694-1990. The wiring shall be done in laid FRLS PVC conduits. Conduit clearance (if required) shall be done by the Contractor for these already laid conduits as per Tender drawings and as available at site. One-way modular switch 6A shall be provided on phase cable. Plugs and Sockets shall conform to IS-1293 and switches to IS-3854. The entire GI box shall have modular plate for switches and 6A modular plugs with required modular design groove cutting for installation of switches/ sockets etc. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for wiring and cable shall be ISI marked confirming to relevant IS code, specifications. The Contractor shall be responsible for proper plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. All metallic parts, fittings etc. shall be connected to the earth cable.
1.2	**Point Wiring By 3x2.5 sqmm Copper Cable (With Modular Switches & Socket) with concealed FRLS PVC Conduits:** Supply of material and wiring of Light point/ Fan point/ Exhaust-Fan point. Wiring shall be done by 3x2.5 sqmm multi stranded copper flexible FRLS PVC insulated ISI marked 1100 volts grade cable, confirming to IS: 694-1990. Concealed conduit shall be laid with FRLS PVC pipe minimum 25 mm dia (as required). Surface conduits shall not be laid and if required, shall be done with GI pipe only with the help of GI clamps/ rawal plugs etc. as required as per site requirement. Wherever required, the flexible metallic conduits shall be provided to complete the circuit. The zinc coating on GI conduits shall be as per IS-4736. Fittings for conduits shall be as

	per IS-3419 and IS-2667. All Junction boxes 1 way, 2 way, 3 way, 4 way, couplers, bends, elbows, tees, etc. accessories shall also be installed along with the conduits as per requirement at site. The 1-way or 2-way or 3-way or 4-way junction boxes, as required shall only be provided (i.e. 4-way junction box shall NOT be provided for 1-way or 2-way or 3-way and similarly applicable for others). Minimum 65 mm depth junction boxes shall be used in roof slabs and the depth of the boxes in other places shall be as per IS-2667: 1988. All the conduits, junction boxes etc. shall be cleared by providing minimum 1.6 mm GI fish wire. While laying of the conduit (including vertical drops of the conduits), sealing of the conduits, junction boxes etc. shall be ensured to avoid any conduit blockage with concrete slurry. The conduits shall be adequately tied to the reinforcement by using GI wire at intervals of maximum 1 m to avoid displacement of the conduits and accessories during casting of the slab. Suitable flexible joints shall be provided at all locations where conduits cross expansion joints in the building. Sharp and acute bends of conduits shall be avoided to ease the wiring in the conduits. In case any conduit and accessories are found blocked and drawing the wires is not possible, it shall be the responsibility of the Contractor to lay surface GI conduit and accessories to meet the requirement. No additional payment shall be made for this work. One-way modular switch 6A shall be provided on phase cable. Plugs and Sockets shall conform to IS-1293 and switches to IS-3854. The entire GI box shall have modular plate for switches and 6A modular plugs with required modular design groove cutting for installation of switches/ sockets etc. The wiring shall be done in such a way that minimum conduit pipes run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for wiring and cable shall be ISI marked confirming to relevant IS code, specifications. The Contractor shall be responsible for proper chiselling, plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. All metallic parts, fittings etc. shall be connected to the earth cable. Contractor shall make necessary interface with Civil Contractor during laying of conduits and shall handover conduiting drawing to Civil Contractor in advance.
1.3	**Supply of Material and Installation of 3x2.5 Sqmm Copper Cable along with FRLS PVC Conduits**: Supply of material and wiring of single core insulated, multi-stranded 2x2.5 sqmm FRLS PVC copper cable in FRLS PVC conduit ISI mark

	concealed in the wall and 2.5 sqmm FRLS PVC insulated copper cable multi-stranded for earthing. Concealed conduit shall be laid with FRLS PVC pipe minimum 25 mm dia. Cable shall be ISI marked confirming to IS: 694-1990 specifications and make of reference list. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for phase wiring. The Contractor shall be responsible for proper plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. The measurement shall be based on conduit length.
1.4	**Supply of Material and Installation of 3x6 Sqmm Copper Cable along with FRLS PVC Conduits**: Supply of material and wiring of single core insulated, multi-stranded 2x6 sqmm FRLS PVC copper cable in FRLS PVC conduit ISI mark concealed in the wall and 6 sqmm FRLS PVC insulated copper cable multi-stranded for earthing. Concealed conduit shall be laid with FRLS PVC pipe minimum 25 mm dia. Cable shall be ISI marked confirming to IS: 694-1990 specifications and make of reference list. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for phase wiring. The Contractor shall be responsible for proper plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. The measurement shall be based on conduit length.
1.5	**Supply and Installation of 6A Modular Switch Socket:** Supply and installation of 6A plug, 5-pin 240V modular type switch socket of standard size on existing board and connection with 2.5 sqmm FRLS PVC copper cable. A switch for controlling power supply of plug shall be connected in phase cable and earth cable size shall be same size of wiring to flow maximum fault current.
1.6	**Supply and Installation of 16A Modular Power Switch**

	Socket: Supply and installation of modular type 16A plug, 6-pin power socket 240V and switch modular type with GI or powder coated metal box concealed in wall and connection with 6sqmm FRLS PVC copper cable. A switch for controlling power supply of plug shall be connected in phase cable and earth cable size shall be same size of wiring to flow maximum fault current.
1.7	**Supply and Installation of 02 Module Plate with GI Box**: Supply and installation of 2 module modular plates for installation of switches and sheet metal GI box of thickness 2 mm (minimum), good quality concealed and fixing of GI box confirming to IS 14772 (2000). GI box should be of standard size along with all steel screws, washer etc.
1.8	**Supply and Installation of 04 Module Plate with GI Box**: Supply and installation of 4 module modular plates for installation of switches and sheet metal GI box of thickness 2 mm (minimum), good quality concealed and fixing of GI box confirming to IS 14772 (2000). GI box should be of standard size along with all steel screws, washer etc.
1.9	**Supply and Installation of 08 Module Plate with GI Box** : Supply and installation of 8 module modular plates for installation of switches and sheet metal GI box of thickness 2 mm (minimum), good quality concealed and fixing of GI box confirming to IS 14772 (2000). GI box should be of standard size along with all steel screws, washer etc.
1.10	**Supply and Installation of 12 Module Plate with GI Box**: Supply and installation of 12 module modular plates for installation of switches and sheet metal GI box of thickness 2 mm (minimum), good quality concealed and fixing of GI box confirming to IS 14772 (2000). GI box should be of standard size along with all steel screws, washer etc.
1.11	**Supply, Installation, Testing and Commissioning of BLDC energy efficient Ceiling Fan 1200 mm Sweep with Fan Regulator:** Supply, installation, testing and commissioning of 240V AC, 1200 mm sweep brushless direct current (BLDC) energy efficient ceiling fan having 3 blades, double ball bearing, copper wound motor, suitably sized down rod as per requirement at site to meet the adequate height of the fan from floor, canopies and capacitor etc. complete with all accessories including fixing phenolic laminated sheet cover on the fan

	box, FR PVC insulated multi-stranded three core copper conductor cabling and connecting with earthing system etc. The ceiling fan hook box shall be fabricated of 2 mm thick GI sheet (to be provided during conduiting) with 10mm dia GI rod with hook to fix the ceiling fan. The hook shall be concealed within the fan hook box. The side extensions of rod shall be 150 mm on either side from centre of the fan box and embedded in the concrete. Fan should have ISI mark and as per IS-374 and 5-star energy rating issued by BEE. The modular type electronic fan regulator shall be 5 step type on existing board and connection as per requirement.
1.12	**Supply, Installation, Testing and Commissioning of BLDC energy efficient Ceiling Fan 1400 mm Sweep with Fan Regulator:** Supply, installation, testing and commissioning of 240V AC, 1400 mm sweep brushless direct current (BLDC) energy efficient ceiling fan having 3 blades, double ball bearing, copper wound motor, suitably sized down rod as per requirement at site to meet the adequate height of the fan from floor, canopies and capacitor etc. complete with all accessories including fixing phenolic laminated sheet cover on the fan box, FR PVC insulated multi-stranded three core copper conductor cabling and connecting with earthing system etc. The ceiling fan hook box shall be fabricated of 2 mm thick GI sheet (to be provided during conduiting) with 10mm dia GI rod with hook to fix the ceiling fan. The hook shall be concealed within the fan hook box. The side extensions of rod shall be 150 mm on either side from centre of the fan box and embedded in the concrete. Fan should have ISI mark and as per IS-374 and 5-star energy rating issued by BEE. The modular type electronic fan regulator shall be 5 step type on existing board and connection as per requirement.
1.13	**Supply, Installation, Testing and Commissioning of 300 mm Sweep Exhaust Fan:** Supply, installation, testing and commissioning of exhaust fan 300 mm sweep (having reinforced insulation and metal blade) with louvre shutter heavy duty (ISI marked, as per IS-2312), 5-star energy rating issued by BEE and making hole in wall including repairing the same properly with cement-sand (1:4) or M-25 grade concrete and connection complete in all respect, installation of suitable fire-resistant framing etc. The price also covers supply and installation of suitable clamps/ brackets, roses etc. as required and of all materials including FR PVC insulated multi stranded single core copper conductor wiring, earthing connection etc.
1.14	**Supply, Installation, Testing and Commissioning of Double Door, Distribution Boards (DB) with 63A MCB TPN, 440V, 8 Module**: Supply, installation, testing and commissioning of minimum 2 mm thick

	CRCA power coated (7 tank process) Double Door Distribution Board with MCB TPN 440V, 8 modules 4 row, with neutral and earth link and minimum IP42 ingress protection. The DB shall be with one no. four pole MCB 63A, one no. four pole RCCB 63A leakage current 30 mA and twenty four nos. SP MCB 40/32/25/16/10/6 A conforming to IS-2675 along with mounting channels. The breakup of 40/32/25/16/10/6 A MCB shall be finalised during design submission stage. All MCB shall be of 'C 'series with breaking capacity not less than 10 kA. MCB, RCCB and DB shall preferably be of same make. The distribution board shall be fixed in such a fashion that its door flushed with the wall on which it is fixed. All cut-outs/ conduit knockouts on top & bottom and covers shall be provided with sealed gaskets to provide the required degree of protection. Appropriate cable entry holes along with internal copper cable of required size shall be provided and sealant shall be used. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as required. All circuits shall be distinctly marked/ feruled with description of service installed. Circuit breakers shall be conforming to IS/IEC-60898-1, as applicable.
1.15	**Supply, Installation, Testing and Commissioning of Double Door, Distribution Boards (DB) with 40A MCB TPN, 440V, 8 Module**: Supply, installation, testing and commissioning of minimum 2 mm thick CRCA power coated (7 tank process) Double Door Distribution Board with MCB TPN 440V, 8 modules 4 row, with neutral and earth link and minimum IP42 ingress protection. The DB shall be with one no. four pole MCB 40A, one no. four pole RCCB 40A leakage current 30 mA and twenty four nos. SP MCB 40/32/25/16/10/6 A conforming to IS-2675 along with mounting channels. The breakup of 40/32/25/16/10/6 A MCB shall be finalised during design submission stage. All MCB shall be of 'C 'series with breaking capacity not less than 10 kA. MCB, RCCB and DB shall preferably be of same make. The distribution board shall be fixed in such a fashion that its door flushed with the wall on which it is fixed. All cut-outs/ conduit knockouts on top & bottom and covers shall be provided with sealed gaskets to provide the required degree of protection. Appropriate cable entry holes along with internal copper cable of required size shall be provided and sealant shall be used. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as required. All circuits shall be distinctly marked/ feruled with description of service installed. Circuit breakers shall be conforming to IS/IEC-60898-1, as applicable.
1.16	**Supply, Installation, Testing and Commissioning of Double Door, Distribution Board (DB) with DP MCB, 40A, 12 way, SP:** Supply, installation, testing and commissioning of minimum 2 mm thick CRCA power coated (7 tank process) Double Door distribution board 12 way with neutral and earth link and minimum IP42 ingress protection, with one no. DP MCB 40A, one no. DP RCCB 40A, leakage current 30 mA and twelve nos. SP MCB 32/25/16/10/6 A conforming to IS-2675 along with mounting channels. The breakup of

	40/32/25/16/10/6 A MCB shall be finalised during design submission stage. All MCB shall be of 'C' series with breaking capacity not less than 10 kA. MCB, RCCB and DB shall preferably be of same make. The distribution board shall be fixed in such a fashion that its door flushed with the wall on which it is fixed. All cut-outs/ conduit knockouts on top & bottom and covers shall be provided with sealed gaskets to provide the required degree of protection. Appropriate cable entry holes, along with internal copper cable of required size, shall be provided and sealant shall be used. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as required. All circuits shall be distinctly marked/ feruled with description of service installed. Circuit breakers shall be conforming to IS/IEC-60898-1, as applicable.
1.17	**Supply, Installation, Testing and Commissioning of 440V, 3-phase Change Over Distribution Board:** Supply, installation, testing and commissioning of minimum 2 mm thick CRCA power coated (7 tank process) box of size 610 x 450 x 190 mm (approximate) change over distribution board with minimum IP42 ingress protection. The distribution board shall be indoor type dust and vermin proof, knock out/ glands plates as applicable shall be provided in the box for incoming and outgoing cables. Earth terminals shall be provided. Danger notice shall be provided at appropriate place. The complete internal wiring for each phase selector shall be done with copper cable of size 10 sqmm. It shall comprise of following items: • 01 no. 440V, 3-phase, 100 A TPN MCCB as incomer • 01 no. 63 A SPN MCCB as outgoing. • 04 nos. integrated LED pilot lamp (3 incoming+1 outgoing) • 01 no. 63A selector switch (phase selector switch) Three pole three ways (Three phase incoming & only one phase outgoing).
1.18	**Supply, Installation, Testing and Commissioning of Double Door, Distribution Board with 63A, 240V, DP MCB, 8 Way, SP:** Supply, installation, testing and commissioning of minimum 2 mm thick CRCA power coated Double Door Distribution Board with MCB SP 8 way, neutral and earth link and minimum IP42 ingress protection, with one no. DP MCB 63A, 240V, one no. DP RCCB 63A, leakage current 30 mA and eight nos. SP MCB 32 A (for feed from ACO Panel). All MCB shall be of 'C' series with breaking capacity not less than 10 kA. MCB, RCCB and DB shall preferably be of same make. The distribution board shall be fixed in such a fashion that its door flushed with the wall on which it is fixed. All cut-outs/ conduit knockouts on top & bottom and covers shall be provided with sealed gaskets to provide the required degree of protection. Appropriate cable entry holes, along with internal copper cable of required size, shall be provided and sealant shall be used. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as required. All circuits shall be distinctly marked/ feruled with description of service installed.

1.19	**Supply and Installation of Metal Clad Plug Socket 20A, 240V, Single Phase with 32A, DP MCB with enclosure:** Supply and installation of metal clad plug socket 20A, 240V AC, single phase with 32A, DP MCB, 10kA, C series including sheet metal enclosure box (CRCA sheet 2 mm thick sheet having power coating with 7 tank processes with rubber gasket, etc.) with one 20A plug top (ray roll type) to be supplied with board. Necessary fixing arrangement including all nuts, bolts, screws, washers, drilling etc. shall be provided.
1.20	**Supply and Installation of Metal Clad Plug Socket 16A, 240V, Single Phase with 20A, DP MCB with enclosure:** Supply and installation of metal clad plug socket 16A, 240V AC, single phase with 20A DP MCB, 10kA, C series including sheet metal enclosure box (CRCA sheet 2 mm thick sheet having power coating with 7 tank processes with rubber gasket, etc.) with one 16A plug top (ray roll type) to be supplied with board. Necessary fixing arrangement including all nuts, bolts, screws, washers, drilling etc. shall be provided.
1.21	**Supply, Installation, Testing and Commissioning of MCCB 200A, 440V, 3-phase (4 Pole, 36 kA) with enclosure:** Supply, installation, testing and commissioning of four Pole Moulded Case Circuit Breaker (MCCB) of 200A, 440V, 3-phase, 36 kA with adjustable thermal, fix magnetic release complete. MCCB is to be provided in minimum 2 mm thick CRCA power coated with 7 tank processes enclosure at location as per the site requirement. Necessary fixing arrangement including all nuts, bolts, screws, washers, drilling etc shall be provided.
1.22	**Supply and Installation of Junction Box Size 390(H)x305(B)x170(D) mm with busbar:** Supply and installation of junction box size 390(H)x305(B)x170(D) mm comprising CRCA sheet material with 2 mm thick sheet having power coating with 7 tank processes with rubber gasket, padlock arrangement, zinc passivated earth bolt, etc. with terminals suitable for 440V/240V supply requirement. All busbars and terminals in the junction box shall be of copper material with 4 nos. copper bus bar capacity 200A, of required length suitable for 440V supply. The box shall be fixed robustly with clamps at pole/ wall as per requirement. All the material should be of good quality. This will include all holes, nuts, bolts, screws, washers, copper cable for interconnections as required of suitable rating, insulations etc.
1.23	**Supply, installation, testing and commissioning of 25 mm dia GI Conduit:** Supply, installation, testing and commissioning of 25 mm dia GI Conduit concealed/surface including all junction boxes (1 way, 2 way, 3 way, 4 way as required), bends, couplers, elbows, tees, fan box etc. accessories conforming to IS-9537, IS-3419 and IS-2667.

	Necessary arrangement for concealed conduits shall be made for support, taping and packing at bottom to avoid entry of cement slurry etc. The Contractor shall be responsible for proper chiselling, plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. Contractor shall make necessary interface with Civil Contractor during laying of conduits. Wherever required, the flexible metallic conduits shall be provided to complete the circuit and measurement shall be done as a part of GI conduit.
1.24	**Supply, installation, testing and commissioning of 32 mm dia GI Conduit:** Supply, installation, testing and commissioning of 32 mm dia GI Conduit concealed/surface including all junction boxes (1 way, 2 way, 3 way, 4 way as required), bends, couplers, elbows, tees, fan box etc. accessories conforming to IS-9537, IS-3419 and IS-2667. Necessary arrangement for concealed conduits shall be made for support, taping and packing at bottom to avoid entry of cement slurry etc. The Contractor shall be responsible for proper chiselling, plastering and distempering/ fixing of tiles to restore the original finish of wall such that it matches with original surface and colour of wall on which conduit pipe has been laid. Contractor shall make necessary interface with Civil Contractor during laying of conduits. Wherever required, the flexible metallic conduits shall be provided to complete the circuit and measurement shall be done as a part of GI conduit.
1.25	**Supply of Material and Installation of FRLS, PVC, 1.1kV, 3x2.5 Sqmm Copper Cable:** Supply of material and wiring of single core insulated, multi-stranded 2x2.5 sqmm FRLS PVC copper cable ISI mark and 2.5 sqmm FRLS PVC insulated, 1.1 kV copper cable multi-stranded for earthing. Cable shall be ISI marked confirming to IS: 694-1990 specifications and make of reference list. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for phase wiring. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. The measurement shall be based on 3 runs of cables as one meter length.
1.26	**Supply of Material and Installation of FRLS, PVC, 1.1 kV, 3x6 Sqmm Copper Cable:** Supply of material and wiring of single core insulated, multi-stranded 2x6 sqmm FRLS PVC, 1.1 kV, copper cable ISI mark and 6 sqmm FRLS PVC insulated copper cable multi-stranded for earthing. Cable shall be ISI marked confirming to IS: 694-1990 specifications

	and make of reference list. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for phase wiring. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. The measurement shall be based on 3 runs of cables as one meter length.
1.27	**Supply of Material and Installation of FRLS, PVC, 1.1 kV, 3x10 Sqmm Copper Cable:** Supply of material and wiring of single core insulated, multi-stranded 2x10 sqmm FRLS PVC, 1.1 kV, copper cable ISI mark and 10 sqmm FRLS PVC insulated copper cable multi-stranded for earthing. Cable shall be ISI marked confirming to IS: 694-1990 specifications and make of reference list. The wiring shall be done in such a way that minimum wires run inside the room as far as possible. The size of copper cable used for earthing purpose shall not be less than the size of cable used for phase wiring. There should be no loose connections in the wiring circuit. Joints in cables are not allowed. Any discrepancy occurred in engineering work during the wiring should be restored in the original condition by the Contractor, at his own cost. The measurement shall be based on 3 runs of cables as one meter length.
2 LT & HT CABLES AND LAYING	
2.1	**Supply of 2 Core x 10 sqmm, XLPE insulated, armoured, 1.1 kV Copper Cable:** Supply of 1.1 KV grade, 2 Core x 10 Sqmm LT XLPE insulated, FRLS, armoured copper conductor cable with end terminations with suitable crimping sockets/ lugs, gland, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.2	**Supply of 2 Core x 16 sqmm, XLPE insulated, armoured, 1.1 kV Copper Cable:** Supply of 1.1 KV grade, 2 Core x 16 Sqmm LT XLPE insulated, FRLS, armoured copper conductor cable with end terminations with suitable crimping sockets/ lugs, gland, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.3	**Supply of 2 Core x 35 sqmm, XLPE insulated, armoured, 1.1**

	kV Aluminium Cable: Supply of 1.1 KV grade, 2 Core x 35 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.4	**Supply of 2 Core x 70 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade, 2 Core x 70 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.5	**Supply of 2 Core x 95 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade, 2 Core x 95 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.6	**Supply of FRLSH XLPE insulated, armoured, 3 Core x 25 sqmm, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade, 3 Core x 25 Sqmm LT XLPE insulated, FRLSH, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.7	**Supply of FRLSH XLPE insulated, armoured, 3 Core x 95 sqmm, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade, 3 Core x 95 Sqmm LT XLPE insulated, FRLSH, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.8	**Supply of FRLSH XLPE insulated, armoured, 3 Core x 120 sqmm, 1.1 kV Aluminium Cable:**

	Supply of 1.1 KV grade, 3 Core x 120 Sqmm LT XLPE insulated, FRLSH, armoured aluminium conductor cable with end terminations with suitable crimping sockets/ lugs, glands, cable marker tags inscribed with cable identification, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.9	**Supply of 4 Core x 16 sqmm, XLPE insulated, armoured, 1.1 kV Copper Cable:** Supply of 1.1 KV grade 4 Core x 16 Sqmm LT XLPE insulated, FRLS, armoured copper conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.10	**Supply of 4 Core x 25 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 25 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.11	**Supply of 4 Core x 50 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 50 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.12	**Supply of 4 Core x 70 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 70 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.13	**Supply of 4 Core x 95 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 95 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130

	and IEC-60502-1 standards with latest amendment.
2.14	**Supply of 4 Core x 120 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 120 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, gland, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.15	**Supply of 4 Core x 240 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 240 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, glands, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.16	**Supply of 4 Core x 300 sqmm, XLPE insulated, armoured, 1.1 kV Aluminium Cable:** Supply of 1.1 KV grade 4 Core x 300 Sqmm LT XLPE insulated, FRLS, armoured aluminium conductor cable, end terminations with suitable crimping sockets/ lugs, glands, testing and meggering etc. as per required technical specifications and confirming to IS: 7098, IS: 8130 and IEC-60502-1 standards with latest amendment.
2.17	**Supply, Installation, Testing and Commissioning of LT Heat Shrinkable Straight Through Joint:** Supply, installation, testing and commissioning of 1.1 kV heat shrinkable straight through joint (conforming to IS-1255) with required accessories complete in all respect suitable for XLPE 1.1 kV and above rating cables as per site requirement. All necessary precautions and arrangements during installation and complete testing with required equipment shall be done. This will include all excavation, refilling of earth and compaction etc. wherever required.
2.18	**Supply of 3 Core x 120 sqmm, XLPE insulated, armoured, 11 kV Aluminium Cable:** Supply of 3 Core x 120 Sqmm 11 kV XLPE insulated, armoured, aluminium conductor Cable , testing and meggering etc, and conforming to IS: 7098 (Part 2)/ 2011 or latest.
2.19	**Supply and Installation of End Termination Kit for 3 core, 70 sqmm to 185 Sqmm, 11 kV Cable:** Supply and installation of outdoor type, heat shrinkable, end termination kit

	suitable for 3 core 11 kV, 70 sqmm to 185 Sqmm XLPE insulated, armoured, aluminium conductor cable and making termination connections with overhead conductor, testing and commissioning etc. The material shall conform to IS-1255.
2.20	**Laying of LT/ HT Cables (All Sizes) In Air/ Pipe/ Cable Tray/ Trench etc.:** Laying, testing and commissioning of LT/ HT (1.1 kV/11 kV) XLPE insulated armoured sheathed cable underground/ under the road/ under the track along with pole/ wall/ trench/ air in already laid pipe. Before and after laying cable, the continuity and IR value of cables along with all other tests as required shall be checked. While laying the cable, care should be taken that no tree roots/ water logging area come on the way of cable, as it may damage the outside insulation of cable. Armouring at both ends of the cable should be earthed. At termination point of cable suitable lugs and brass glands of suitable size and good quality shall be provided. The Contractor shall restore the original condition of the Roads/ platform/ concrete flooring after laying of cable. Bending radius of the cable shall not be less than 16 times of dia of the cable. Wherever, the cable emerges out of the ground at least two loops of sufficient radius should be laid. Installation of cable along with wall/ pole/ roof top/ underneath sheds wherever required shall be done with support of G.I. Saddles/ clamp of proper size and GI Pipe as required. Breaking of floor/ wall/ road and other civil structures and repairing up to original condition shall be done by the Contractor and no extra cost shall be paid for it. Permission for crossing any road/ track, if required, shall be arranged by the Contractor in coordination with Engineer, and all the expenditures shall be borne by the Contractor. All the instruments required for insulation testing, high voltage testing shall be arranged by the Contractor at his own cost. The cable shall be transported by the Contractor through his own means from major electrical depot to required site of work. Before transportation of the cable, it shall be tested at site to ascertain the serviceability of the cable by the Contractor. The work shall conform to IS-1255.
2.21	**Excavation and Refilling of Trench of Size 500 mm wide and depth up to 1200 mm (as per design) for cables:** Excavation and refilling of Trench of size 500 mm wide and depth up to 1200 mm (as per design with the approval of the Engineer) in all kinds of soil for laying of HDPE/ GI pipe for underground cables crossing. Contractor shall clear all metallic parts & stones etc. in trench. After laying of pipe, the trench should be refilled with same soil, ramming (compaction not less than 95%) and restore to original position. After cable/ pipe laying Contractor shall clear all site debris. The excess earth and debris etc. shall be disposed off up to a distance of 2km at suitable place by the Contractor.
2.22	**Excavation and Refilling of Trench of Size 500 mm wide and depth up to 1200 mm with brick protection (as per design) for cables:**

	Excavation and refilling of Trench of size 500 mm wide and depth up to 1200 mm with burnt clay brick protection (as per design with the approval of the Engineer) for laying of LT/HT (1.1kV/11kV) cables in all kinds of soils. The trench shall have sand cushioning, protective covering with bricks of compressive strength class designation 10 (minimum). Suitable rows of bricks (size 200mm x 100mm x 100mm) (IS-1077) shall be laid width-wise (i.e. brick length shall be 90 degree to the laid cable) and entire 500 mm width of the trench shall be covered by making suitable brick combination. The height of the brick shall not be less than 100 mm. Contractor shall clear all metallic parts & stones etc. in trench. After laying of cables and bricks, the trench should be refilled with same soil, ramming (compaction not less than 95%) and restore to original position. After cable laying Contractor shall clear all site debris. The excess earth and debris etc. shall be disposed off up to a distance of 2km at suitable place by the Contractor.
2.23	**Supply and Laying of HDPE Pipe (90 mm outside dia):** Supply and laying of HDPE pipe in already excavated trench, under floor, platform, road, ground, air etc. as per site requirement size 90 mm outside dia wall thickness 4.3 mm to 5.0 mm, PN-4 conforming to IS 4984:1995 or latest as per site requirement (including laying of 63 mm outside dia HDPE pipe for making connection to 90 mm outside dia HDPE pipe and reducer wherever required). Pipe should be laid in trench such that it shall be possible to withdraw the cables for repair or replacement without disturbing the work. The pipes shall be laid with a gradient to facilitate drainage of water. Accessories related with laying of HDPE pipe like fitting, bends joints/ coupler junction, flange end cap, reducer etc. as per site requirement shall be provided by Contractor and the payment of 90 mm outside dia HDPE pipe shall include all these items as required.
2.24	**Supply and Laying of HDPE Pipe (90 mm outside dia) at platform along with pit and cover:** Supply and laying of HDPE Pipe (90 mm outside dia) at platform along with pit and cover at every 40m-50m as per design in already excavated trench at platform as per site requirement. The HDPE pipe size shall be 90 mm outside dia, wall thickness 4.3 mm to 5.0 mm, PN-4 conforming to IS 4984:1995 or latest. Pipe should be laid in trench such that it shall be possible to withdraw the cables for repair or replacement without disturbing the work. The pipes shall be laid with a gradient to facilitate drainage of water. Accessories related with laying of HDPE pipe like fitting, bends joints/ coupler junction, flange end cap, reducer etc. as per site requirement shall be provided by Contractor and the payment of 90 mm outside dia HDPE pipe shall include all these items as required. The pit shall be with burnt clay bricks (IS-1077) having inside dimensions 400x400 mm with 400 mm depth and M-25 RCC cover thickness shall be 75mm and pit cover shall cover the entire brick work. The top layer of cover shall flush with platform level as per design.

2.25	**Supply and Laying of HDPE Pipe (125 mm outside dia):** Supply and laying of HDPE pipe in already excavated trench underfloor, platform, road, ground, air etc. as per site requirement, size 125 mm outside dia wall thickness 6 mm to 6.8 mm, PN-4 conforming to IS 4984:1995 or latest. Pipe shall be laid in trench such that It shall be possible to withdraw the cables for repair or replacement without disturbing the work. The pipes shall be laid with a gradient to facilitate drainage of water. Accessories related with laying of HDPE pipe like fitting, bends joints/ coupler junction, flange end cap, reducer etc. as per site requirement shall be provided by Contractor and payment of HDPE pipe shall include all these items as required.
2.26	**Supply and Laying of HDPE Pipe (160 mm outside dia):** Supply and laying of HDPE pipe in already excavated trench under floor, platform, road, ground, air etc. with technical specification of 160 mm dia (OD), wall thickness between 7.7 mm to 8.6 mm, PN-4 confirming to IS: 4984/1995 of latest. Pipe shall be laid in trench such that possible to withdraw the cable for repair or replacement. The pipes shall be laid with a gradient to facilitate drainage of water. Accessories related with laying of HDPE pipe like fitting, bends joints/ coupler junction, flange end cap, reducer etc. as per site requirement shall be provided by Contractor and payment of HDPE pipe shall include all these items as required.
2.27	**Supply and Laying of GI Pipe (nominal bore 150 mm):** Supply and laying of 150 mm nominal bore GI Pipe medium class as per IS 1239 under road/ Railway track. The GI pipe shall be fixed with pole/ wall/ structure etc. by GI flat/clamps of suitable size & GI nut-bolt-washer etc. In the case of GI pipe is laid in road/ permanent floor/ other civil structures etc. and require any dismantling then repairing up to original condition shall be done by the Contractor. The pipes shall be laid with a gradient to facilitate drainage of water. The G.I pipe shall be laid right angle to the track. Accessories related with laying of GI pipe like fitting, bends joints/ coupler junction, reducer, flange end cap etc. as per site requirement shall be provided by Contractor and payment of GI pipe shall include all these items as required.
2.28	**Supply and Installation of Cable Route Marker:** Supply and installation of Cable Route marker along the cables at locations approved by the Engineer and generally at intervals not exceeding 100 meters. Wherever, the cable route is changing or it is entering a fixed installation, route marker shall be provided. Route marker shall also be provided at joints of the cable. The item price includes labour & cost of all materials including cost of cable route markers. The route marker shall be 150mm dia, 6mm thick GI plate

	welded with GI angle of size 40x25x5mm and lower part of angle shall be embedded (end slightly bent) in 150x150x150mm M-25 cube which shall be buried 200 mm below the ground as per drawing. The plate shall be painted in yellow paint and on one face of plate HRIDC shall be painted in black paint and on other side voltage level (240V/440V/11000V) as applicable shall be marked. Drawing of cable route marker shall get approved from Engineer before installation.
2.29	**Drilling of horizontal bore below Railway track or road by pushing method for laying of HDPE/ GI pipe:** Drilling of horizontal bore by pushing method (trenchless technology) in all types of soil for laying of HDPE/ GI pipe dia up to 250mm by pushing method. Horizontal boring shall be done at minimum 1.5 metre below or as per site requirement from ground level at Road/ canal/ bridges/ Railway track portion but in case, where bank is high then boring shall be such that outer side pipe and under track HDPE/ GI pipes are in same alignment. All work shall be done without disturbing the Road/ canal/ bridges/ Railway track taking all necessary safety precautions related to Road/ canal/ bridges/ track and movement of Road transport and trains. Permission for crossing any road/ track, if required, shall be arranged by the Contractor in coordination with Engineer and all the expenditures shall be borne by the Contractor.
3 LIGHTING, STREET LIGHT POLE AND HIGH MAST	
3.1	**Supply, Installation, Testing and Commissioning of 22 Watt LED Tube Light with fitting:** Supply, installation, testing and commissioning of surface mounted Energy efficient LED tube light with fitting and its driver and Luminaries (22 watt), of CRCA steel sheet enclosure, IP-20 for indoor application, operating voltage (140-270) V, minimum 2000 lumens, complete with all accessories of approved make etc. The item price also includes labour & cost of all materials including cost of FRLS PVC insulated multi stranded single core copper conductor cable for inter-connections, earthing connection etc. The Contractor shall design the requirement of lights based on lux level calculations. The price also covers supply and installation of suitable clamps/ brackets etc. to fix light fittings under Subway/FOB/ Poles/ roofs/ walls/ sheds etc. The material shall conform to IS-2418, IS-3528, IS-5077, IS-10322, IS-16101, IS-16102, IS-16103, IS-16106, IS-16107 and other specifications as applicable.
3.2	**Supply, Installation, Testing and Commissioning of 40W LED, 2X2 recess mounting luminaire with fitting:** Supply, installation, testing and commissioning of 40W LED 2x2 recess mounting luminaire with mid flux LED using efficient optics enclosed in a metallic CRCA powder coated housing with high efficiency Lumio diffuser. It has a system lumen efficacy > 80 lumen/watt with system level luminous flux of 3100 lumens and system wattage of 40W. 50,000 hours burning life for the system at 70% lumen maintenance with a colour rendering index (CRI) > 80 and colour temperature 6500K, PF > 0.9 and THD (Total Harmonic

	Distortion)<33%. Luminaire is sealed from bottom and has an inbuilt gear. The Contractor shall design the requirement of lights based on lux level calculations. The Luminaire is IP 20 protected, similar to Philips Fullglow RC380B LED-30-4000 PSE OD WH or similar as per approved material reference list.
3.3	**Supply, Installation, Testing and Commissioning of 18W recessed type LED downlighter with fitting:** Supply, installation, testing and commissioning of recessed type LED downlighter, 18W (including Driver), die cast Aluminium ring with sand blasted anodized reflector, efficiency of 60 lm/W, with CCT of 4000K and CRI≥80 similar to Philips Cat. No. BBS145/18W or similar as per approved material reference list. The Contractor shall design the requirement of lights based on lux level calculations.
3.4	**Supply, Installation, Testing and Commissioning of 40 Watt LED Street Light with Fitting:** Supply, installation, testing and commissioning of Energy efficient 40 Watt LED with street light fitting with pressure die cast aluminium housing with driver & suitable fixing arrangement with street light pole, IP-65 for outdoor application, operating voltage (140-270) V, System efficacy more than 100 lumen/W, complete with all accessories of approved make etc. The Contractor shall design the requirement of lights based on lux level calculations. The item price also includes labour & cost of all materials including cost of FRLS PVC insulated multi-stranded single core copper conductor cable for inter-connections, earthing connection etc.
3.5	**Supply, Installation, Testing and Commissioning of 60 Watt LED Street Light with Fitting:** Supply, installation, testing & commissioning of Energy efficient 60 Watt LED with street light fitting with pressure die cast aluminium housing with driver & suitable fixing arrangement, IP-65 for outdoor application, operating voltage (140-270) V, System efficacy more than 100 lumen/W, complete with all accessories of approved make etc. The Contractor shall design the requirement of lights based on lux level calculations. The item price also includes labour & cost of all materials including cost of FRLS PVC insulated multi-stranded single core copper conductor cable for inter-connections, earthing connection etc.
3.6	**Supply, Installation, Testing and Commissioning of 40 Watt LED light with Bulkhead Light Fitting along with anti-theft provision:** Supply, installation, testing & commissioning of Energy efficient 40 Watt LED light with bulkhead light fitting along with anti-theft provision with pressure die cast aluminium housing with driver & suitable fixing arrangement, for outdoor application, operating voltage (140-270) V AC, system efficacy more than 100 lumen/W, wattage of each LED shall be greater than 1 W and less than 3 W, complete with all accessories of approved make etc. The light fitting shall be provided on the wall of both sides of subway and other locations as per requirement. The item price includes labour and cost of all materials

	including cost of FRLS PVC insulated multi-stranded single core copper conductor cable used for connection to light fitting from the terminal or junction box etc, earthing connection etc. The Contractor shall submit dialux calculations and design for approval of the Engineer. The luminaire shall conform to IEC 60598. The bulkhead lighting shall be installed in subways and protective anti-theft arrangement shall be made to secure the light fitting.
3.7	**Supply, Installation, Testing and Commissioning of 120 Watt LED Street Light with Fitting:** Supply, installation, testing and commissioning of Energy efficient 120 Watt LED with street light fitting with pressure die cast aluminium housing with driver & suitable fixing arrangement with street light pole, IP-65 for outdoor application, operating voltage (140-270) V, System efficacy more than 100 lumen/W, complete with all accessories of approved make etc. The Contractor shall design the requirement of lights based on lux level calculations. The item price also includes labour & cost of all materials including cost of FRLS PVC insulated multi-stranded single core copper conductor cable for inter-connections, earthing connection etc.
3.8	**Supply, Installation, Testing and Commissioning of Rechargeable Batten Type 240 Watt (60 LEDs, 4 watts) Emergency Light:** Supply, installation, testing and commissioning of rechargeable batten type Emergency light, 240 watt (60 LEDs, 4 watts) with Two-hour minimum backup. The battery life shall be minimum 4 years. The luminaire shall provide rated lumen within 5 second after switching on. The material shall conform to IS-9583.The Contractor shall submit technical details for approval of the Engineer.
3.9	**Supply, Installation, Testing and Commissioning of Outdoor LED Type Flood Light Luminaries (200 Watt) with fitting:** Supply, installation, testing and commissioning of 200 watt pre wired LED Flood light fitting with 200 watt LED Type Flood Light Luminaries complete conforming to BAJAJ Cat. No. BARFEG-200W LED or equivalent with IP- 65 protection with LEDs and driver and all accessories. The Contractor shall make necessary fixing/ suspension arrangement for LED fitting. **Specification of LED fitting:** The LED lamps, driver & luminaries shall be suitable for outdoor lighting/ facade lighting and other installations. **Technical requirements of LED Flood light fitting:** (i) LED efficacy shall be 120 lumen/ watt for luminaire system wattage.

	(ii) LED used should be of Surface Mounted Diode (SMD) type only. (iii) L70 Reported Life span of LEDs used in the luminaries shall be greater than 50,000 hrs. at the soldering point temperature of 85°C. (iv) Color temperature of the proposed white color LED shall be 5700 K (minimum). (v) Color Rendering Index (CRI): Greater than 65. **Technical requirements of Driver:** (i) Efficiency of driver: power output rating > 100 W = 90% (ii) Power factor of complete fitting: 0.90. (iii) Input Operating Voltage: 140V to 270 V. (iv) Short circuit protection: Compliant (v) Open load protection: Compliant (vi) Driver Surge Protection standard: (a) 3 kV Min (b) 10 kV for lighting prone location (External to driver circuit). (vii) Total Harmonic Distortion (THD): Less than 20% at full load. (viii) Tc (Maximum Driver case temperature) must be declared on the data sheet. (ix) Isolated driver should be used. **Technical requirements of Luminaire:** (i) Shall submit the LM-79 and/or IS: 16106 test report. The manufacturer shall submit accreditation that the luminaire submitted for LM-79 testing was equipped with the LED Driver now being offered by the Contractor. (ii) Cover type: Toughened glass or UV stabilized polycarbonate cover. The material shall conform to IS-3528, IS-10322, IS-16101, IS-16106, IS-16107 and other specifications as applicable.
3.10	**Supply, Installation, Testing and Commissioning of 6 meter high hot dip galvanised steel octagonal with single/double arm street light pole with foundation bolt, galvanised base plate complete with foundation (M-25 grade), entry and exit pipes, control junction box with connector etc. complete as per drawing:** Supply, installation, testing and commissioning of 6 meter high street light pole hot dip galvanised steel octagonal with single/ double arm street light pole (straight arm or curved hanging type arm) with foundation bolt, galvanised base plate complete with foundation (M-25 grade), entry and exit pipes, control junction box with connector etc. complete as per drawing with all accessories i.e. GI pipe, clamps, nuts, bolts etc. along with outdoor type junction box with 6A MCB complete as required with anti-corrosive treatment and suitable for 50m/s wind speed. It shall be galvanised internally and externally by single dipping methods. Galvanized base plate of 220 x 220x 12 mm (as per IS 2062) and GI bolt size M20 X 600mm X 4 nos. (as minimum) in position including excavation of pit and filling the same with M-25 grade concrete with two curved 63mm dia HDPE pipe embedded in foundation for cable loop-in-loop-out including supply of material as required or recommended by pole manufacturer.

	The allied accessories such as cross arms bakelite sheet with SP MCB (6A, C series) and stud terminals, clamping, etc. are included. Single arm (and double arm as per requirement) of 500 to 1500 mm length are to be provided as per the site requirement with the approval of Engineer. The bakelite sheet with MCB & stud terminals shall be provided in the base compartment of the poles. All the connecting terminals shall be properly tightened and crimped in order to avoid any loose connection. Earthing of pole shall be done in proper manner under the designated item of earthing. Prior approval of foundation and pole/arm drawing shall be obtained from Engineer. The item shall also include LED light fitting accessories i.e. GI pipe, clamps, nuts, bolts etc. The outdoor type junction box (IP65 protection) shall have loop-in loop-out arrangement for feeding cable and with 6A MCB to control pole light fittings. The cable connections shall be with proper thimbling arrangement. GI pipe shall be medium class conforming to IS 1239 and size of GI pipe shall be as per LED fitting. The Contractor shall design the spacing between two poles based on lux level calculations. The item price also includes labour & cost of all materials including cost of FRLS PVC insulated multi-stranded single core copper conductor cable for inter-connections to the light luminaire, etc. The platform lights at Manesar station shall be controlled by Assistant Station Master (ASM) and suitable control shall be provided by the Contractor. This is in addition to the metallic astronomical and pre-settable street light Timers for control of platform lights and the cost of items required for this arrangement shall be paid under designated items. Contractor shall prepare complete drawing of platform/ street light pole, single/ double arm, its foundation, accessories, control from ASM chamber at Manesar station etc. as required and obtain approval of the Engineer.
3.11	**Supply, Installation, Testing and Commissioning of metallic astronomical and pre-settable street light timer:** Supply, installation, testing and commissioning of metallic astronomical and pre-settable street light timer for automatic operation of platform, circulating area, street light etc. complete with required power contactor, metallic astronomical and pre-settable street light timer, wiring, MCB etc. suitable for outdoor as required in minimum 2 mm CRCA powder coated enclosure of suitable size. The timer shall be programmable to any time (ON/OFF) in 24 hours. The timer shall switch ON lights at preset time and shall switch OFF also at preset time. The life of timer shall not be less than 10 years. The manufacturer's certificate regarding life shall be submitted. Contractor shall submit drawing and obtain approval of the Engineer.
3.12	**Supply, Installation, Testing and Commissioning of 20 Meter High Mast:**

Structure:

The 20 meter high mast, shall be of continuously tapered, polygonal cross section minimum 20 sided, presenting a good and pleasing appearance (as per manufacture design) and shall be based on proven in-tension design conforming to relevant standards to give an assured performance and reliable service. The mast shall be designed as per IS-875 (Part 3) and Technical Report 7 (TR 7) of the Institution of Lighting Engineers.

Construction:

The Mast shall be fabricated from special steel plates, to BSEN-10025 cut and folded to form polygonal section and shall be telescopically jointed and fillet welded. The welding shall be in accordance with BS: 5135. The mast section shall have one longitudinal seam weld and no circumferential weld as per section. The Mast shall be delivered in minimum sections as per design without any circumferential welding at site, which shall be joined together by slip-stressed-fit method. The jointing shall be with stressing equipment, thus forming the sleeve joint. No site welding or bolted joint shall be accepted. The overlap distance shall have full penetration of longitudinal welds. The overlap distance shall be 1.5 times the diameter at penetration. The base plate of the mast shall be at least 25mm thick. For metal protection of the Mast, the entire fabricated Mast shall be hot dip galvanized internally and externally, having minimum average thickness of 75 microns suitable for wind velocity of 50m/s as per IS 875 Part-3.
The mast sections shall be galvanized by single dipping method. Sections galvanized by double/ multiple dipping methods shall not be accepted. The Contractor may propose heavier sections also.

Foundation: -

The Contractor shall see the site closely and minutely with regard to the nature of the soil, average depth of decomposed garbage and debris at proposed site, mast location and the other site conditions before working out the type of foundation and specification for the proposed High Mast. The Contractor shall be responsible for the design of the foundation and safe installation of the High Mast in mechanically and structurally safe working condition for the design life of the Mast. The load bearing (safe) capacity of the soil shall be carried out by the Contractor to decide the type of foundation. The holding down GI bolts shall be 16 Nos. of high tensile strength (EN – 19 grades) and shall be supplied complete with GI anchor plate of 6 mm thick for casting into the foundation. The precision made steel template with tube holes shall be provided to ensure correct vertically and horizontally of bolt alignment. The casting shall be with M-25 grade RCC concrete with safe soil bearing cap at site as 10 T/m^2 at 3 meter depth. Foundation shall bear the wind pressure minimum 200 kg/m^2 and earthquake of Haryana region. Prior approval of foundation drawing shall be obtained from the Engineer.

Door Opening: -

An adequate door opening shall be provided at the base of the mast

	and the opening shall be such that it permits clear access to equipment's like winches, cables, plugs and sockets etc. and also facilitate easy removal of the winch. The door opening shall be complete with a close fitting, vandal resistant, weatherproof door, provided with a heavy-duty double internal lock with special paddle key. The door opening shall be carefully designed and reinforced with welded steel section; so that the mast section at the base shall be unaffected and undue buckling of the cut portion is prevented. Size of door opening shall be 1200mm x 250mm to avoid buckling of the mast section under heavy wind condition. **Dynamic Loading for Mast: -** The Mast structure shall be designed for an assumed maximum reaction arising from the maximum wind speed (50m/s) likely to be exceeded only once in 50 years (180 km per hour) and is measured at height of 10M above ground level. The design life of the Mast shall be 30 years. Wind excited oscillations shall be damped by the method of construction and adequate allowance is made for the related stresses. The offered High Mast shall be a tested design. **Fabrication: -** A fabricated lantern carriage shall be provided for installation and holding the flood light fittings and control gearboxes. The lantern carriage shall be of special design and shall be of steel tube construction, the tubes acting as conduits for wires, with holes fully protected by grommets. The lantern carriage shall be so designed and fabricated to hold the required number of flood light fittings and the control gearboxes also have a perfect self-balance. The lantern carriage shall be fabricated in two halves and joined by bolted flanges with stainless steel bolts and nylon type stainless steel nuts to enable easy installation or removal from the erected mast. The inner lining of the carriage shall be provided with protective PVC arrangement, so that no damage is caused to the surface of the mast during the raising and lowering operation of the carriage. The entire lantern carriage shall be hot dip galvanized after fabrication. **Raising And Lowering Mechanism: -** For the installation and maintenance of the luminaries and lamps, it shall be necessary to lower and raise the lantern carriage assembly. To enable this, a suitable winch arrangement shall be provided, with the winch fixed at the base of the mast and the specially designed head frame assembly at the top. **Winch: -** The winch shall be of completely self-sustaining type, without the need for brake shoe, springs or clutches. Each driving spindle of the winch shall be positively locked when not in use, by gravity activated pawls. Individual drum also should be operated for fine adjustment of lantern carriage. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be clearly marked on each winch.

The gear ratio of the winch shall be 53:1. However, the minimum working load shall be not less than 750 kg. The winch shall be self-lubricating type by means of an oil bath and the oil shall be readily available grades of reputed producers. The winch drums shall be grooved to ensure perfect seat for stable and tidy rope lay, with no chances of rope slippage. The rope termination in the winch shall be such that distortion or twisting is eliminated and at least 5 to 6 turns of rope remains on the drum even when the lantern carriage is fully lowered and rested on the rest pads.

It should be possible to operate the winch manually by a suitable handle and/or by an integral power tool. Operation of the winch with manual handle shall be independent of the power tool. Winches with manually operation through the power tools shaft shall not be accepted. Individual drum operation of the winch shall be possible. A Double drum winch shall have 2 drums and two worm gears independent in operation for increased safety. It shall be possible to remove the double drum after dismantling, through the door opening provided at the base of the mast. Also, a winch gearbox for simultaneous and reversible operation of the double drum winch shall be provided as part of the Contract.

The winch shall be type tested in presence of a reputed institution and the test certificates shall be furnished before supply of materials. A test certificates shall be furnished by the Contractor from the original equipment manufacturer, for each winch in support of the maximum load operated by the winch.

Head Frame: -

The head frame which is to be designed as a capping unit of the mast, shall be of welded steel construction, galvanized both internally and externally after assembly. The top pulley shall be of appropriate diameter, large enough to accommodate the stainless steel wire ropes and the multi-core electrical cable. The pulley block shall be made of non-corrodible material and shall be of die-cast Aluminium Alloy (LM-6). Pulley made of synthetic materials such as plastic or PVC is not acceptable. Self-lubricating bearings and stainless steel shaft shall be provided to facilitate smooth and maintenance free operation for a long period.

The pulley assembly shall be fully protected by a canopy galvanized internally and externally. Close fitting guides and sleeves shall be provided to ensure that the ropes and cables do not dislodge from their respective positions in the grooves. The head frame shall be provided with guides and stops with PVC buffer for docking the lantern carriage.

Stainless Steel Wire Ropes: -

The suspension system shall essentially be without any intermediate joint and shall consist of only non-corrodible stainless steel of

	minimum AISI 316 grade. The stainless steel wire ropes shall be of 7/19 (7 strands including 19 wires each), the central core of stainless steel material. The overall diameter of the rope shall not be less than 8mm. The breaking load of each rope shall not be less than 2350 kg giving a factor of safety of not less than 5 for the system at full load as per the TR-7. The end constructions of rope to the winch drum shall be fitted with talurit. The thimbles shall be secured on ropes by compression splices. Three continuous lengths of stainless steel wire ropes shall be used in the system and no intermediate joints are acceptable in view of the required safety. No intermediate joints/ terminations, either bolted or else, shall be provided on the wire ropes between winch and lantern carriage. **Power Tool for Winch: -** A suitable high powered, electrically driven, internally mounted power tool, with manual override shall be supplied for the raising and lowering of the lantern carriage for maintenance purposes. The speed for the power tool shall be to suit the system. The power tool shall be single speed. Provided with motor of the required rating. The power tool shall be supplied complete with a suitable control switch so that the operation of the mast can be done at a safe distance. The capacity and speed of the electric motor used in the power tool shall be suitable for the lifting of the design load installed on the lantern carriage. The power tool mounting shall be so designed that it shall be not only self-supporting but also aligns the power tool perfectly with respect to the winch spindle during the operations. Also, a handle for the manual operation of the winches in case of problems with the electrically operated tool, shall be provided and shall incorporate a torque limiting device. There shall be a separate torque-limiting device to protect the wire ropes from over stretching. It shall be mechanical with suitable load adjusting device. The torque limiter shall trip the load when it exceeds the adjusted limits. There shall be suitable provision for warning the operator once the load is tripped off. The torque limiter is a requirement as per the relevant standards in view of the overall safety of the system. Each mast shall have its own power tool motor. **Electrical System, Cable and Cable Connections: -** A suitable terminal box shall be provided as part of the contract at the base compartment of the high mast for terminating the incoming cable. The electrical connections from the bottom to the top shall be made by special trailing cable. The cable shall be EPR (Ethylene Propylene Rubber) insulated and PCP (Polychloroprene) sheathed to get flexibility and endurance. Size of the copper cable shall be minimum 5 core 2.5 Sqmm of reputed make. At the top there shall be weatherproof (GI or 7 tank powder coated) junction box to terminate the trailing cable. Connections from the top junction box to the individual luminaries shall be made by using 3 core 1.5 Sqmm flexible PVC copper cables of reputed make. The system shall have in-built facilities for testing the luminaries while in lowered position. Also, suitable provision shall be made at the base compartment of the mast

	to facilitate the operation of internally mounted, electrically operated power tool for raising and lowering of the lantern carriage assembly. The trailing cables of the lantern carriage rings shall be terminated by means of specially designed, metal clad, multi-pin plug and socket provided in the base compartment to enable easy disconnection when required. **Incoming Power Cable:** 4x2.5 Sqmm copper conductor armored cable for motor supply shall be provided from High mast control panel to the base compartment of the high mast. Cable shall be taken to the base compartment of the high mast through the provision made with 63mm dia HDPE pipe embedded in foundation. Power cable of suitable size up to the feeder pillar from supply point shall be laid by the Contractor. All copper cables required are included in the cost of the tender. **Lightning Arrestor:** One number heavy duty hot dip galvanized lighting spike rod shall be provided for each mast. The lightning spike rod shall be minimum 1.2 meter in length and shall be provided at the centre of the head frame. It shall be bolted solidly to the head frame to get a direct conducting path to the earth through the mast. **Aviation Obstruction Lights:** Aviation lighting arrangement shall be made on the top of high mast system and two nos. light fittings shall be fitted on each high mast complete with wiring. The fittings shall be of Bajaj reference BJAOL-I or similar Philips/ Crompton make. **Earthing Terminals:** Suitable earth terminal using 12 mm diameter stainless steel bolts shall be provided at a convenient location on the base of the mast for lightening and electrical earthing of the mast. **High Mast Control Panel:** Each mast shall be provided with a control panel fabricated out of 14 SWG CRCA sheet (GI or 7 tank powder coated). It is to be mounted on a raised plate from above ground level. Construction endures suitability for outdoor use. Basic components inside the control panel shall consist of the following: - • 1X63 A TPN MCB for incoming supply • 3X32 A SPN MCB for outgoing (50% lighting, 100% lighting, motor) • Automatic Astronomical Timer with contactor of suitable capacity for control of lighting. • 1 no. multi plug socket 16A for Auxiliary power supply. • 2 nos. of contactors for forward and reverse operation of winch motor.

Control Panel shall be connected with the help of a cable to the remote control switch for raising and lowering of the lantern carriage. The power feed cable should be flexible, sheathed copper type and shall be connected between the control panel and the junction box on the lantern carriage. The control panel shall be suitable for outside use weatherproof. The design and drawing of control panel shall be submitted by the Contractor for approval of the Engineer.

Technical Data for High Mast and Components:

A. High Mast Structures:

i) Height of Mast : 20 Meter
ii) Material of construction: High tensile steel as per BSEN 10025
iii) Thickness (in mm)

Section	Thickness
Top	3 mm
Bottom	3 mm(minimum)

iv) Cross section of mast : In polygon minimum 20 sides or as per design
v) No. of section of Masts : 2

vi) Base and top diameters : 150mm (minimum) at Top
410mm (minimum) at bottom
As per design of manufacture

vii) Type of joints : Telescopic stress fit (slip over joint system) with no circumferential weld

viii) Thickness of galvanization : Minimum 75 Microns as per BSEN ISO 1461

ix) Size of opening of door at base : 1200mm x 250mm

x) Length of overlap minimum : 1.5 times the diameter at penetration

B. Dynamic Loading:

i) Max. Wind speed : 50m/s
ii) Height forms the ground level : 10 Meter for measurement of wind Velocity
iii) Factor of safety for wind loads : More than 1.25
iv) Factor of safety for material : More than 1.15 (as per TR No.7)
v) Factor of safety of Tower : More than 1.5

C. Lantern Carriage:

i) Material of construction : G.I (Hot dip galvanized)
ii) Buffer arrangement between Carriage & mast. : PVC sleeves

	D. Winch: i) No. of winch per mast : One (Double drum) **E. Method Of Operation:** : MANUAL/ ELECTRICAL i) Lubrication : Self-lubricating permanent oil bath ii) Safe Working Load (SWL) of the winch : 750 Kg iii) Breaking system : In built iv) Gear ratio : 53:1 **F. Power Tool:** i) Power supply : 240 Volts, 50 C/S, AC supply ii) Speed of power tool : 1.2 meter/ min iii) Number of speeds : Single speed iv) Reversible/ non-reversible : Reversible v) Remote control switch a) Type : Push Button. b) Length of control cable : 5 Meter copper. **G. Foundation:** i) Type of foundation : Open raft shallow M-25 grade RCC type ii) Size of foundation : As per site conditions considered and as per design iii) Considered wind speed/ pressure : 200 Kg/ SqM iv) Design safety factor considered : 2.5 (minimum) **H. Stainless Steel Wire Rope:** i) Grade : AISI 316 or better Grade ii) Nos. of ropes : Not less than 2 continuous ropes iii) Construction : 7/19 iv) Center core material : Stainless steel wire. v) Breaking load capacity : 2350 Kg vi) Factor of safety : not less than 5 per rope as per TR-7 **I. Torque Limitor:** i) Lifting capacity : Up to 700 Kg ii) Adjustable/ Non- Adjustable : Adjustable **J. High Mast Enclosure:** Each mast shall be completely enclosed from all sides with GI panels of dimensions 1200mmx1200mm (with GI Wire Mesh 25mmx25mmx5mm) with 50x6 mm GI stiffners and wire mesh shall be enclosed in GI angles 50x50x6mm. The enclosure shall have proper entrance supported with 75x75x8 mm GI angles and 50x6 mm GI flats as required with locking arrangement etc. This enclosure shall be embedded in M-25 grade concrete work as per site requirement and approved by the Engineer.
4 ELECTRICAL EQUIPMENTS (PUMPS, AIR-CONDITIONERS, UPS, WATER COOLER ETC.)	
4.1	**Supply, Installation, Testing and Commissioning of Submersible Pump Set of 1.5 kW, 440V, 3-phase along with Automatic Control Panel:**

	Supply, Installation, Testing and Commissioning of submersible energy efficient pump set of 1.5 kW (3 star & above rated), Head Range: 15 Metre or above, 15000 LPH or above, 440 V, 3-phase, AC complete with all accessories as per site requirement. The material shall conform to IS-8034, IS-9283 or as applicable. Supply, installation, testing and commissioning of automatic control panel with DOL starter for 1.5 kW, three-phase submersible pump voltage 380 – 440 volt, 3-phase, AC, 50Hz, protection IP-52. The panel box shall be stainless steel or CRCA powder coated (7 tank processes) with minimum 2 mm thickness sheet. Suitable Water Level Controller (WLC) arrangement shall be provided between main reservoir and submersible pump. Necessary switchgear including protection, meters, selector switch, pushbuttons etc. as required for successful operation of submersible pump shall be provided. The design and drawing of the control panel and WLC shall be submitted by the Contractor and approval of Engineer shall be obtained. Earthing of panel shall be ensured by operating the relevant earthing item of the BOQ. Testing and commissioning shall be done after completion of all activities i.e. submersible pump-set, cables, control panel, Water Level Controller, pipes, all accessories etc., as required. Interface shall be made with Civil agencies who shall be making the bore hole and reservoir etc. The complete design arrangement along with drawings with pipe sizes and accessories compatible with discharge, shall be submitted to Engineer for approval.
4.2	**Supply, Installation, Testing and Commissioning of Submersible Pump Set of 3 kW, 440V, 3-phase along with Automatic Control Panel:** Supply, Installation, Testing and Commissioning of submersible energy efficient pump set of 3 kW (3 star & above rated), Head Range: 15 Metre or above, 15000 LPH or above, 440 V, 3-phase, AC complete with all accessories as per site requirement. The material shall conform to IS-8034, IS-9283 or as applicable. Supply, installation, testing and commissioning of automatic control panel with DOL starter for 3 kW three-phase submersible pump voltage 380 – 440 volt, 3-phase, AC, 50Hz, protection IP-52. The panel box shall be stainless steel or CRCA powder coated (7 tank processes) with minimum 2 mm thickness sheet. Suitable Water Level Controller (WLC) arrangement shall be provided between main reservoir and submersible pump. Necessary switchgear including protection, meters, selector switch, pushbuttons etc. as required for successful operation of submersible pump shall be provided. The design and drawing of the control panel and WLC shall be submitted by the Contractor and approval of Engineer shall be obtained. Earthing of panel shall be ensured by operating the relevant earthing item of the BOQ. Testing and commissioning shall be done after completion of all activities i.e. submersible pump-set, cables, control panel, Water Level Controller, pipes, all accessories etc, as required. Interface shall be made with Civil agencies who shall be making the bore hole and reservoir etc.

	The complete design arrangement along with drawings with pipe sizes and accessories compatible with discharge, shall be submitted to Engineer for approval.
4.3	**Supply of Submersible Pump Set of 7.5 kW, 440V, 3-phase:** Supply of submersible energy efficient pump set of 7.5 kW (3 star & above rated), 20 Stages, Head Range: 15 Metre or above, 15000 LPH or above, 440 V, 3-phase, AC complete with all accessories as per site requirement. The material shall conform to IS-8034, IS-9283 or as applicable.
4.4	**Supply, Installation, Testing and Commissioning of Automatic Control Panel for 7.5 kW, 440V, 3-Phase Submersible Pump:** Supply, installation, testing and commissioning of automatic control panel with star-delta starter for 7.5 kW three-phase submersible pump voltage 380 – 440 volt, 3-phase, AC, 50Hz, protection IP-52. The panel box shall be stainless steel or CRCA powder coated (7 tank processes) with minimum 2 mm thickness sheet. Suitable Water Level Controller (WLC) arrangement shall be provided between main reservoir and submersible pump. Necessary switchgear including protection, meters, selector switch, pushbuttons etc. as required for successful operation of submersible pump shall be provided. The design and drawing of the control panel and WLC shall be submitted by the Contractor and approval of Engineer shall be obtained. Earthing of panel shall be ensured by operating the relevant earthing item of the BOQ.
4.5	**Installation, Testing and Commissioning of Submersible Pump Set of 7.5 kW:** Installation, testing and commissioning of complete submersible pump set of 7.5 kW shall be done. Testing and commissioning shall be done after completion of all activities i.e. submersible pump-set, cables, control panel, Water Level Controller, pipes, all accessories etc, as required. Interface shall be made with Civil agencies who shall be making the bore hole and reservoir etc. The complete design arrangement along with drawings with pipe sizes and accessories compatible with discharge, shall be submitted to Engineer for approval.
4.6	**Supply, installation, testing and commissioning of Mono-Block Pump 1.5 kW, 240V, complete with all accessories and control panel:** Supply, installation, testing and commissioning of single stage Mono-block open well submersible pump set with control panel rating 1.5 kW with starter, Head range-26 meter and above, suction and delivery size shall be 50X40mm, Discharge (LPM):180 or above at 26-meter head, IP-55 protection, suitable for 240V, single phase, 50Hz, AC supply, complete with all accessories.
4.7	**Supply of Mono Block Pump 3.75 kW, 440V, 3-phase:**

	Supply of mono-block Horizontal/ sump pump, 3.75 kW, 20-25 meters Head, discharge 15000 LPH complete with all accessories with IP-55 protection, suitable for 440V, 3-phase, 50Hz, AC supply (IS-12699).
4.8	**Supply, Installation, Testing and Commissioning of Automatic Control Panel with DOL Starter for 3.75 kW, 440V, 3-Phase Pump:** Supply, installation, testing and commissioning of automatic control panel with with DOL starter for 3.75 kW mono-block pump, voltage 440V, 3-phase, AC, 50Hz, protection IP-52. The panel box shall be stainless steel or CRCA powder coated (7 tank process) with minimum 2 mm thickness sheet. Suitable Water Level Controller (WLC) arrangement shall be provided between main reservoir and overhead tank. Necessary switchgear including protection, meters, selector switch, push buttons etc. as required for successful operation of pump shall be provided. The design and drawing of the control panel and WLC shall be submitted by the Contractor and approval of Engineer shall be obtained. Earthing of panel shall be ensured by operating the relevant earthing item of the BOQ.
4.9	**Installation, Testing and Commissioning of 3.75 kW, 440V, 3-phase Mono Block Pump Set:** Installation, testing and commissioning of complete pump set of 3.75 kW, 440V, 3-phase, mono block pump complete with DOL starter shall be done. Testing and commissioning shall be done after completion of all activities i.e. pump-set, cables, control panel, Water Level Controller, pipes, all accessories etc, as required. Necessary masonry work (bricks and mortar), if required, shall be done by the Contractor. Interface shall be made with Civil agencies who shall be making the reservoir and overhead tank etc. The complete design arrangement along with drawings with pipe sizes and accessories compatible with discharge, shall be submitted to Engineer for approval.
4.10	**Supply, Installation, Testing and Commissioning of Mono Block Pump Set of 5.5 kW, 440V, 3-phase along with Automatic Control Panel with DOL starter:** Supply, Installation, Testing and Commissioning of mono-block Horizontal/ sump pump, 5.5 kW, 20-25 meters Head, discharge 15000 LPH complete with all accessories with IP-55 protection, suitable for 440V, 3-phase, 50Hz, AC supply (IS-12699). Supply, installation, testing and commissioning of automatic control panel with with DOL starter for 5.5 kW mono-block pump, voltage 440V, 3-phase, AC, 50 Hz, protection IP-52. The panel box shall be stainless steel or CRCA powder coated (7 tank process) with minimum 2 mm thickness sheet. Suitable Water Level Controller (WLC) arrangement shall be provided between main reservoir and overhead tank. Necessary switchgear including protection, meters, selector

	switch, push buttons etc. as required for successful operation of pump shall be provided. The design and drawing of the control panel and WLC shall be submitted by the Contractor and approval of Engineer shall be obtained. Earthing of panel shall be ensured by operating the relevant earthing item of the BOQ. Testing and commissioning shall be done after completion of all activities i.e. pump-set, cables, control panel, Water Level Controller, pipes, all accessories etc, as required. Necessary masonry work (bricks and mortar), if required, shall be done by the Contractor. Interface shall be made with Civil agencies who shall be making the reservoir and overhead tank etc. The complete design arrangement along with drawings with pipe sizes and accessories compatible with discharge, shall be submitted to Engineer for approval.
4.11	**Supply, Installation, Testing and Commissioning of 3 Core, 10 Sqmm Copper Flat Cable:** Supply, Installation, Testing and Commissioning of flat submersible copper cable, 3C x 10 sqmm for pump set ISI mark as per IS 694 Part-I latest**.** Connections on pumpset side and control panel side shall be made.
4.12	**Supply and Installation of G.I. Pipe 40 mm nominal bore Medium Class with bends, fitting bends, sockets, flanges, delivery valve, non-return valve etc. as required:** Supply and installation of GI pipe B class 40 mm nominal bore as per IS-1239: Part-1 or latest including all accessories as per required. This will include supply and installation of G.I. pipe fittings, bends, sockets, flanges, delivery valve and non-return valve, supporting clamps, nuts, bolts, washers and supporting system etc. as required conforming to IS-1239: Part-2, IS-5312, IS-6392, IS-5290, IS-13095, IS-14846 etc. as applicable.
4.13	**Supply and Installation of G.I. Pipe 50 mm nominal bore Medium Class with bends, fitting bends, sockets, flanges, delivery valve, non-return valve etc. as required:** Supply and installation of GI pipe B class 50 mm nominal bore as per IS-1239: Part-1 or latest including all accessories as per required. This will include supply and installation of G.I. pipe fittings, bends, sockets, flanges, delivery valve and non-return valve, supporting clamps, nuts, bolts, washers and supporting system etc. as required conforming to IS-1239: Part-2, IS-5312, IS-6392, IS-5290, IS-13095, IS-14846 etc. as applicable.
4.14	**Supply and Installation of G.I. Pipe 65 mm nominal bore Medium Class with bends, fitting bends, sockets, flanges, delivery valve, non-return valve etc. as required:**

	Supply and installation of GI pipe B class 65 mm nominal bore as per IS-1239: Part-1 or latest including all accessories as per required. This will include supply and installation of G.I. pipe fittings, bends, sockets, flanges, delivery valve and non-return valve, supporting clamps, nuts, bolts, washers and supporting system etc.as required conforming to IS-1239: Part-2, IS-5312, IS-6392, IS-5290, IS-13095, IS-14846 etc. as applicable.
4.15	**Supply and Installation of G.I. Pipe 80 mm nominal bore Medium Class with bends, fitting bends, sockets, flanges, delivery valve, non-return valve etc. as required:** Supply and installation of GI pipe B class 80 mm nominal bore as per IS-1239: Part-1 or latest including all accessories as per required. This will include supply and installation of G.I. pipe fittings, bends, sockets, flanges, delivery valve and non-return valve, supporting clamps, nuts, bolts, washers and supporting system etc. as required conforming to IS-1239: Part-2, IS-5312, IS-6392, IS-5290, IS-13095, IS-14846 etc. as applicable.
4.16	**Supply and Installation of G.I. Pipe 100 mm nominal bore Medium Class with bends, fitting bends, sockets, flanges, delivery valve, non-return valve etc. as required:** Supply and installation of GI pipe B class 100 mm nominal bore as per IS-1239: Part-1 or latest including all accessories as per required. This will include supply and installation of G.I. pipe fittings, bends, sockets, flanges, delivery valve and non-return valve, supporting clamps, nuts, bolts, washers and supporting system etc. as required conforming to IS-1239: Part-2, IS-5312, IS-6392, IS-5290, IS-13095, IS-14846 etc. as applicable.
4.17	**Supply, Installation, Testing and Commissioning of 32A, 240V, DP MCB with enclosure:** Supply, installation, testing and commissioning of Double Pole MCB of 32A, 240V, 10 kA, C series with 2mm thick metal enclosure powder coated (7 tank process) as per the site requirement. The material shall conform to IS-2147, IS-8623, IS/IEC-60898 Part-1 etc as applicable.
4.18	**Supply, Installation, Testing and Commissioning of 2 KVA, 240 Volt, AC, Pure Sine Wave Online UPS cum Inverter:** Supply, installation, testing and commissioning of 2 kVA pure sine wave, online UPS cum inverter. The input supply shall be 240 Volt (range 170 volt to 265 volt), AC, and inverter full load output voltage shall be 230(+/-10%) volt. The unit shall consist of intelligent battery charging mechanism with adaptive battery charging with 180 AH tubular battery of voltage 12 volt (2 Nos. batteries) suitable for heavy duty application with minimum two hours capacity. All features i.e. meters, switches, overload and underload indications, input/output indications, charging current, battery voltage etc. shall be provided. The material shall conform to relevant IS specifications.

4.19	**Supply, Installation, Testing and Commissioning of Water Cooler (150 Litre):** Supply, installation, testing and commissioning of self-contained drinking water cooler 150 litre capacity (cooling capacity 150 litres per hour) [conforming to IS-1475 (part-1)], ISI marked, minimum 3-star rated, suitable for operation on 240 volt (+/- 10%), 50Hz, AC supply system. The unit shall be complete with all connected standard fittings, accessories etc. and 5 KVA, wall mounted, I.C. controlled electronic auto-voltage corrector conforming to relevant IS (latest version), suitable for operation on single phase 190 to 280 volts, 50Hz incoming AC supply and output 200 to 240 volts A.C. supply. All the indicating instruments, switches etc complete with time delay relay (for initial start), voltmeter, instant start provision with push button switch etc. shall be provided. Necessary arrangement for provision of earthing of the unit shall be provided. Necessary platform of M-25 grade concrete or GI angle frame of 75x75x6mm size shall be provided as decided by the Engineer. Necessary drainage system to drain out excess water with drain pipe shall be provided as per site requirement.
4.20	**Supply, Installation, Testing and Commissioning of 5 star rated storage geyser 25 litre capacity:** Supply, installation, testing and commissioning of 5-star rated storage geyser 25 litre capacity suitable for 240V, single-phase AC supply. All the required GI nuts, bolts, fasteners, petty hardware, connecting pipe assemblies, supply ON, Supply OFF indications etc shall be provided. Geyser shall be ISI/ BIS marked with 5-star rating. All safety provisions against earth fault, bursting, overload trip etc shall be provided. Necessary hole in wall, concrete etc as required shall be made for installation of geyser and its accessories and the surface shall be restored to original finish after installation.
4.21	**Supply, Installation, Testing and Commissioning of Heavy Duty 5 Star, 1.5 Ton Split Inverter Type Air Conditioner, 240V:** Supply, installation, testing and commissioning of 1.5 Ton heavy duty, 5-star inverter type Split air conditioner, with remote control, suitable for 240V, single-phase, 50Hz, AC supply along with 4kVA voltage stabilizer (input range 190V to 280V and output range 200V to 240V) IC controlled with initial time delay. Suitable size GI nuts, bolts, fasteners, copper pipe with insulation, drain pipe & petty hardware shall be provided to complete the work in all respect along with the required refrigerant & maintain the pressure with Eco-friendly refrigerant. Necessary hole in wall, concrete etc as required shall be made for pipe laying and the surface shall be restored to original finish. All fixtures etc. for installation of indoor unit and outdoor unit shall be provided. The outdoor unit shall rest on floor or wall or roof as per site requirement and heavy duty GI support fixtures shall be provided as required. The 3 core copper cable of suitable size from power point to indoor and outdoor unit shall be provided by the Contractor. The material shall conform to IS-694, IS-996, IS-10617, IS-10773, IS-11338 etc as applicable.
4.22	**Supply, Installation, Testing and Commissioning of Heavy Duty 5**

	Star, 2 Ton Split Inverter Type Air Conditioner, 240V: Supply, installation, testing and commissioning of 2 Ton heavy duty, 5-star inverter type Split air conditioner, with remote control, suitable for 240V, single-phase, 50Hz, AC supply along with 5kVA voltage stabilizer (input range 190V to 280V and output 200V to 240V) IC controlled with initial time delay. Suitable size GI nuts, bolts, fasteners, copper pipe with insulation, drain pipe & petty hardware shall be provided to complete the work in all respect along with the required refrigerant & maintain the pressure with Eco-friendly refrigerant. Necessary hole in wall, concrete etc as required shall be made for pipe laying and the surface shall be restored to original finish. All fixtures etc for installation of indoor unit and outdoor unit shall be provided. The outdoor unit shall rest on floor or wall or roof as per site requirement and heavy duty G.I support fixtures shall be provided as required. The 3 core copper cable of suitable size from power point to indoor and outdoor unit shall be provided by the Contractor. The material shall conform to IS-694, IS-996, IS-10617, IS-10773, IS-11338 etc as applicable. In ALH and stations, two nos. of 2 Ton air-conditioners shall be provided each in signal equipment room and telecom equipment room. The air-conditioners of signal equipment room and telecom equipment room shall be provided with automatic switchover switches/contactor/timers etc so that each air-conditioner in the room work for 12 hours each or as programmed by the Engineer. In case of failure on one Air-conditioner of the room, the healthy air-conditioner shall work for 24 hours of the day. The cost of this provision is included in this item price. The design of this arrangement shall be submitted to Engineer for approval by the Contractor.
5. SUBSTATION 11kV/ 0.44 KV, HT PANEL, LT PANEL, APFC PANEL, GENSET AND EARTHING	
5.1	**Supply, Installation, Testing and Commissioning of 11kV/ 0.44kV, 1x250 kVA, Compact Substation (CSS):** Supply, installation, testing and commissioning of Compact Sub-Station (CSS) (11/0.440 kV) consisting of 11 kV, 630A Load break switch, 11kV Compact VCB panel, 11 kV off load break switch, 1 outgoing 440V 3-phase ACB with air insulated BUS PT metering module and DRY type Transformer (250 kVA) Capacity, Current transformer, relay and LT Switchgear with all HT & LT inter-connections, accessories, fittings & auxiliary equipment inside GI enclosure. CSS shall include (1) 11 kV, 630 Amp load break switch; (2) 11 KV VCB , 630 Amp; (3) 11 kV, 630 Amp off load break switch; (4) Dry type 250 kVA transformer; (5) CT/ PT for Metering system and relay; (6) LT panel; (7) all HT and LT cable with proper termination arrangement of suitable size and length; (8) suitable connection to H-pole arrangement with GO/ DO (gang operated/ drop out) switch (as required). The HT connection from metering panel output to Load break switch of CSS shall be made. Provision of earthing as per requirement. Supply and installation of all safety items required for 11/0.44 kV substation as per rules. Payment of earthing shall be made under the designated items of earthing. Schematic Diagram of substation and

	Transformer Data computer printed and suitably laminated, shall be provided. The material shall conform to detailed specification (Appendix-5) and drawings mentioned in the tender document. Necessary cable trench or hole in wall wherever required for the CSS, HT/LT Panels, APFC Panel, Genset, HT/LT metering system etc. for HT/LT cables shall be provided. Chequered plates of G.I. 8 mm thick, with hook arrangement for lifting, with installation support arrangement of G.I. channel, G.I. angles etc. as required shall be provided. Necessary interface with Civil Contractor shall be made for trenching system and hole in wall. The Contractor shall submit detailed design of CSS for approval of the Engineer. The payment of 11 kV cable, cable laying and terminations shall be made under designated items in BOQ.
5.2	**Supply, Installation, Testing and Commissioning of Automatic Power Factor Correction (APFC) Panel with 150 kVAR shunt capacitors complete in all respect:** Supply, Installation, Testing and Commissioning of Automatic Power Factor Correction (APFC) Panel with 150 kVAR, 440 V (+/- 10%), 3-phase, 50 Hz shunt capacitors complete in all respects. The APFC panel shall be fabricated out of 2 mm thick CRCA sheets modular 7 tank process powder coated, compartmentalized, free standing, floor mounting, front hinged doors for indoor use, removable bottom gland plates for incoming cables, dust and vermin proof (IP:42 protection) with 3-phase copper busbars, complete with busbar connection, internal wiring, name plates, painting (shade grey RAL 7032) etc. The APFC panel shall consist of 4x25 kVAR + 1x50 kVAR configuration of capacitors with suitable stages microprocessor based APFC relay. Capacitor shall be rated for 500 V, AC, incoming supply controlled by MCCB with fuses for backup protection. APFC shall have over voltage and over current protection. Automatic power factor control shall be intelligent microprocessor based of L&T/ ABB/ Schneider/ Siemens make. Capacitors shall be heavy duty type suitable for continuous operation of make L&T/ Neptune/ ABB/ Schneider. APFC panel shall have ventilation exhaust fan of suitable size. All nuts, bolts, washers and mounting channel shall be stainless steel or GI. Necessary arrangement of earthing shall be made (earthing payment shall be made under the designated item of earthing). APFC panel shall be connected with main LT panel and shall become operative when power factor goes below 0.98 lagging and shall not operate on leading power factor. Power factor shall always be between 0.98 lagging to unity. The capacitors shall conform to IS:13340, IS-13341, IS-13925 (part-1 & part-2) and other applicable standards. Complete design shall be submitted to Engineer for approval.
5.3	**Supply, Installation, Testing and Commissioning of Indoor Type Main LT Panel with incomer 2x800A ACB and outgoings 2x400A MCCB, 2x250A MCCB & 14x200A MCCB:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per 7 tank process having indoor type, 440 V, AC, 3-phase, LT panel, having IP42 protection, floor mounted, front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin

	proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 800A, 4 pole, ACBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ices=100%Icu). (2) outgoing 2x400A, 2x250A, and 14x200A, 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The MCCBs shall be arranged in multi-tier formation and care shall be taken for providing space to terminate specified number of cables. Checking and removal of components shall be possible without disturbing adjacent equipment. The panel shall be provided with over voltage protection with suitable relay. The copper bus bars shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 1000A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. APFC panel shall be connected to this LT panel. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution boards of anodised aluminium or stainless steel plate in English and Hindi shall be provided. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel for earthing of panel. The payment of earthing shall be made under the designated earthing items. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant Indian Standards, Indian Electricity Rules & Regulations and IEC specifications.
5.4	**Supply, Installation, Testing and Commissioning of Indoor Type LT Distribution Panel with incomer 2x160A MCCB and outgoings 9x63A MCCB:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per 7 tank process having indoor type 440 V, AC, 3-phase, LT panel having suitable IP42 protection, floor mounted front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by

	minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 160A, 4 pole, MCCBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ices=100%Icu). (2) outgoing 9x63A, 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The panel shall be provided with over voltage protection with suitable relay. The copper bus bar shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 240A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution board of anodised aluminium or stainless steel plate in English and Hindi shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel for earthing of panel. The payment of earthing shall be made under the designated earthing items. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant specifications.
5.5	**Supply, Installation, Testing and Commissioning of Indoor Type LT Distribution Panel with incomer 2x160A MCCB and outgoings 6x63A MCCB:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per 7 tank process having indoor type 440 V, AC, 3-phase, LT panel having suitable IP42 protection, floor mounted front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 160A, 4 pole, MCCBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ices=100%Icu). (2) outgoing 6x63A, 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The panel shall be provided with over voltage protection with suitable relay. The copper bus bar shall be insulated by heat shrinkable sleeves. The copper busbar current carrying

	capacity shall be minimum 240A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution board of anodised aluminium or stainless steel plate in English and Hindi shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel for earthing of panel. The payment of earthing shall be made under the designated earthing items. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant specifications.
5.6	**Supply, Installation, Testing and Commissioning of Indoor Type Main LT Panel with Incomer 2x800A ACB and outgoings 1x400A, 2x250A, 4x125A, 4x100A and 6x63A MCCBs:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per 7 tank process having indoor type, 440 V, AC, 3-phase, LT panel, having IP42 protection, floor mounted, front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 800A, 4 pole, ACBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ics=100%Icu); (2) outgoing 1x400A, 2x250A, 4x125A, 4x100A and 6x63A, 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The MCCBs shall be arranged in multi-tier formation and care shall be taken for providing space to terminate specified number of cables. Checking and removal of components shall be possible without disturbing adjacent equipment. The panel shall be provided with over voltage protection with suitable relay. The copper bus bars shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 1000A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. APFC panel shall be connected

	to this LT panel. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution boards of anodised aluminium or stainless steel plate in English and Hindi shall be provided. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel for earthing of panel. The payment of earthing shall be made under the designated earthing items. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant Indian Standards, Indian Electricity Rules & Regulations and IEC specifications.
5.7	**Supply, Installation, Testing and Commissioning of Indoor Type Essential LT Panel with Incomer 2x800A ACB and outgoings 1x400A, 2x250A, 4x125A, 3x100A and 2x63A MCCBs:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per 7 tank process having indoor type, 440 V, AC, 3-phase, LT panel, having IP42 protection, floor mounted, front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 800A, 4 pole, ACBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ics=100%Icu); (2) outgoing 1x400A, 2x250A, 4x125A, 3x100A and 2x63A, 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The MCCBs shall be arranged in multi-tier formation and care shall be taken for providing space to terminate specified number of cables. Checking and removal of components shall be possible without disturbing adjacent equipment. The panel shall be provided with over voltage protection with suitable relay. The copper bus bars shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 1000A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. APFC panel shall be connected to this LT panel. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before

	fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution boards of anodised aluminium or stainless steel plate in English and Hindi shall be provided. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel for earthing of panel. The payment of earthing shall be made under the designated earthing items. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant Indian Standards, Indian Electricity Rules & Regulations and IEC specifications.
5.8	**Supply, installation, testing and commissioning of VRV LT Panel distribution board consisting of (1) incoming 2x400A, 4 pole MCCB, (2) outgoing 20x63A, 4 poles, MCCB's complete with all accessories as required:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per standard 7 tank process having outdoor type VRV LT panel distribution board, having suitable IP54 protection, floor mounted front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) 2 nos. incoming 400A, 4 pole, MCCBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ices=100%Icu). (2) outgoing 20x63A with 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The panel shall be provided with over voltage protection with suitable relay. The copper bus bar shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 600A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution board of anodised aluminium or stainless steel plate in English/ Hindi shall be provided.

	The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel. The material shall conform to IS/IEC-60947 part-2; IS/IEC-60898 Part-1 and other relevant specifications.
5.9	**Supply, installation, testing and commissioning of Lift Panel consisting of (1) incoming 1x100A, 4 pole MCCB, (2) outgoing 3x63A, 4 poles, MCCB's complete with all accessories as required:** Supply, installation, testing and commissioning of minimum 2 mm CRCA sheet steel fabricated, cubicle, powder coated as per standard 7 tank process having outdoor type Lift panel distribution board, having suitable IP54 protection, floor mounted front operated, mounted on GI base channel of suitable size, with top/ bottom removable cable gland plate as required, earth bus, hinged and lockable doors, dust and vermin proof, complete with all inter connections, small wiring by minimum 2.5 sq. mm copper FRLS cables. The panel shall consist of (1) incoming 1x100A, 4 pole, MCCBs with microprocessor release having integral overload, short circuit, earth fault and neutral protection and breaking capacity 60 KA (Ices=100%Icu). (2) outgoing 3x63A with 4 poles, MCCBs with adjustable overload and adjustable short trip unit and breaking capacity 36KA (Ics=100%Icu). The panel shall be provided with over voltage protection with suitable relay. The copper bus bar shall be insulated by heat shrinkable sleeves. The copper busbar current carrying capacity shall be minimum 150A. The copper earth bus shall also be provided for suitable length and capacity for earthing purpose. The instrument shall be of flush type ammeter, voltmeter, and selector switches with CTs, feeder name and danger board. Schematic Diagram of LT Panel, computer printed and suitably laminated shall be provided. General arrangement and wiring diagram along with panel dimensions shall be supplied by the Contractor for approval of Engineer before fabrication of panel. Special tools shall be supplied with the panel. Danger notice plate shall be placed on the front. All metal structures shall be 7 tank process powder coated. The final finishing shall be smooth and attractive. Caution board of anodised aluminium or stainless steel plate in English/ Hindi shall be provided. The foundation of panel and trenching (with M-25 concrete) with GI/ CC/ Stone cover work shall be provided. Circuit identification by means of engraved on poly propylene sheet as per design approved by Engineer shall be provided. The panel shall be fixed on GI Channel of 100x50x6mm size with lifting hooks also. The earthing arrangement terminals (2 nos.) shall be made in the panel. The material shall conform to IS/IEC-60947 part-2 ; IS/IEC-60898 Part-1 and other

	relevant specifications.
5.10	**Supply and Installation of 3 mm Thick Rubber Mat:** Supply and Installation of (ISI marked) Rubber mat with thickness 3 mm in required length and breadth size suitable for 11kV as per IS: 15652 (2006).
5.11	**Supply, Installation, Testing and Commissioning of 200 kVA Capacity, 440 volt, 3-phase, Radiator Cooled Silent Genset:** Supply, installation, testing and commissioning of silent 1x200 kVA Generator set (Genset) (emission CPCB 4-plus norm), (440 volt, 3-phase, AC, 50 Hz, at unity power factor) suitable for emergency operation at full load with acoustic enclosure, AMF panel and all other accessories, construction of plinth with materials as per OEM recommendations and approved drawings. The detailed specification is given in Appendix-6 of the tender document.
5.12	**Supply, Installation, Testing and Commissioning of Feeder Pillar:** Supply, installation, testing and commissioning of feeder pillar minimum size 900x600x300 mm fabricated from 2 mm thick CRCA sheet powder coated with 7 tank process suitable for outdoor installation with IP-54 protection, powder coated complete enclosed type dust and vermin proof, with gland plate in bottom as required. The connecting incoming and outgoing cables with copper lugs and brass glands, with (i) incoming 440V, 3-phase one no., 100 amp, 4 pole MCB, breaking capacity 35 kA and (ii) outgoing 440V, 3-phase, 4 nos. 40A, 4 pole, breaking capacity 25 kA, MCB, (iii) outgoing 6 nos., 240V, 40A, 10 kA double pole MCB (iv) copper busbar 200 A in bus bar chamber (v) indication lights, complete with locking arrangement with GI angle stand 600 mm height angle size 50x50x6 mm grouted in M-25 grade concrete up to depth of 150mm. Schematic Diagram of feeder pillar supplies and cabling shall be submitted to Engineer for approval.
5.13	**Supply, Installation, Testing and Commissioning of Earth Electrode (4 meter long, 19 mm dia, copper cladded steel electrode with minimum 250 micron copper cladding) complete with RCC chamber etc.:** Supply, installation, testing and commissioning of the earthing system and earthing shall be done with 4 meter long, 19 mm dia, copper cladded steel electrode with minimum 250 micron copper cladding. RCC chamber with cover (M-25 grade concrete) along with 50 kg earth enhancing compound as per drawing shall be provided as per Employer's Requirements. Each earth electrode shall be connected with 40x6 mm GI flat with GI nuts, bolts, spring washer etc. The earth resistance shall be mentioned as per specification. The cost of 40x6mm GI flat shall be paid under the designated item.
5.14	**Supply, Installation, Testing and Commissioning of Earth Electrode (4 meter long, 19 mm dia, copper cladded steel**

	electrode with minimum 250 micron copper cladding) buried in ground complete: Supply, installation, testing and commissioning of earth system with 4 metre long, 19 mm dia copper cladded earth electrode with minimum 250 micron copper cladding, buried 500 mm below the earth with connections complete as required. The connections shall be made with 40x6 mm GI flat with GI nuts, bolts, spring washer etc. The earth resistance shall be mentioned as per specification or as approved by the Engineer. The earth system buried in earth shall be provided anti corrosion treatment. The cost of 40x6mm GI flat shall be paid under the designated item.
5.15	**Supply and Installation of 40x5 mm Copper Strip on Surface or in Recess or in GI Pipe**: Supply and installation of all materials including cost of copper strip of size 40x5 mm on surface or recess or digging in ground or making chase in wall/floor or in GI pipe and making good the damages, connections including soldering/ riveting etc. as required. This includes nuts, bolts, washers, etc as required.
5.16	**Supply and Installation of 40x6 mm GI Flat:** Supply and laying 40mm x 6mm G.I strip for earth connection on the ground, below the ground, on wall or recess etc as applicable as per site including bending, cutting, welding, drilling holes, nuts, bolts, washers etc. The GI strip shall be in compliance to IS-1730 for mild steel strips /flats and IS 4826 for hot-dip galvanization coating on steel strip/flat.
5.17	**Supply and Installation of 5 mm Dia GI Wire:** Supply and installation of 5 mm dia GI Wire on surface or in recess for earthing as required. The GI wire shall be in compliance to IS 280 for mild steel wire and IS 4826 for hot-dip galvanization coating on round steel wire. This shall include bending, cutting, nuts, bolts, washers etc as required.
5.18	**Supply and Installation of lightning conductor finials (air conductor) of 25 mm dia 1000 mm long GI pipe having a single copper prong and welding on base:** Supply and installation of lightning conductor finials (air conductor) made of 25 mm dia 1000 mm long GI pipe having a single copper prong at the top and welding on base with GI base plate of 100 mm dia, 6 mm thick, fixing accessories and clamping with down conductor as per specifications complete, along with GI or stainless steel nuts, bolts, washers etc. as required. Copper prong shall be properly fitted with the GI pipe.
5.19	Supply, installation, testing and commissioning of air craft warning lights complete with non flickering type lights similar to GEC model ZH 752 or WIPRO model no. WAN 20001 or equivalent including lamps, mounting bracket, earthing, painting complete with accessories to automatically switch off lights.

6 FIRE DETECTION & ALARM SYSTEM AND FIRE FIGHTING (APPENDIX-3)	
6.1	**Supply and Installation of Safety Items for IMD Manesar:** Supply and installation of First Aid Box with medicine (ISI mark) and associated materials, Shock Treatment Chart on Aluminium frame, hand gloves etc as under: (a) First Aid Box (ISI mark) complete with medicines – 2 set (b) Electric Shock Treatment Chart (large size) with Aluminium frame and laminated (in Hindi and English) as approved – 4 nos. of each (c) Supply of hand gloves (tested for 11 kV AC) – 2 set
6.2	**Supply and Installation of Safety Items for Manesar Station:** Supply and installation of First Aid Box with medicine (ISI mark) and associated materials, Shock Treatment Chart on Aluminium frame, hand gloves etc as under: (a) First Aid Box (ISI mark) complete with medicines – 2 set (b) Electric Shock Treatment Chart (large size) with Aluminium frame and laminated (in Hindi and English) as approved – 3 nos. of each (c) Supply of hand gloves (tested for 11 kV AC) – 1 set
6.3	**Supply and installation of Set of 04 nos. fire buckets (10 litre) capacity with one GI stand and GI cover:** Supply and installation of set of (1) 04 nos. stainless steel fire buckets (10 litre) capacity as per IS 2546; (2) one G.I stand and (3) GI cover of thickness minimum 2mm supported with suitable GI angles (50x50x6 mm) at suitable location and design as approved by Engineer. The frame shall be painted with two coats of post office red paint.
6.4	**Supply, installation, testing and commissioning of microprocessor based 4 loop Fire Alarm Control Panel:** Supply, installation, testing and commissioning of microprocessor based 4 loop Fire Alarm Control Panel, complete as required and as per specification.
6.5	**Supply, installation, testing and commissioning of Repeater Panel:** Supply, installation, testing and commissioning of Repeater Panel complete as required and as per specification.
6.6	**Supply, installation, testing and commissioning of analogue addressable microprocessor based photo thermal multi criteria smoke cum heat detector:** Supply, installation, testing and commissioning of analogue addressable microprocessor based photo thermal multi criteria smoke cum heat detector with mounting based LED, complete as required and as per specification.
6.7	**Supply, installation, testing and commissioning of Multi Co-operative Sensing Analogue Addressable Rate of Rise Cum Fixed temperature, heat detector:**

	Supply, installation, testing and commissioning of Multi Co-operative Sensing Analog Addressable Rate of Rise Cum Fixed temperature, heat detector complete as required and as per specification.
6.8	**Supply, Installation, testing and commissioning of addressable Manual Glass Break station:** Supply, Installation, testing and commissioning of addressable Manual Glass Break station complete as required and as per specification.
6.9	**Supply, installation, testing and commissioning of Conventional Sounder cum strobe:** Supply, installation, testing and commissioning of Conventional Sounder cum strobe complete as required and as per specification.
6.10	**Supply, Installation, testing and commissioning of Addressable Control modules for Hooters/ Sounders/ Strobes:** Supply, Installation, testing and commissioning of Addressable Control modules for Hooters/ Sounders/ Strobes complete as required and as per specification.
6.11	**Supply, installation, testing and commissioning of addressable type Fault isolator:** Supply, installation, testing and commissioning of addressable type Fault isolator for isolating shorted, dewired and loose circuits between two successive fault isolators complete as required and as per specification.
6.12	**Supply, installation, testing and commissioning of Response Indicators:** Supply, installation, testing and commissioning of Response Indicators complete as required and as per specification.
6.13	**Supply and installation on surface/ conduit 2x1.5 sq.mm 1.1 kV grade FRLS insulated PVC sheathed copper conductor armoured cable:** Supply and laying on surface/ conduit 2x1.5 sq.mm 1100V grade, FRLS insulated, PVC sheathed, copper conductor armoured cable including termination, connections and all labour and material etc. complete as required and as per specification. Wherever required, the flexible metallic conduits shall be provided to complete the circuit and payment of flexible conduit shall be done as per conduit item.
6.14	**Supply, installation, testing and commissioning of single pair PVC insulated twisted 32/ 0.2 mm dia copper conductor 1.1 kV cable:** Supply, installation, testing and commissioning of single pair PVC insulated twisted 32/ 0.2 mm dia copper conductor cable in existing conduit for hooter complete as required.
7 FIRE FIGHTING AND FIRE SUPPRESSION SYSTEM (APPENDIX-2)	
7.1	**Supply, Installation, Testing and Commissioning of Main Fire Pump (2850 LPM at 90 m head):** Supply, Installation, Testing and Commissioning of electric driven main fire pump suitable for automatic operation and complete in all respect as required, as per specification (Appendix-2). Horizontal type, multistage, centrifugal, split casing

	pump of cast iron body & SS impeller with stainless steel shaft, mechanical seal to ensure a minimum pressure of 3.5 kg/sqcm at highest and farthest outlet at specified flow of 2850 LPM at 90m head conforming to IS 1520. The pump shall have suitable HP, squirrel cage induction motor, totally enclosed fan cooled (TEFC), synchronous speed 1500 RPM, suitable for operation on 440 volts, 3 phase 50 Hz. AC with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' winding insulation, conforming to IS-325. The pump and motor shell be on GI fabricated Common base plate, coupling, coupling guard, GI foundation bolts etc. as required. Suitable cement concrete foundation in M-25 cement concrete - 300mm high and 150mm projection on all side of base plate, 12mm thick cement plaster in cement mortar 1:4 finished with a floating coat of neat cement duly plastered with anti-vibration pads. The pump shall be complete in all with all cabling system. Complete design and drawing shall be submitted by the Contractor to Engineer for approval.
7.2	**Supply, Installation, Testing and Commissioning of Diesel Fire Pump (2850 LPM at outlet head of 90 m):** Supply, installation, testing and commissioning of Diesel Engine driven fire pump suitable for automatic operation comprising of the following and conforming to BS 649 or IS 10002 (latest), Horizontal, end section/ split casing, high pressure single / multistage centrifugal pump. The installation shall be complete with flexible coupling and coupling guard as required. Fire pump shall have CI casing, CS diffusers, bronze impeller (hard finished and dynamically balanced) and SS (304) shaft with mechanical seal, gland packing seal, capable for delivering 2850 LPM at outlet head of 90 m to ensure a minimum pressure of 3.5 kg/Sqcm at the farthest or topmost hydrant. The installation shall be complete with necessary pressure gauge with gun metal shut off cock on delivery side (The pump should be tested for bench mark duty point test at factory and shall be got approved by the Local Fire Authority). Pump shall be capable of furnishing not less than 150% of rate discharge capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 140% of rated head. Heat exchanger/Radiator cooled (secondary cooling) diesel engine of speed 1500 RPM suitable for the above pump with automatic starting mechanism and other accessories. The fuel shall be gravity fed from fuel storage tank (fabricated from 3 mm GI sheet, painted with two coats of synthetic enamel paint) mounted on GI brackets, of capacity adequate to sustain pump operation for 8 hours continuous working. The fuel filter shall be suitably located for to permit easy service. All fuel piping in the engine shall be of copper and fuel piping from day tank to engine shall be with reinforced flexible hose connection. The tank shall be fitted and magnetic oil level indicator, drain valve, air vent including structure supports (painted with approved shade). There shall be 2 nos. x 12 volt battery (180AH) along with battery charger. The heat exchanger with necessary piping connections & fittings, flexible coupling, coupling guard & exhaust pipe connection complete as required shall be provided. Common base plate shall be from GI channel of required size. Cement concrete M-25 grade foundation with 1:4 plaster. Engine shall have lube oil pressure gauge, lube oil temperature gauge, water temperature gauge, tachometer, hour meter etc. Engine shall have protection and automatic shut down facility for low lube oil pressure, high water temperature, high lube oil temperature and over speeding. Complete design and drawing shall be submitted by the Contractor to Engineer for approval.
7.3	**Supply, Installation, Testing and Commissioning of Jockey Pump (180 LPM at 90 m head):** Supply, Installation, Testing and Commissioning of electric driven pressurization Jockey pump suitable for automatic operation and complete in all respect as required. Vertical type, multistage, centrifugal pump of Cast iron body and SS impeller with stainless steel shaft, mechanical seal and flow of 180 LPM at 90m head conforming to IS: 1520. The pump shall have suitable HP, squirrel cage induction motor TEFC type suitable for operation on 440 volts, 3 phase 50 Hz.

	AC with IP 55 class of protection for enclosure, horizontal foot mounted type with Class 'F' winding insulation, conforming to IS: 325. The pump and motor shell be on FI fabricated Common base plate, coupling, coupling guard, GI foundation bolts etc. as required. Suitable cement concrete foundation in M-25 cement concrete -300mm high and 150mm projection on all side of base plate, 12mm thick cement plaster in cement mortar 1:4 finished with a floating coat of neat cement with anti-vibration pads, The pump shall be complete in all respects with all cabling. Complete design and drawing shall be submitted by the Contractor to Engineer for approval.
7.4	**Supply, Installation, Testing and Commissioning of Drainage Pump (400 LPM discharge of water at 10 m head):** Supply, Installation, Testing and Commissioning of a set of two submersible dewatering pump of 400 LPM discharge of water at 10m head complete with all accessories suitable for operation on 230 V, single phase (or 440 V, 3-phase), 50 Hz. AC supply complete with starter for automatic operation including water level sensing device, inter connection with submersible cable etc. common electrical panel with alterative operation of pumps including all cabling, wiring etc. The GI pipe for discharge of suitable length and educate size including bends connector etc. One set will comprise two submersible Pumps with all accessories including all supports, clamps, GI pipe etc. Complete design and drawing shall be submitted by the Contractor to Engineer for approval.
7.5	**Supply, Installation, Testing and Commissioning of Electrical Control Panel for Main Fire Pump, Jockey Pump, Drainage Pump:** Supply, Fabrication, Installation, Testing & Commissioning of electrical control panel of cubical construction, floor mounted type, fabricated out of 2 mm. Thick CRCA sheet, compartmentalized with hinged lockable doors, dust and vermin proof, powder coated of approved shade after 7 tank treatment process, cable alley, inter-connection, having-switchgears and accessories mounting and internal wiring, earth terminals, numbering etc. complete in all respect, suitable for operation on 440 V, 3 phase, 50 Hz. AC supply with enclosure protection class IP 42 as required. It will be a common panel in Fire Pump House having Incomer and Outgoing as under: **INCOMER having** i. 400 A TPN, MCCB ii. Voltmeter (0-500 Volts) with selector switch iii. Ammeter (0-400 A) with selector switch & CT's etc. iv. Set of 3 Phase indicating lamp v. Set of Copper Bus bar 400 A **OUTGOING for** **Main fire pump: 2 Set** 250A TP MCCB, 25 KA with suitable power capacity fully automatic star/delta Starter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for automatic operation, selector switch for automatic operation, selector switch for local/remote, auto/manual/OFF operation. One outgoing set shall be for each main fire pump and for 2 main fire pumps, the outgoing shall have 2 identical sets. **Jockey pump: 2 Set** 100A TP MCCB, 10 KA with suitable power capacity fully automatic star/delta starter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for automatic

	operation, selector switch for local/remote, auto/manual/OFF operation. **Drainage pump: 1 Set (2 nos.)** 2x63A TP MCCB, 10 KA with suitable power capacity fully automatic starter with over load protection, current sensing type single phase preventer complete with all accessories and internal wiring required for automatic operation, selector switch for local/remote, auto/manual/OFF operation. The panel shall be complete in all respects having incomer and outgoing for operating 2 nos. main fire pumps, 2 nos. jockey pump and 2 nos. drainage pumps including all the items as per technical specification required for successful operation of fire fighting system.
7.6	**Supply, Installation, Testing and Commissioning of Annunciation Panel:** Supply, installation, testing and commissioning of annunciation panel made out of not less 2 mm thick CRCA sheet powder coated with 7 tank processes in approved colour with locking arrangement, audio and visual indication of fault and operation of automatic sprinkler, system monitoring including providing connections interconnections etc. complete as required and fixing the following: - The Panel shall be Microprocessor type. - Monitoring 4 Nos. of flow switches (2W+2S) - Monitoring the open circuit, short circuit & earth fault in control cable between panel and flow switches. - Battery charger trickle cum boost to take complete load of annunciation panel complete with indication of low battery voltage, mains failure and other accessories including providing and fixing of 2 Nos. 12 volts 60 AH (minimum) each sealed maintenance free batteries.
7.7 to 7.10	**Supply, Installation, Testing and Commissioning of G.I. Heavy Class External Pipe:** Supply, fabricating, laying, testing, painting and commissioning external GI heavy class piping (UNDERGROUND) generally as specified using heavy class steel conforming to IS-1239 and IS-3589 with all fittings at a depth of 1.0 m and complete with one protection layer of corrosion protection 4 mm thick PYPKOTE tape as per specification. All pipes and all heavy grade fittings conforming to IS 1239 together with welded joints, flanges, gaskets, GI bolts, nuts, washers, fittings adapter pieces etc. complete in all respects as per requirement. Item No. 7.7: 200 mm nominal bore Item No. 7.8: 150 mm nominal bore Item No. 7.9: 100 mm nominal bore Item No. 7.10: 80 mm nominal bore
7.11 to 7.14	**Supply, Installation, Testing and Commissioning of G.I. Heavy Class Internal Pipe:** Supply, laying, jointing, painting and testing of GI heavy class pipes conforming to IS:1239 / IS-3589 inside building with all accessories like fittings with welded joint shall be used like tees, elbows, reducers, flanges, rubber gaskets, GI nuts, bolts, washer and fixing the pipe on floor / wall / ceiling with suitable size clamps, hangers and GI pipe sleeve to be provided wherever the pipes are crossing the walls/floors and sealing the steeves with fire proof material inclosing cutting holes and chases in brick, RCC. work and making good the same to original conditions complete in all respects. The work shall be complete in all respects.

	Item No. 7.11: 65 mm nominal bore Item No. 7.12: 50 mm nominal bore Item No. 7.13: 40 mm nominal bore Item No. 7.14: 25 mm nominal bore
7.15	**Excavating and refilling of Trenches width 500 mm and depth up to 1500 mm for External Pipes, as per design:** Excavating trenches for pipes, cables etc. width 500 mm including excavation for socket and dressing of sides ramming of bottoms depth up to 1500 mm including getting out the excavated soil and then returning the soil as required in layers of not exceeding 250 mm thickness at a time including consolidating each deposited layer by ramming and watering etc. and disposal of surplus excavated soil as directed within a lead of 2000m. The soil can be of any type and pipe and cable sizes shall as per specifications and as required. After finishing, the top surface of earth shall match with the original earth surface.
7.16 to 7.23	**Supply and Installation of Synthetic Enamel Paint:** Providing two coats of synthetic enamel paint of approved shade over two coats of primer on GI pipes, fittings and supports, including painting of legends with both direction arrow as per the approval of the Engineer. Item No. 7.16: 200 mm nominal bore Item No. 7.17: 150 mm nominal bore Item No. 7.18: 100 mm nominal bore Item No. 7.19: 80 mm nominal bore Item No. 7.20: 65 mm nominal bore Item No. 7.21: 50 mm nominal bore Item No. 7.22: 40 mm nominal bore Item No. 7.23: 25 mm nominal bore
7.24	**Supply and Installation of Single Headed Hydrant Valve - Internal Works:** Supply and fixing stainless steel single headed hydrant valve with instantaneous Stainless-steel couplings of 63 mm dia with cast iron wheel ISI marked conforming to IS 5290 (Type-A) with blank Stainless-steel cap and chain, nuts, bolts, rubber gaskets etc. as required.
7.25	**Supply and Installation of Single Headed Hydrant Valve - External Works:** Supply and fixing stainless steel Single headed external yard hydrant valve with 1 no. 63 mm dia instantaneous FM Stainless steel coupling and cast-iron wheel, ISI marked, conforming to IS 5290 (type- A) with blank Stainless-steel cap and chains nuts, bolts, rubber gaskets etc. as required.
7.26 to 7.29	**Supply, Installation, Testing and Commissioning of Butterfly Valve:** Supply, fixing, testing and commissioning of butterfly valve PN 1.6, with Bronze/Gunmetal seat duly ISI marked complete with Nuts, Bolts, washers, gaskets, conforming to IS 13095, of following sizes as required: Item. No. 7.26: 150 mm nominal size Item.No. 7.27: 100 mm nominal size Item. No. 7.28: 80 mm nominal size Item. No. 7.29: 50 mm nominal size
7.30	**Supply and Installation of Orifice Plate of size 80 mm dia:**

	Supply and installation of stainless 80 mm dia orifice plate made out of 8 mm thick stainless-steel plate for pipe to reduce pressure up to 33 kg/sqcm. complete in all respects (IS-15675).
7.31 to 7.33	**Supply, Installation, Testing and Commissioning of Non-Return Valve:** Supply, installation, testing and commissioning of dual plate non-return valve of following sizes confirming to IS: 5312 complete with rubber gasket, GI bolts, nuts, washers etc. as required. Item No. 7.31: 150 mm nominal size Item No. 7.32: 100 mm nominal size Item No. 7.33: 80 mm nominal size
7.34 to 7.35	**Supply and installation of Pot Strainer:** Supply and installation of Pot strainer with stainless steel perforated sheet basket tested to a pressure of 15 kg/sqcm Including rubber gasket, flanges, GI nuts, bolts and washers complete as required (IS-3582). Item No. 7.34: 150 mm size Item No. 7.35: 100 mm size
7.36	**Supply and installation of Gun Metal Ball Valve of size 50 mm nominal size:** Supply and installation of 50 mm nominal size Gun metal ball valve with CI hand wheel suitable for pressure 15 kg/sqcm and confirming to IS-9890 including providing necessary union/flange and making proper connection for air testing and drainage system.
7.37	**Supply and installation of Non-Percolating Fire hose Pipe - 15m length:** Supply and fixing non-percolating fire hose pipe (as per IS-636 Type B) of 63 mm size and 15 m length. The hose shall be rated for burst pressure of 35.7 kg/cm^2. Hose shall be complete with ISI marked stainless steel male and female coupling (IS- 903) bound and riveted to hose pipe with copper wire.-
7.38	**Supply and installation of Short Branch Pipe for fire hose:** Supply and fixing of 63 mm dia standard stainless steel short Branch Pipe for fire hose as per IS-903 with 20 mm nozzle complete with fixing clamps.
7.39	**Supply and installation of First Aid Hose Reel:** Supply and fixing First-Aid Hose Reel with GI construction spray painted in Post office Red, conforming to IS-884 with up-to-date amendments, complete with the following as required. The hose reel shall be 45 meter, 25 mm (nominal internal) bore water hose Thermoplastic (Textile reinforced) Type- 2 as per IS: 12585, 25 mm (nominal internal) bore stainless steel globe valve and 7 mm shut off nozzle. Drum and brackets for fixing the equipments on wall. Connections from riser with 40 mm dia stop valve (stainless steel) and GI Pipe.
7.40 to 7.42	**Supply, installation, testing and commissioning of Double Flanged Rubber Expansion Joint:** Supply, installation, testing and commissioning of double flanged rubber expansion joint with unit control of standard length. Tested to a pressure of 15 kg/sqcm including rubber gaskets, flanges, nuts, bolts and washers complete as

	required and as per specifications. Item No. 7.40: 150 mm dia Item No. 7.41: 100 mm dia Item No. 7.42: 80 mm dia
7.43	**Supply, installation, testing and commissioning of Hose Cabinet (External):** Supply, installation, testing and commissioning of hose cabinet of size 900 mm x 600 mm x 450 mm (minimum) made of 3 mm thick stainless steel with 6 mm thick glazed glass doors including necessary locking arrangement suitable to accommodate external hydrant with butter fly valve, 2 Nos. 15 metre Long Hose pipe, 1 No. branch pipe, mounted on wall or raised brick platform 600 mm in height built in brick (class designation 10 minimum) masonry in cement mortar 1:4, 12mm thick plaster on all sides and finished with existing/ proposed external finish & duly painted with Post office red externally and white internally with synthetic enamel paint complete in all respect, for external hydrants, as required and as specifications. Mounting on wall shall be with GI flat, angle, nuts, bolts, washers etc.
7.44	**Supply and installation of Breeching Head:** Supply and installation of inlet breeching head having C.I. body, 4-way gun metal 63 mm dia instantaneous inlets conforming to IS-905 fitted with non return valves 25 mm dia gun metal drain cock, blank cap, brass chains and 150 mm dia flanges with all accessories suitable for local fire tender complete.
7.45	**Supply and installation of Fire Brigade Connection:** Supply and installation of 2 way, fire brigade connection of cast iron body with 4 Nos. gun metal male instantaneous inlet complete with cap and chain as required for 100 mm nominal bore GI pipe connection, conforming to IS-904 as required (for supply of water by fire tender into the tank).
7.46	**Supply and installation of Stainless Steel Collecting Head:** Supply and installation of stainless steel collecting head (draw off connection) with 150 mm dia outlet, suitable for local fire tender complete in all respects (for collecting water from tank by fire tender).
7.47	**Supply, installation, testing and commissioning of Air Cushion Tank:** Supply, installation, testing and commissioning of GI air cushion tank on top of each riser fabricated from 6 mm thick GI plate, 200 mm in dimeter and 1.2 m in height with dished ends of 8 mm thick GI plate with air release valve , stop cock flanged inlet connection and drain arrangement with 25 mm dia valve, pressure gauge with gun metal stop cock complete with all accessories as required and conforming to IS 4736-1968, painting the vessel piping etc. with two coats of anticorrosive postal red enamel outside of approved make and as per specifications.
7.48	**Supply, installation, testing and commissioning of Air Vessel Tank:** Supply, fixing, testing and commissioning of air vessel tank made from 6 mm thick GI plate of 450 mm dia & 2m height with dished ends of 8 mm thick, supporting legs, inlet & outlet flanged connections pressure switches with valve to operate as per operating sequences including 80 mm dia GI drain valve, GI air release valve with stop cock on the top duly painted with two coats of anticorrosive postal red enamel outside of approved make and outside complete as required and as per specifications.

7.49	**Supply and installation of Fireman's Axe:** Supply and fixing standard fire man's axe with as per IS 926-1985 or latest.
7.50	**Supply, installation, testing and commissioning of Inspector's Test Assembly:** Supply and fixing inspector's test assembly complete with 50 mm test valve. Contractor shall provide all testing facilities during testing by Fire Inspector.
7.51	**Supply, installation, testing and commissioning of Quartzoid Bulb Type Sprinklers:** Supply, fixing, testing and commissioning of 15 mm size quartzoid bulb type sprinklers of rating 68 degree C. Pendent / upright with required accessories and as per IS:9972 specification.
7.52	**Supply and installation of Pressure Switch:** Supply and installation of Pressure Switch in the Pipeline including connection etc. as required.
7.53	**Supply and installation of 100 mm dia Control Valve:** Supply and installation of 100 mm dia control valve of cast iron body and brass / bronze working part comprising water motor alarm, bronze seat clapper and clapper arm, hydraulically driven mechanical gong bell to sound continuous alarm when the Wet/ Sprinkler system activates, pressure gauges, emergency releases, strainer, pressure switch, cock valve complete with drain valve and bypass, test control box, ball valves, GI pipe of required size, flanges, orifice plate, gasket etc. of size 150 mm dia as required. All exposed pipe fitting and other parts will be painted with two coats of anticorrosive postal enamel of approved make.
7.54	**Supply and installation of GI Angle Door Frame (size 2100 mm x 1200 mm):** Supply and installation of GI angle (40mm x 40mm x5mm) door frame with door of size 2100mm x 1200mm with 25 mm x 25 mm x 3 mm GI angle frame all around & stiffened in between including hinges, handle, locking arrangement and GI sheet (2mm thick) cum toughened glass (minimum 5 mm thick),along with painting with two coats of postal red synthetic enamel paint of approved make. Sign writing on glass at internal hydrant including providing & fixing GI sheet 2 mm thick on remaining portion above door to close opening including painting etc. as required.
7.55	**Supply and installation of Pressure Gauge:** Supply and installation of pressure gauges of not less than 100 mm dia dial of pressure range 0-15 kg/sqcm complete with shut off valve duly calibrated before installation (IS-3624).
7.56	**Supply and installation of Flow Switch:** Supply and installation of flow switches in 100 mm dia GI pipe complete in all respects.
7.57	**Supply and installation of ABC Dry Powder 5 Kg:** Supply and installation of 5 kg fire extinguishers (A, B, C type powder) complete

	with all accessories as per IS: 2171 (Appendix-4).
7.58	**Supply and installation of Fire Extinguisher Water CO2 9 Litre:** Supply and installation of fire extinguisher water type of capacity 9 litre with internal plastic lining and IS marked as per IS: 940 with stainless steel cap, CO2 cartridge and initial refill (Appendix-4).
7.59	**Supply and installation of Masonry Chamber (900 x 900 x 900 mm inside):** Construction of masonry chamber 900 x 900 x 900 mm inside, in brick (class designation 10 or above and size 200x100x100mm) work in cement mortar 1:4 (1 cement : 4 coarse sand) and RCC top slab in M-25 grade RCC 100mm thick including necessary excavation, foundation concrete M-25 grade and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design.
8 AIRCONDITIONING VRV SYSTEM (Appendix-1)	
8.1	**Supply, Installation, Testing and Commissioning of Modular type Outdoor Condensing Units (for cooling and heating) as per specifications: 16 HP along with EEV and all other accessories (Appendix-1).** Supply, Installation, Testing and Commissioning of Modular type Outdoor Condensing Units of 16 HP suitable for cooling and heating application equipped with highly efficient (Minimum COP 3.8 at 100% load as per AHRI (Air-Conditioning, Heating and Refrigeration Institute) conditions, Inverter scroll compressors to work on 440 V, 50 Hz AC supply with inverter technology, Air Cooled Variable Refrigerant Volume System suitable for R410A, special acryl precoated heat exchanger, Electronic Expansion Valve (EEV), special reversing valves (for cooling and heating), with electronic controls, low noise condenser fan with motor, auto check function for errors in display panel, auto address setting. The unit shall be fully charged with gas and oil. The unit shall be complete with necessary mounting frames. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements.
8.2 to 8.5	**Supply, Installation, Testing and Commissioning of Wall mounted type Indoor Units (for cooling and heating) as per specifications, along with EEV, remote control and all other accessories:** Supply, Installation, Testing and Commissioning of wall mounted Indoor Units each complete (for cooling and heating), with coil, filter, Electronic Expansion Valve (EEV), special reversing valves (if required), with electronic controls, cordless remote etc. Air-conditioners with evaporating unit comprising of cooling coil, drain pipe, blower with motor suitable for 240 V, single phase, 50 Hz, AC supply all. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements. 2 TR indoor units shall be wall/ ceiling mounted type as per instruction of Engineer as per requirement and cost shall remain the same. The unit shall be complete with necessary mounting frames: Item No. 8.2: 1 TR Item No. 8.3: 1.6 TR Item No. 8.4: 2 TR Item No. 8.5: 3.18 TR

8.6	**Supply, Installation, Testing and Commissioning of Ceiling mounted type (cassette type) Indoor Units (for cooling and heating) 3.18 TR each along with EEV, remote control and all other accessories complete and as per specifications:** Supply, Installation, Testing and Commissioning of Ceiling mounted type (cassette type) 3.18 TR Indoor Units each complete (for cooling and heating), with coil, filter, Electronic Expansion Valve (EEV), special reversing valves (if required), with electronic controls, cordless remote etc. Air-conditioners with evaporating unit comprising of cooling coil, drain pipe, blower with motor suitable for 240 V, single-phase, 50 Hz, AC supply all and as per specifications. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements. The unit shall be complete with necessary mounting frames.
8.7 to 8.12	**Supply, Installation, Testing and Commissioning of interconnecting refrigerant copper pipe work with elastomeric nitrile rubber/ closed cell expanded polythene tubular insulation between each set of indoor and outdoor units as per specifications:** Supply, Installation, Testing and Commissioning of interconnecting refrigerant copper pipe work with elastomeric nitrile rubber/ closed cell expanded polythene tubular insulation between each set of indoor and outdoor units as per specifications. All piping should be laid on Galvanized/ Powder Coated tray supported by Galvanized G.I. Hangers and Clamps. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements. The rate also includes cost of Y-joints, separation tubes, distributers and headers in the refrigeration piping system wherever required: Item No. 8.7 : 28.6 mm OD (outer dia); (insulation: 19 mm) Item No. 8.8 : 22.2 mm OD (outer dia); (insulation: 19 mm Item No. 8.9 : 19.1 mm OD (outer dia); (insulation: 19 mm Item No. 8.10 : 15.9 mm OD (outer dia); (insulation: 13 mm) Item No. 8.11 : 12.7 mm OD (outer dia); (insulation: 13 mm) Item No. 8.12 : 9.5 mm OD (outer dia); (insulation: 13 mm)
8.13	**Supply, Installation, Testing and Commissioning of control cum transmission wiring of 2 core x 2.5 sqmm copper FRLS, XLPE insulated cable along with suitable GI conduits between indoor and outdoor units**. Supply, Installation, Testing and Commissioning of control cum transmission wiring of 2 core x 2.5 sqmm copper FRLS, XLPE insulated cable in minimum 25 mm dia GI conduits between indoor and outdoor units. GI conduits shall be laid and necessary securing of GI conduits with clamps, junction box, tees, bends etc, as required, including metallic flexible conduits to complete the conduiting circuit shall be made by Contractor. After completion of work, wall, shaft, ceiling, floor etc shall be repaired and brought to its original finish. The payment shall be made based on the running length of the cable. The drawing of the cabling and conduiting shall be submitted to Engineer for approval.
8.14 to 8.17	**Supply, Installation, Testing and Commissioning of factory fabricated G.I. sheet metal ducts with flanges complete as per specifications:** Supply, Installation, Testing and Commissioning of factory fabricated G.I. sheet metal ducts with flanges complete with supports, vanes, links, levers and

	quadrants etc along with rivets, nuts, bolts, washers, screws etc . as per specifications and drawings. The suspension and supporting arrangement (all GI material) of ducts for plenums, ducts, complete with fire retardant flexible connection shall be made as required and as per specification: Item No. 8.14 : 0.63 mm Item No. 8.15 : 0.80 mm Item No. 8.16: 1.00 mm Item No. 8.17 : 1.25 mm
8.18	**Supply, Installation, Testing and Commissioning of powder coated extruded aluminium section Linear grills for supply/ return air as per specification:** Supply, Installation, Testing and Commissioning of powder coated extruded aluminium section Linear grills for supply and return air as approved by the Engineer as per specification.
8.19	**Supply, Installation, Testing and Commissioning of powder coated extruded aluminium section grills with dampers for supply and air terminal for air-conditioning as per specification:** Supply, Installation, Testing and Commissioning of powder coated extruded aluminium section grills with dampers for supply and control of air terminal for air-conditioning as approved by the Engineer as per specification.
9 LIFT (APPENDIX-7)	
9.1	**Supply, installation, testing and commissioning of 13 passenger (G+5), stainless steel door, heavy duty machine-room less elevator including spares:** Supply, installation, testing and commissioning of 13 passenger (G+5), stainless steel door, heavy duty machine-room less elevator with 6 stops including spares for IMD building as per specifications (Appendix-7).
10 MISCELLANEOUS: Signage, Cable Tray, Cable Duct, Raceway, RO, Spares	
10.1	**Supply, Installation, Testing and Commissioning of 25 Litre Fully Automatic with Auto Cut-Off RO water purification system:** Wall mounted potable water purification system (Reverse Osmosis), 240V, AC with inbuilt storage tank (stainless steel type) 25 litre capacity, minimum inlet pressure 1 kg/cm^2, Maximum inlet pressure 3.5 kg/cm^2, High pressure pump, Micron filter and also confirming to ISO 9001:2015, ISO 14001:2004, IS 10500 or latest. All the accessories required for installation of this system on wall/ structure shall be provided and after installation the wall shall be restored to the original finish by the Contractor.
10.2 & 10.3	**Supply, Installation, Testing and Commissioning of Single Sided and Double Sided LED Signage Board:** Supply, installation, testing and commissioning of LED back lit single & double sided signage boards with IP-65 CRCA housing, vinyl print on acrylic sheet which is back lit with high grade, high brightness LED modules inbuilt Switch Mode Power Supply (SMPS) driver, without battery backup. Operating voltage 80-270V AC. LED with L70 life of

minimum 50,000 hours, LPM technology, including fabrication and supply of clamping arrangements. The Engineer Authorities shall decide the size, colour & content to be printed on the signage Board. Signage Board shall be prewired with flexible copper cable and terminated in a connector from where 3-core flexible cable shall be brought out for connecting the board to ceiling rose, as per site requirement. The body of Glow sign board to be connected with earth. The pictogram and letter of desired colour and size made by translucent vinyl sheet cut through computerized machine shall be pasted on acrylic sheet. Acrylic sheet with pictogram shall be fixed on CRCA/ GI sheet powder coated box with suitable arrangement. Subject matter and pictogram can be seen in the standard book of signage available in office. The installation shall be done with GI or stainless steel nuts/ bolts/ washers etc.

LED Signage Board:- Depth of box shall be approximately 100 mm (for single sided) 140mm (for double sided) and made by 0.8 mm thick CRCA/ GI sheet with powder coated having louvers for ventilation on two sides having suitable gaskets for protection against water and vermin ingress. Louvers should be covered with wire mesh to avoid entry of insects/ lizards of suitable size as per requirement. LED light shall be provided inside the box in such way that intensity of light on both side of box (no dark spot) remains same. Individual Switch Mode Power Supply (SMPS) operated from AC source ranging from 80V to 270 Volts, 50 Hz AC, single phase shall be supplied in each board and fitted in such way that no impression is appeared outside the board. The box is to be fitted in shed with approx. size 40x40x5 mm slotted angle nut bolt etc. at a minimum clear height.

Script slogan shall be advised to the Contractor by the Site Engineer.

LED:- Clear cool white colour 5 mm LEDs of uniform intensity and luminosity shall be used for excellent Visibility. The intensity of the illumination is such that it shall be possible to read the information clearly from a distance of minimum 20 meters. NICHIA/ PHILIPS/ LUMILIDE/ AVAGO/ Seol semiconductor/ OSRAM make LED with L70 life of minimum 50,000 hours and with specified parameters as per latest data sheet of Original Equipment Manufacturer shall be used.

SMPS:- All power supply units supplied are Switch Mode Power Supply type (SMPS) operated from AC source ranging from 80V to 270 Volts, 50 Hz AC, and single phase. All the power units are tested at 50% load of maximum working capacity. Protection against transient coming in the power supply source or generated by some other source is provided. Protection against voltage fluctuations of short durations is also provided.

Signage board has following specifications:

Acrylic sheet thickness	3 mm
Dimension of LED module	295 mm x 295 mm or 600 mm x 295 m approx.

Protection	IP-65	
LED System Wattage	6 W max per square feet	
LED Wattage	0.06 W per LED	
Luminosity	700 mcd	
LED Color	Cool White	
Viewing Angle	70 Degree	
Solid Angle	70 Degree	
Distance between LEDs	1.5” Diagonally	
No. of LEDs in each module	72 (for 295 mm x 295 mm)	
Lux level inside the surface	≥3400 Lux @ 2” +/- 10%	
Color Temperature	5500K/ 6500K	

10.4	**Supply and Installation of GI Cable Duct 40x60 mm (wxh) minimum 2 mm thick sheet:** Supply and installation of GI cable duct 40 x 60 mm (w x h) minimum 2 mm thick and fixing as per site requirement. All drilling work, hole in wall, suspenders, anchors bolts, angle supports, nuts, bolts etc shall be provided. The wall/floor may involve dismantling and the same shall be done by the Contractor and after the work, the same shall be restored to the original finish.
10.5	**Supply and Installation of Stainless Steel Wire Mesh 25mm X 25mm (of 5 mm dia wire) welded on GI Angle:** Supply and installation of Stainless Steel Wire Mesh 25mm x 25mm (of 5 mm dia steel wire) welded on GI angle frame 30x30x3 mm which shall be fixed on base GI angle frame of 50x50x6 mm and 40x6 mm GI flat in center to support the mesh. Necessary GI nuts, bolts, washers etc shall be provided. The grouting (1 to 2 m interval) of GI angle 50x50x6 mm or as required shall be done in M-25 grade concrete.
10.6	**Supply, Fabrication and Installation of hot dipped galvanised GI Perforated Cable Tray of size 150 mm wide x 50 mm deep with sheet thickness 2 mm complete as per specification:** Supply, fabrication and installation of perforated hot dipped galvanised double bended cable trays of size 150 mm wide x 50 mm deep from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees & other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40mm x 5mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as required. Trays shall be supported adequately at minimum 1 m distance from the building structure/ ceiling by means of painted/ galvanized (as specified) GI structure members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent to 3 m length of the cables that can be laid in the trays. At turns, the support has to be double and at both

	ends of the bend. The cable trays and their fittings shall conform to the Indian Standards or their latest amended editions or equivalent International Standard. All drilling work, holes in wall, suspenders, anchors bolts, angle supports, nuts, bolts etc shall be provided. The wall/floor may involve dismantling and the same shall be restored to the original finish.
10.7	**Supply, Fabrication and Installation of hot dipped galvanised GI Perforated Cable Tray of size 300 mm wide x 50 mm deep with sheet thickness 2 mm complete as per specification:** Supply, fabrication and installation of perforated hot dipped galvanised double bended cable trays of size 300 mm wide x 50 mm deep from 2 mm thick GI sheets continuously connected including horizontal and vertical bends, reducers, tees & other accessories and duly suspended from the ceiling with 12 mm dia vertical GI rods supported by 40mm x 40mm x 5mm GI angle etc. (or installed on wall supported on suitable brackets as required) complete as required. Trays shall be supported adequately at minimum 1 m distance from the building structure/ ceiling by means of painted/ galvanized (as specified) GI structure members secured to the structure by dash fasteners or by grouting. This support should be capable of withstanding the weight equivalent to 3 m length of the cables that can be laid in the trays. At turns, the support has to be double and at both ends of the bend. The cable trays and their fittings shall conform to the Indian Standards or their latest amended editions or equivalent International Standard. All drilling work, holes in wall, suspenders, anchors bolts, angle supports, nuts, bolts etc shall be provided. The wall/ floor may involve dismantling and the same shall be restored to the original finish.
10.8	**Supply, Fabrication and Installation of hot dipped galvanised GI Cable ladders with sheet thickness 2 mm complete as per specification:** Supply, fabrication and installation of hot dipped galvanised cable ladders from 2 mm thick GI sheets continuously connected with suitable size runners horizontal and vertical bends, reducers, tees, cross members, suspenders & other accessories and duly suspended from the ceiling with GI suspenders etc. complete as required. GI suspenders and necessary anchor fasteners or any other fabricated GI item of any size is included in this item and shall not be paid separately. The cable ladders and their fittings shall conform to the Indian Standards or their latest amended editions or equivalent International Standard. All drilling work, holes in wall, suspenders, anchors bolts, angle supports, nuts, bolts etc shall be provided. The wall/ floor may involve dismantling and the same shall be restored to the original finish.

10.9	**Supply, Installation and Testing of hot dipped galvanised GI Raceway of size 200 mm wide x 50 mm deep with sheet thickness 2 mm complete as per specification:** Supply, Installation and Testing of hot dipped galvanised GI Raceway in floor of size 200 mm wide x 50 mm deep with sheet thickness 2 mm with minimum coating thickness 260 gm/ sqm on both sides with removal cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junction, cross junction box of suitable size with cover plate etc. rendered electrically continuous etc. as required. The cost of cross junction box of suitable size with cover plate shall be deemed to be included in this item. The drawing of raceway system with cross junction of suitable size with cover plate shall be submitted by the Contractor to Engineer for approval.
10.10	**Supply, Installation and Testing of hot dipped galvanised GI Raceway of size 100 mm wide x 50 mm deep with sheet thickness 2 mm complete as per specification:** Supply, Installation and Testing of hot dipped galvanised GI Raceway in floor of size 100 mm wide x 50 mm deep with sheet thickness 2 mm with minimum coating thickness 260 gm/ sqm on both sides with removal cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junction, cross junction box of suitable size with cover plate etc. rendered electrically continuous etc. as required. The cost of cross junction box of suitable size with cover plate shall be deemed to be included in this item. The drawing of raceway system with cross junction of suitable size with cover plate shall be submitted by the Contractor to Engineer for approval.
10.11	**Supply, Installation and Testing of hot dipped galvanised GI Raceway of size 100 mm wide x 25 mm deep with sheet thickness 2 mm complete as per specification:** Supply, Installation and Testing of hot dipped galvanised GI Raceway in floor of size 100 mm wide x 25 mm deep with sheet thickness 2 mm with minimum coating thickness 260 gm/ sqm on both sides with removal cover plate complete with counter sunk cadmium plated brass screws, bends, tee-junction, cross junction box of suitable size with cover plate etc. rendered electrically continuous etc. as required. The cost of cross junction box of suitable size with cover plate shall be deemed to be included in this item. The drawing of raceway system with cross junction of suitable size with cover plate shall be submitted by the Contractor to Engineer for approval.
10.12	**Spares:** Supply and Testing of maintenance spares. (1) Digital earth testers: Mains operation & rechargeable battery operation, 0-20-200-2000 Ohms, Short circuit current 6 mA, noise rejection 8 mA, Guard out parallel leakage resistance with a max error of 2%, IP65 rated & CAT IV rating, Safety - IEC1010-1, EMC-IEC61326-1. (2) Earth Leakage Detector 1000 V: Range: 0-30 mA/300 mA/30 A/300 A, 0.01 mA resolution for measuring earth leakage currents, Jaw Opening 40 mm, Analogue Bar graph Display for trending, 300 V phase to earth and 500 V phase to phase CAT III or 600 V CAT II double insulated, Safety - IEC1010-1, EMC-IEC61326-1.

Not	(3) Digital Insulation Tester 2.5 kV: 2.5 kV Insulation Tester measurement consisting of selectable measurement voltage in the 100…2500 V range with 100 V step, continuous indication of 2.5 kV insulation resistance or leakage current, automatic discharge of capacitance of tested object after the insulation resistance measurement, acoustic signalling of five-second periods to facilitate obtaining time characteristics, indication of actual test voltage during the measurement, protection against measuring live objects, two and three-lead measurement method, Continuity measurement of protective and equipotential conductors according to EN 61557-4 with the >200 mA current, Leakage current measurement, Measurement of alternating and direct voltages, Built-in rechargeable battery pack. The instruments meet the requirements of the EN 61557 standard. (4) Digital Insulation Tester 0 – 1000 V: Measures Insulation Resistance, Continuity and AC Voltage, Three rated test voltages of 250V, 500V and 1000V, IR measurement upto 2000MΩ, Robust Design: Protection class IP54, 200mA current for continuity measurement, Auto discharge of test voltage, Meets international safety standards EN 61010-1 CAT III 600V. (5) Digital Vernier Caliper: Top quality material, 150mm measuring range, Precision reading, laser reticle, Measuring Range: 0-150 millimeter, Resolution: 0.01 millimeter, Repeatability: 0.01 millimeter, Maximum measurement speed: 1m/s, Power: 1 x 1.5V LR44 cell (included), Size: 237 x 76 x 11 millimeter for caliper 40 x 15 millimeter for LCD screen. (6) Digital Multi-meter: 1000V AC/DC; 10A AC/DC (with test leads and current jacks); resistance to 50 MΩ; capacitance to 10,000 µF, frequency to 100 kHz; temperature from -10 ℃ to 60 ℃, Robust, fast and accurate with manual and automatic ranging, Display Hold, Auto Hold, and Min/Max-Average recording, Backlit digital display. (7) Tool Kit box having impact drill, 1-piece case, masonry drill bits, wood drill bits, allen keys, 10-pieces hex bits, sockets, screws, wall plugs, 7-pieces wrenches (size 8/9,10/11,12/13,14/15,16/17,18/19,21/22), 1-piece magnetic bit holder, 1-piece cutter, 1-piece hammer, 1-piece plier, 1-piece long nose plier, 1-piece 1/4-inch adapter and 1-piece socket etc. (8) Portable Electric drill: Max. Drilling Diameter: 16mm, Size: 6.5-16.0mm, No-Load Speed : 330-2700 RPM, Rated Voltage : 220V, Frequency : 50 Hz, Rated Input Power : 305-1600W.
10.13	**Operation and Maintenance Manuals:** Preparation of Operations and Maintenance Manuals and supply of requisite hard bound copies and in soft copies (pdf and word format) as per Employer's requirement.
10.14	**Training to Staff:** Imparting Training to Employers/ Engineer Staff in Classroom and at Site. Preparation of Training manuals for supply to each Trainee in hard bound copy. Supply of requisite hard bound copies and in soft copies (pdf and word format) as per Employer's requirement.

Notes:

1. The make of material shall be as per Reference list.
2. The plastering shall be done with 1:4 (cement : sand ratio) and concrete grade shall be minimum M-25. The brick class designation shall be minimum 10. The painting and distempering etc. shall match the original finish.
3. The specifications, wherever mentioned, shall be latest or with latest amendment. Contractor to provide specifications, if not included in the tender document, as applicable. The indicative list of Standards is given in the tender document for reference purpose for all items of BOQ.
4. Cable terminations of any type shall include thimble, lugs, crimping, ferrules, connectors, nuts, bolts, washers, taping etc., as required.
5. Prices of all items mentioned in each price schedule are included in the respective price schedule of BOQ.
6. Danger notice boards, danger signs and warning boards, indication boards etc. shall be provided at all 440V and above voltage rated equipment and prices of these shall be considered inbuilt in the respective prices.
7. Design and Drawings of Electrical items under the schedule mentioned in BOQ, Explanatory Notes, Tender Specification etc. including calculation, survey, as-built drawings etc. has already been considered in the BOQ items. The Contractor shall provide all Design and Drawings including calculation, survey, as-built drawings etc. as required to complete the work. The payment of Design and Drawings shall be made after testing and commissioning. The cost of Design and Drawings shall remain fixed irrespective of increase/ decrease of BOQ items and introduction of any Non-schedule item.

3.2 PAYMENT

3.2.1 Payment shall be made after carrying out the work to the satisfaction of the Engineer. Item-wise payment shall be made as under:

A: Composite Items – where cost of supply and installation is combined:

(1) The cost of material and erection shall be taken in the ratio of 80%:20% of the item cost.

(2) Material cost payment (80%):
   (a) 60% payment of material shall be made after supply and acceptance of material
   (b) 15% payment of material shall be made after erection of material.
   (c) 5% payment of material shall be made after testing and commissioning of items of work.

(3) Erection cost payment (20%):
   (a) 10% payment shall be made after erection of material.
   (b) 10% payment shall be made after testing and commissioning of item of work.

B: Supply items:

(a) 80% payment of material cost shall be made after supply and acceptance of the material.
(b) 20% payment of material cost shall be made after testing and commissioning of the work.

C: Laying/ installation items:

(a) 80% payment of laying/ installation cost shall be made after completion of laying/ installation of the item.
(b) 20% payment of laying/ installation cost of shall be made after testing and commissioning of the work.

3.2.2 Payment shall be made for the executed quantity. All wastages etc. shall be on the Contractor's account.

3.2.3 The quantities given in BOQ are indicative only and final quantities shall be as per approved drawings and quantities executed at site. The items given in Schedule 'B' are fixed rate item. The Contractor shall be bound to execute and complete the work and any increase in the quantity shall be paid at the accepted rates. In case of variation of quantity on minus side, the Contractor shall be paid for the executed at the accepted rates.

3.3 COMPLETION OF WORK

The completion period shall be as mentioned in SCC.

3.4 TAKING OVER

3.4.1 On completion of work of IMD Manesar Building, the work shall be Taken Over by the Employer and Defect Notification Period (DNP) shall start from the date of Taking Over for IMD Manesar Building.

3.4.2 On completion of work of Manesar Station and other buildings, the work shall be Taken Over by the Employer and Defect Notification Period (DNP) shall start from the date of Taking Over for Manesar Station and other buildings.

3.5 ELECTRICAL LICENCE

The Contractor executing the work shall have valid Electrical Licence for Electrical system up to 11kV.

3.6 LIST OF STANDARDS

IS/ IEC Code	Title

IS/ IEC Code	Title
IS - 5	Ready mixed paints and Enamels
IS - 307	Specification for carbon dioxide
IS - 318	Specification for Leaded Tin Bronze Ingots and Castings
IS - 325	Three phase induction motors.
IS - 374	Specification for electric ceiling type fans and regulators
IS - 513	Cold reduced low carbon steel sheets and strips
IS - 636	Non percolating flexible fire fighting delivery hose.
IS - 694	Polyvinyl chloride insulated unsheathed and sheathed cables/cords with rigid and flexible conductor for rated voltages up to and including 450/750 V
IS -732	Code of practice for electrical wiring and fitting of building.
IS -778	Gunmetal gate, globe and check valves for general purpose.
IS -780	Sluice valve for water works purpose (50 to 300 mm size).
IS - 875	Code of practice for design loads (other than earthquake) for buildings and structures
IS - 884	Specification for first aid hose reel for fire fighting.
IS - 900	Code of practice for installation and maintenance of induction motor.
IS - 901	Specification for coupling, double male and double female instantaneous pattern for fire fighting.
IS - 902	Specification for suction hose couplings for fire fighting purposes.
IS - 903	Specification for fire hose delivery coupling branch pipe, nozzles and nozzle spanner.
IS - 904	Specification for two-way and three-way suction collecting heads for fire fighting purposes.
IS - 907	Specification for suction strainers, cylindrical type for fire fighting purposes.
IS - 908	Specifications for hydrant, sand post type.
IS - 909	Specification for ground fire hydrant.
IS - 937	Specification for washers for water fittings for fire fighting purposes.
IS - 996	Single-phase AC industrial motors for general purpose.
IS-1077	Common burnt clay building Bricks
IS - 1239 Pt.1	steel tubes, tubulars and other wrought steel fittings — specification
IS – 1248 Pt.1	Direct acting indicating analogue electrical measuring instruments and their accessories
IS – 1255	Code of practice for installation and maintenance of power cables up to and including 33 kV rating
IS - 1271	Specification for thermal evaluation and classification of electrical insulation.
IS - 1293	Plugs and Sockets
IS - 1475	Self-contained drinking water coolers – specification
IS - 1514	Specification for PVC insulated (heavy duty) electric cables
IS - 1520	Horizontal centrifugal pumps for clear, cold, fresh water.
IS - 1536	Centrifugally Cast Iron Pipe.
IS - 1537	Vertically Cast Iron Pipe.
IS - 1538	Cast Iron Pipe Fitting.
IS -1554 Pt. I	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100 volts.

IS/ IEC Code	Title
IS -1554 Pt. II	PVC insulated (heavy duty) electric cables for working voltage up to and including 11000 volts.
IS - 1641	Code of practices for fire safety of building (general) : General principles for fire grading and classifications.
IS - 1642	Code of practice for fire safety of building (general): Details of construction.
IS - 1643	Code of practice for fire safety of building (general) : Exposure hazard.
IS - 1644	Code of practice for fire safety of building (general): Exit requirements and personal hazard.
IS – 1646	Code of practice for fire safety of building (general) : Electrical Installation.
IS - 1822	Motor starter for voltage not exceeding 1000 volts.
IS - 1860	Code of practice for installation, operation and maintenance of electric passenger and goods lift
IS – 1893 Pt. I	Criteria for earthquake resistant design of structures.
IS – 2062	Hot rolled medium and high tensile structural steel - specification
IS - 2082	Stationary storage type electric water heaters - specification
IS - 2147	Degrees of protection provided by enclosures for low voltage switchgear and control gear.
IS - 2171	Portable fire extinguishers, dry powder (cartridge type) – specification
IS - 2189	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System Code of Practice
IS - 2190	Selection, installation and maintenance of first-aid fire extinguishers - Code of practice
IS - 2208	HRC cartridge fuse links upto 650 volts.
IS - 2253	Designations for types of construction and mounting arrangements of rotating electrical machines.
IS - 2268	electric call bells and buzzers for indoor use-specification
IS - 2309	Protection of buildings and allied structures against lightning code of practice.
IS - 2312	Specification for propeller type ac ventilating fans
IS - 2339	Aluminium paint for general purposes, in dual container
IS – 2418	Tubular fluorescent lamps for general lighting services
IS - 2516	A.C. circuit breaker for voltages not exceeding 1000 volts.
IS-2553 Part-1 (2018)	Safety Glass, Part 1: General Purpose
IS - 2592	Recommendation for methods for measurement or fluid flow be means of orifice plates and nozzles.
IS - 2629	Recommended practice for hot-dip galvanizing of iron and steel
IS - 2675	Specification for enclosed distribution fuseboards and

IS/ IEC Code	Title
	cutouts for voltages not exceeding 1000 V ac and 1200 V dc
IS - 2705	Current transformers-specification
IS - 2871	Specification for branch pipe, universal for fire fighting.
IS - 2878	Fire extinguisher, carbon dioxide type (portable and trolley mounted) – specification.
IS -2930	Functional requirements for hose laying tender for fire brigade use.
IS - 3043	Code of practice for earthing
IS - 3224	Valve Fittings for Compressed Gas Cylinders Excluding Liquefied Petroleum Gas (LPG) Cylinders
IS - 3231	Specification for electrical relays for power system protection
IS - 3427	AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV
IS – 3528	Waterproof electric lighting fitting
IS - 3589	Electrically welded steel pipes for water, gas and sewage.
IS - 3624	Burden tube pressure and vacuum gauges.
IS – 3646	Code of practice for interior illumination Part 1 – General requirements and recommendations for working interiors Part 2 – Schedule of illumination and glare index Part 3 – Calculations of coefficients of utilization
IS - 3844	Code of practice for installation and maintenance of internal fire hydrants and hose reel on premises.
IS - 3854	Switches for domestic and similar purposes
IS - 4047	Heavy duty air break switches and composite units of air break switches and fuses for voltage not exceeding 1000 volts.
IS - 4308	Specification for Dry Chemical Powder for Fighting B and C Class Fires
IS - 4454	Steel Wires for Mechanical Springs, Part I: Patented and Cold Drawn Steel Wires – Unalloyed
IS - 4722	Rotating electrical machines — specification
IS - 4728	Terminal markings and direction of rotation for rotating electrical machinery
IS-4736	Specification for hot-dip zinc coatings on mild steel tubes
IS - 4889	Methods of Determination of Efficiency of Rotating Electrical Machines
IS - 4984	High density polyethylene pipes for water supply - specification
IS - 5077	Specification for decorative lighting outfits
IS – 5135	Arc welding of carbon and carbon manganese steels
IS - 5290	Specification for landing valves.
IS - 6392	Steel pipe flanges.
IS - 5312	Swing check type reflux (non-return) valves for water works purposes – specification
IS - 6362	Designation of methods of cooling of rotating electrical machines

IS/ IEC Code	Title
IS - 6392	Steel pipe flanges.
IS – 6665	Code of practice of industrial lighting
IS - 7098 Pt.1	Specification for crosslinked polyethylene insulated pvc sheathed cables
IS – 7098 Pt.2	Crosslinked polyethylene insulated thermoplastic sheathed cables — specification
IS - 7132	Guide for testing synchronous machines
IS - 7285	Refillable Seamless Steel Gas Cylinders, Part1: Normalized Steel Cylinders
IS - 7306	Methods for determining synchronous machine quantities from tests
IS - 7637	Glossary of terms for fire fighting equipment.
IS - 7816	Guide for testing insulation resistance of rotating machines
IS - 8034	submersible pump sets — specification
IS - 8090	Specification for coupling, branch pipe, node, used in hose reel tubing for fire fighting.
IS - 8216	Inspection of lifts wire and ropes
IS - 8329	Centrifugally Cast (Spun) Ductile Iron Pressure Pipes for Water, Gas and Sewage
IS - 8442	Specification for stand post type water monitor for fire fighting.
IS – 8623 Part-1	Low-Voltage Switchgear and Control gear Assemblies, Part 1: Requirements for Type-Tested and Partially Type-Tested Assemblies.
IS - 8757	Glossary of terms associated with Fire safety.
IS - 8828	Electrical accessories - circuit-breakers for overcurrent protection for household and similar installations
IS - 9283	Motors for submersible pump sets — specification
IS - 9523	Ductile Iron Fittings for Pressure Pipes for Water, Gas and Sewage
IS - 9537	Specification for conduits for electrical installations
IS – 9583	Specification for emergency lighting units
IS - 9668	Code of practice for provision and maintenance of water supplies and fire fighting.
IS – 9920 Part-1	High Voltage Switches for Rated Voltages Above 1 kV and Less Than 52 kV.
IS - 9972	Specification for Automatic sprinkler heads.
IS - 9974	Specification for high pressure sodium vapour lamps
IS - 10001	Performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kw)
IS - 10221	Code of practice for-coating and wrapping of under ground mild steel pipe lines.
IS – 10322	Luminaires Part 1 – General requirements Part 2 – Constructional requirements Part 3 – Screw and screwless terminals Part 4 – Methods of tests Part 5 (All Sections) – Particular requirements
IS - 10500	Drinking water — specification

IS/ IEC Code	Title
IS - 10617	Hermetic compressors — specification
IS - 10773	Wrought Copper Tubes for Refrigeration and Air-Conditioning Purposes
IS - 11037	Specification for electronic type fan regulators
IS - 11101	Specification for extended branch pipe for fire brigade use.
IS - 11171	Dry type Power transformer
IS - 11260	Stabilized power supplies ac output, Part 1: Ratings and performance
IS - 11338	Thermostats for Use in Refrigerators, Air Conditioners, Water Coolers and Beverage Coolers
IS - 11360	Specification for smoke detectors for use in automatic electrical fire alarm system
IS - 12065	Permissible limits of noise level; for rotating electrical machines
IS - 12075	Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm and Higher - Measurement, Evaluation and Limits of Vibration Severity
12585	Specification for Thermoplastic hoses
IS - 12615	Energy efficient induction motors — three phase squirrel cage
IS - 12349	Fire Protection sign.
IS - 12585	Specification for thermoplastic hoses Textile Reinforcement for water Genset purposes.
IS - 12407	Graphic symbols for protection plan.
IS - 12640	Residual Current Operated Circuit - Breakers for Household and Similar Uses, Part 1: Circuit-Breakers Without Integral Overcurrent Protection (RCCBs) [ETD 7: Low Voltage Switchgear and Control gear]
IS-12699	Selection, installation, operation and maintenance of Jet centrifugal pumps
IS - 12802	Temperature-rise measurements of rotating electrical machines
IS - 13095	Butterfly valves.
IS - 13118	High-Voltage Alternating-Current Circuit-Breakers
IS - 13314	Solid state invertors run from storage batteries
IS - 13340	Power Capacitors of Self-healing Type for AC Power Systems having Rated Voltage up to 650 V
IS - 13341	Requirements for ageing test, self-healing test and destruction test on shunt capacitors of the self-healing type for ac power systems having a rated voltage up to and including 650 V
IS - 13364	AC generators driven by reciprocating internal combustion engines- specification
IS – 13573 Pt.1, Pt.2, Pt.3	Joints and terminations of polymeric cables for working voltages from 66kV up to and including 33 kV - performance requirements and type test
IS - 13703	Specification for low-voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC
IS - 13779	AC static watthour meters, class 1and 2 - specification
IS – 13875 Pt.2	Digital measuring instruments for measurement, control,

IS/ IEC Code	Title
	Part 2: Terms, tests, data sheet details of instruments for measuring analog quantities
IS – 13947 Pt.1, Pt.2, Pt.3, Pt.4, Pt.5	Specification for low-voltage switchgear and control gear
IS - 14220	Open well submersible pump sets — specification
IS -14665 Pt.2/Sec.1	Code of practice for installation, operation & maintenance of passenger lifts.
IS:14665 Pt.3/sec. 1	Safety rules
IS: 14665 Pt.4/Sec. 6	Lift Doors and Locking Devices and Contacts
IS: 14665 Pt.4/Sec. 8	Lift Wire Ropes
IS:14665-part-5	Inspection manual
IS – 14772	General requirements for accessories for household and similar fixed Electrical installations - specification
IS - 14846	Sluice valve for water works purposes (50 to 1 200 mm size) — specification
IS - 15105	Design and installation of fixed automatic sprinkler fire extinguisher system - Code of practices
IS - 15111	Self-ballasted lamps for general lighting services
IS - 15222	Carbon Dioxide as Fire Extinguishing Media for Fire Protection -Specification
IS - 15330	Code of Practice for Installation and Maintenance of Lifts for Handicapped Persons
IS - 15652	Insulating mats for electrical purposes — specification
IS - 15683	Portable fire extinguishers – Performance and construction
IS - 15785	Code of practice for Installation and maintenance of lift without conventional machine rooms
IS – 16101	General lighting — LEDs and LED modules — terms and definitions
IS - 16102 Pt.1, Pt.2	Self-ballasted led lamps for general lighting services
IS - 16103	LED modules for general lighting
IS – 16106	Methods of electrical and photometric measurements of solid state lighting (LED) products
IS – 16107	Luminaires performance
IEC 60502-1	Power cables with extruded insulation and their accessories for rated voltages from 1 kV up to 30 kV. Part 1: Cables for rated voltages of 1 kV and 3 kV.
IS/IEC – 60034-1	Rotating electrical machines rating and performance
IS/IEC-60898-1	Electrical accessories – circuit breakers for over current protection for house and similar installations.

IS/ IEC Code	Title
IS/IEC-60947-1	Low-voltage switchgear and control gear.
BSEN 10025	Hot rolled products of structural steels
Technical Report 7	Technical Report 7 of Institution of Lighting Engineers - High masts

3.7 MATERIAL REFERENCE LIST

Items	Reference Makes
11 kV Vacuum Circuit Breaker	GEC, Siemens, Crompton Greave, Alsthom (Areva), ABB, BHEL, L&T, Schneider or similar
Air Circuit Breaker (ACB)	ABB / Schneider/ L&T/ Siemens or similar
Compact Substation (CSS) with HT/ LT switch gear, transformer and connected accessories	ABB, Siemens, L&T, Crompton Greave, BHEL, GEC, Alsthom (Areva), Schneider, Voltamp or similar
MCCBs, MCBs, ELCBS/ RCCBs, RCBO, DB, TP, HRC fuse, Changing over switch, Switch Fuse Unit	ABB / Legrand/ / Schneider/ L&T/ Havells or similar
XLPE HT Cable 11 kV grade	Havells/ CCI/ KEC /RPG / Universal Cable / Sterlite/ Polycab or similar
PVC/ XLPE Power Cables up to 1.1kV grade	Havells/ CCI / KEI / Finolex / Lapp Cable / RPG / Universal/ Polycab or similar
Instrument Voltmeter, Ammeter, PF meter	AE / Precise / IMP / Secure or similar
11kV Cable End Termination & Jointing kits	Raychem RPG / 3M or similar
Relays	ABB / Schneider/L&T or similar
Luminaries, LED & related Accessories	Phillips/ Crompton/ Bajaj/ GE/ Osram/ Wipro/ Surya/Syska or similar
PVC insulated Elect. Cables Sheathed/ unsheathed, PVC flexible LT cable, multicore, single core, Flat cable for submersible pumps	Finolex / Polycab / KEI/ Havells / Lapp/ Universal or similar
Current Transformer	AE / Kappa / Pragati / Precise / Hitachi / Plastofab or similar

Items	Reference Makes
On line UPS, Servo Stabilizer, Inverter, CVT	Luminous/ Microtek/ APC Schneider / Emerson Network Power / Exide/ Amaron or similar
Rotary Switches, Selector Switches	ABB / Kay Cee / L&T / Schneider or similar
Exhaust fan/ Air Circulator/ Bracket & Pedestal fans/ Ceiling fan	Crompton Greaves/ Usha/ Bajaj/ Havells/ Schneider/ Orient/ Khaitan or similar
High Mast Tower / Street Light pole for general purpose lighting	Bajaj/ Philips/ Crompton/ Wipro or similar
Electronic Energy Meter	L&T, IMP, HPL, Secure, ABB, Enercon or Similar.
Capacitors - PF correction for Electrical General Services	Elspec / Schneider / ABB/ Siemens or similar
Gensets - Portable	Birla Yamaha/ CGL/ Shriram, Mahindra/ Honda or Similar.
Genset	Sterling / Powerica/ Jackson/ Cummins/ Caterpiller/ Greaves Cotton or similar
Alternator for Genset	Stamford/ Landert motoren AG / Crompton Greaves/ Kirloskar/ Bharat Bijlee or similar
Induction Motor	ABB/ BBL/ Crompton Greaves / Kirloskar or similar
LT Switchgear & control gears- Contactors & motor starters, Energy Efficient Soft Starter panel/ Earthing Switch, Single phase Preventer	GE/ Schneider/ ABB, L&T or similar
Pumps- Submersible	ABB/ BBL/ Crompton Greaves / KSB/ Kirloskar or similar
Timers- electronic solid State	ABB/ Schneider Electric / Omron or similar
Water Coolers	Blue Star, Kelvinator, Shriram, Voltas or Similar.
Electrical accessories (Plugs & sockets, ceiling rose, Angle holder, holders, Modular switch and socket)	Anchor / Roma/ North-West/ Schneider/ Legrand/ Havells Crabtree or similar
Bell Buzzer	CONA/ MAX/ Anchor/ SSK or similar

Items	Reference Makes
Electronic fan regulator/ modular Fan Regulator	Anchor/ Roma/ North-West/ Schneider/ Legrand/ Havells Crabtree or similar
GI Pipe	TATA/ Jindal/ Prakash/ Surya SAIL or similar
Lifts	OTIS, Schindler, KONE, Johnson
LEDs	NICHIA/ OSRAM/ SEOUL SEMICONDUCTOR/ PHILIPS/ LUMILEDS/ Syska or Similar
HDPE PIPE	Duraline/ Godavari/ Rex Polyextrusion/ Eflex or similar
Battery Charger for battery room	Amar Raja/ Exide/ RS Power or Similar.
Conduits GI/ PVC including accessories	BEC / AKG / Polypack/ Precision or similar
LT Panels	Rittal/ ABB/ Schneider/ Neptune/ Adlec or similar
Glands	Comet/ Dowells/ Lapp Kabel/ Hummel or similar
Insulating Mats	Vardhman/ ERDI certified/ as per IS or similar
Lugs	Dowells/ Jainsons or similar
High Mast Lights	Philips/ Bajaj/ Crompton/ Wipro or similar
Lights and Luminaire	Philips/ Bajaj/ Crompton/ Wipro/ Surya or similar
Light aviation	Philips/ Bajaj/ Avaids or similar
MCB Distribution Boards	ABB/ Havells/ Legrand/ Schneider or similar
Cable Trays & Covers and raceways etc.	Adarsh/ Indiana / Maheshwari/ BEC or similar
Split Air Conditioner	Voltas/ Hitachi/ Carrier/ Daikin/ Toshiba/ Blue Star/ O-General/ LG/ Samsung or similar
Geyser	Bajaj, Usha, Havells, Crompton or similar
Fire Alarm System	Honeywell/ Notifier/ Edwards/ Tyco/ Siemens/ Apollo/ Rockwell or similar
Portable Fire Extinguisher	Minimax/ Newage/ Safeguard/ Kanex/ Cease Fire/ Safex/ Nitin/ Zenith

Items	Reference Makes
Tool kit box	Bosch, Taparia, Hitachi, Stanley
VRV Air-conditioning system	Voltas/ Hitachi/ Carrier/ Daikin/ Toshiba/ Blue Star/ O-General/ LG/ Samsung
Fire fighting and suppression system	
Horizontal Centrifugal Pumps	Kiloskar/ Mather & Platt (Wilo)/ Grundfoss
Jockey Pump	Kiloskar/ Mather & Platt (Wilo)/ Grundfoss
Diesel Engine	Kisrloskar/ Cummins/ Caterpiller/ Greaves Cotton
Motors	Kirloskar/ Crompton/ Siemens/ABB/BBL/NGEF/GEC/Alsthom/Jyothi
Gate Valve	Leader/ Zoloto/ Kirloskar
Y-Type/ Suction Strainer	Zoloto/ Emerald/ Heaven/ Kirloskar/ Leader
Sluice Valve/ NRV/ Butterfly Valve	Kirloskar/ Zoloto/ Audco/ Cair Euromatic/ Inter valve/ Leader
Air release valve	Newage/ Safeguard/ Kirloskar
Pressure Switch	Indfoss/ Switzer/ Danfoss/ Morley/ System Sensor
Flow Switch	Danfoss/ System Sensor/ Forbes Marshall/ Switzer/ Viking/ GEM/ MACDONALD/ Grinnel/ Morley
Hydrant Valve	New age/ Safeguard/ GETECH/ Minimax
First Aid Hose reel	Kesara/ Mitraflex/ Exflame/ Syntex
Reinforced Rubber Line (RRL) Hose Pipe	New age/ Safeguard/ GETECH/ Jayashree/ CRC/ Jyoti/ Maruti/ Dunlop/ Minimax/ Safex/ Zenith
Stainless steel Branch pipes, Nozzles and couplings	New age/ Safeguard/ GETECH/ Minimax
Sprinklers	Tyco/ HD/ Spraysafe (UK)/ Reliable (USA)/ Grinnel/ Star
Installation Control Valve	Tyco/ HD/ Viking/ Mather & Platt/ Spraysafe/ Central
Batteries	Exide/ Standard/Amara Raja
Cushy Foot mountings	Dunlop/ Resistoflex/ Flenonics (USA)/ GERB

Items	Reference Makes
Fire Hose Cabinet	New Age/ Safeguard/ Omex

3.8 TYPICAL ILLUMINATION LEVEL AT VARIOUS LOCATIONS

SN	Location	Recommended Normal Lux Level at floor level	Type of Fitting	Indoor/Outdoor
1	Circulating Area	100	LED	Outdoor
2	Entrance	200	LED	Outdoor
3	Covered Passageway Corridor Stair	150	LED	Indoor
4	Stores	200	LED	Indoor
5	Other Service Building	200	LED	Indoor
6	Public Utility Services (Toilet/Bathroom)	150	LED	Indoor
7	Equipment Room	300	LED	Indoor
8	Control Room	300	LED	Indoor
9	Staff Quarters	200	LED	Indoor
10	Streetlight	15	LED	Outdoor
11	Rest Room	150	LED	Indoor
12	Rooms	200	LED	Indoor
13	Washbasin	150	LED	Indoor
14	Substation building/ battery room/ Cable distribution Area	150	LED	Indoor
15	Sign Boards	-	LED	Outdoor
16	Level Crossing	50	LED	Outdoor
17	Switch Yard	50	LED	Outdoor
18	Depot (Technical Rooms)	300	LED	Outdoor
19	Sign, Maps, Displays	200	LED	Indoor/ Outdoor

Note: Above Lux levels may be ascertained from relevant standards as per applicability.

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CHAPTER – 4 INSTALLATION AND CONSTRUCTION

4.1 REQUIREMENTS

4.1.1 General Requirements

(i) The Contractor shall comply with all Enactments in executing the Works, including but not limited to all statutory provisions on occupational health and safety.

(ii) The Contractor shall co-ordinate with Other Contractors in the execution of the Works.

(iii) The Contractor shall co-operate with all Relevant Authorities in the execution of the Works.

(iv) The installation of all equipment shall be undertaken at all times by suitably trained and competent employees of the Contractor, to the satisfaction of the Engineer.

(v) Only appropriate tools, plant, equipment, and vehicles shall be used. The equipment used shall be latest, calibrated properly and calibration certificate shall be updated and available at site.

(vi) Installation of all equipment shall be in accordance with the Construction and Installation Plan described in the drawing/plans as approved by Engineer.

(vii) Installation of all equipment shall conform to the best industry practices.

(viii) Precautions shall be undertaken to ensure the safety of personnel and equipment for all installation works.

(ix) The Contractor shall, prior to starting any installation and construction work, identify any possible hazards, and implement measures of eliminating and/or controlling such potential hazards, in line with safe working practices.

(x) The Contractor shall ensure that all areas of work are sufficiently illuminated for the works to be undertaken and that a safe system of work is employed for all activities.

(xi) The Contractor shall operate a robust system for the control of persons entering or working upon the site.

(xii) The Contractor shall always co-operate with the Engineer and Other Contractors to ensure that the Site is protected from unauthorised admission, either wilfully or otherwise.

(xiii) The Contractor shall make due provision for the safe access and egress to the Site of Works for its staff and subcontractors.

(xiv) This access shall be maintained such that it is free of all hazards and is in a safe condition throughout the duration of the Works.

(xv) Contractor shall submit method statement for (a) Erection of equipment, (b) Equipment testing and commissioning and (c) Performa and checklist for recording during equipment testing for review by the Engineer.

(xvi) The Contractor shall set up at least one main store/ depot for receiving and storing materials & other equipment at his own cost. The Contractor shall keep the stores in safe and secure manner to avoid any damage or rust.

(xvii) Contractor shall always keep at least one set of drawing / design/ documents approved by Engineer in hard copy at site.

(xviii) The Contractor shall make own necessary arrangement of power supply, Genset, water supply, tools, M&P etc. at site required for construction, testing and commissioning of the project.

(xix) The Contractor shall ensure all safety provisions to avoid any incident on account of electrical system failure. Wherever, there is any cabling or electrical connection for project use, the same shall be secured properly following adequate practice with precaution.

(xx) The Contractor shall coordinate the relevant Local Authority for any hindrance occurred during the project working at site. The Contractor shall be responsible for restoring any fault/ damage to existing facilities of the Local Authority complying to their norms and requirements.

4.1.2 Specific Requirements

The installation and construction work pertaining to this Contract shall include, but not be limited to the following:

i. Finalisation of the Construction and Installation Programme provided by Contractor and duly approved by Engineer.
ii. Survey on site and review the technical requirements shown in this Specification and the Engineer's Drawings (if any).
iii. Production of the calculation sheets and installation drawings for Site installation.
iv. Production of specific site designs and drawings based on typical designs and drawings supplied.
v. Installation in accordance with the finalised installation drawings.
vi. Co-ordination with Other Contractors.
vii. Submission of the installation reports and records.
viii. Testing and commissioning, as per finalised protocol and programme.

4.2 CONSTRUCTION AND INSTALLATION PLAN

4.2.1 The Contractor shall undertake installation work in stages as shown in the detailed installation programme. Installation, testing and commissioning of later stages shall not impact revenue operation of earlier stages. As a minimum, the detailed Construction and Installation Plan shall include but not be limited to all the activities, installation details and methods of all activities, equipment, and tools to be used for installation, safety issues, supervision, temporary land occupation needed and the vehicles to be used for installation.

4.2.2 Material Handling

To facilitate handling of equipment during installation and maintenance thereafter, the Contractor shall closely co-ordinate and interface with other Contractors. The entire material handling plan for movement of bulky items such as Transformers, Panels, Gensets, fire fighting pumps, VRV units, high masts, street light poles and cables etc. shall be carefully planned. Crane of adequate capacity with a jib of requisite length will be arranged by the Contractor at his own cost. A road crane for handling heavy materials at the contractor's depot for loading and unloading of material will be arranged by the Contractor and shall arrange his own crew for its operation and maintenance. All charges including pay and allowances of the crew and all running expenditure shall be borne by the Contractor.

4.3 SITE SUPERVISION/ DEPLOYMENT OF TECHNICAL STAFF:

4.3.1 The Contractor shall set up a Site supervision system, which shall be part of the overall safety, system assurance and quality management system.

(i) The Contractor shall provide sufficient number of experienced Engineers, Supervisors, and skilled workers to ensure progress and quality of the work at site and in the Contractor's workshops (if any), are maintained to the satisfaction of the Engineer. The minimum number of "Key Personnel" to be deployed is as under:

No.	Post	Minimum Eligibility	Minimum Requirements in nos.
1	Project Manager (Overall, in charge)	Graduate in Electrical Engineering with minimum 8 years experience in Electrical General Services work i.e. HT & LT works, substation, Lift, air-conditioning (VRV or chiller based) and fire detection and fire suppression work etc.	1
2	Senior Designer (Electrical)	Graduate in Electrical Engineering or Electronics and Communications Engineering with minimum 5 years experience in Electrical General Services work i.e. HT & LT works, Lift, substation, Airconditioning and Fire Detection and Suppression work.	1
3	Field Engineer (Electrical)	Graduate in Electrical Engineering or Electronics and Communications Engineering with minimum 4 years experience in General Services work i.e. HT & LT works, substation, Airconditioning works or lift, air-conditioning works. **Or** Diploma in Electrical Engineering with minimum 6 years experience in General Services work i.e. HT/ LT, substation, Airconditioning, lift etc.	2

(ii) The Contractor shall submit to the Engineer, within 60 days from the date of issue of LOA, the CVs of the key personnel along with all details of qualification and experience. The Engineer shall issue Notice of "No- objection" or otherwise for the appointment of "key positions" within stipulated working days of such submission. The incomplete submission of CV shall not be considered as submission.

(iii) The performance of personnel shall be under observation by Engineer. In case the performance of any personnel is not up to the mark, as decided by Engineer, Contractor shall provide replacement of such personnel, with similar experience within one month.

(iv) In case the Contractor fails to employ the technical staff as aforesaid to the satisfaction of the Engineer, the recovery shall be as mentioned below per month or part thereof of default.

SN	Post	Amount to be recovered per person per month or part thereof of default (Rs)
1	Project Manager (Overall In charge)	Rs. 2,00,000/-
2	Senior Designer (Electrical)	Rs.1,50,000/-
3	Field Engineer (Electrical)	Rs.50,000 /-

(v) Contractor shall abide by the provisions of Payment of Wages act & Minimum wage act.

(vi) The Contractor shall be responsible for the supervision of the concerned system installation, primary fixing system, earth mats etc.

(vii) The Contractor shall maintain a set of drawings of each system which accurately reflect the current status of field changes. The Contractor shall obtain letter of No Objection from the Engineer for any such changes. The Contractor shall prepare final drawings showing the as built configuration. These drawings shall be developed in a logical format to facilitate routine system maintenance and troubleshooting.

(viii) The Engineer reserves the right to undertake, at any time, checks on the proficiency of the Contractor's staff, licensing and all associated documentation. If any of the Contractor's staff be found incompetent or unlicensed, he shall be removed from the site until their Competency has been established.

4.4 WORKMANSHIP

4.4.1 All the installation shall be carried out according to the instructions shown in these specifications and Drawings (as approved). All assemblies of equipment and their components and parts shall be completely interchangeable if they are of similar type. The style and procedure of the workmanship shall be consistent throughout the Works. Unless otherwise specified, the Engineer shall decide the final colours for all paint work and other finishes to be applied to any part of the Works. All parts, which are subject to, wear or damage by dust, shall be completely enclosed in dust proof housings.

4.4.2 Installation of Cables

(1) The Contractor shall co-ordinate with the Civil Contractors wherever necessary, for the installation of cables in cable galleries, trenches, ducts, trays, risers, shafts, walls, holes/opening in walls, under ground, under road, under track and other locations.

(2) The cable system shall, during installation, be fully protected from mechanical damage and be generally accessible at all points for inspection along its entire route. Suitable cable route markers shall be provided for covered cables upon completion of installation. Should it prove necessary to cut any cable during installation, all cut ends shall be properly sealed.

(3) The maximum pulling force of any cable during installation shall not exceed the design force of cables.

(4) All cables shall be installed in the formed cable trenches, shafts, hangers, trays and brackets etc. The minimum recommended bending radius of the cables shall be adhered to during installation.

(5) All materials used for termination, jointing and installation of cables in confined spaces shall have flame retardant, low smoke, halogen free characteristics.

4.5 Interface Between Electrical/ Civil Contractor and Other Contractors

The Contractor shall carry out necessary interface with other Contractors working in the area for successful completion of works. The indicative list of interfaces as under:

S. No	Item Description	Electrical Contractor	Other Contractor
1.	Laying of conduits in the buildings	Shall interface with Civil Contractor and shall lay conduits during building construction in the roof.	Civil Contractor shall allow Electrical Contractor to lay conduits in the roof during construction of the building.
2.	Track Crossing of HT/LT cables	Shall lay GI pipes under the tracks for crossing the HT/LT cable	Track Contractor shall facilitate laying of GI pipe below the track
3	Installation of cables in Metering room, CSS room, Genset room and LT panel	Shall make necessary cable trenches, hole in wall, cable trays with suspenders & necessary cable supports, chase in wall etc. for laying of HT and LT cables. Shall interface with Civil Contractor for providing these facilities during construction stage.	Civil Contractor shall provide cable trenches and hole in walls etc for facilitating laying of HT/LT cables by Electrical Contractor.
4.	Power supply from State Electricity Authority at 11 kV, 3-phase.	Shall connect 11 kV cable from H-pole of State Electricity Authorities to 11 kV Metering room and CSS.	State Electricity Authorities to facilitate connection of 11 kV cable by Electrical Contractor at H-pole.

5.	SCADA connectivity of HTP, MDP, GENSET supply	Shall facilitate SYS-1 Contractor to connect SCADA to General Power Supply system i.e. High Tension Panel, Main Distribution Panel and GENSET supply.	SYS-1 Contractor shall provide SCADA connectivity for General Power Supply.
6	Air-Conditioning System (VRV) in IMD Manesar	Shall interface with Civil Contractor for installation of air-conditioning (VRV) system in IMD Manesar building. Necessary modification in building shall be carried out by Electrical Contractor for installation of air-conditioning system.	Civil Contractor of IMD Manesar building shall facilitate Electrical Contractor for installation of air-conditioning system in IMD Manesar building.
7.	Air-Conditioners in station rooms	Shall interface with Civil Contractor for installation of air-conditioners in the buildings. Necessary modification in building shall be carried out by Electrical Contractor for installation of air-conditioners.	Civil Contractor shall facilitate Electrical Contractor for installation of air-conditioners in the building.
8.	Fire fighting system	Shall interface with Civil Contractor for installation of Fire Fighting system in IMD Manesar building. Necessary modification in building shall be carried out by Electrical Contractor for installation of fire fighting system.	Civil Contractor of IMD Manesar building shall facilitate Electrical Contractor for installation of Fire Fighting system in IMD Manesar building.
9.	Submersible pump	Electrical Contractor shall install submersible pumps in the bore hole provided by the Civil Contractor. Shall interface with Civil Contractor and advise the bore hole dia to Civil Contractor.	Civil Contractor shall provide the bore hole for installation of submersible pump by Electrical Contractor.

10.	Installations of Lift	Shall interface with Civil Contractor for installation of Lift in IMD Manesar building for modification in lift well, guide rails, cables, landings etc.	Civil Contractor of IMD Manesar building shall carry out modifications in lift well, landings etc. to facilitate Electrical Contractor for installation of Lift in IMD Manesar building.

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CHAPTER – 5 TESTING AND COMMISSIONING

5.1 TESTING

(1) The testing & commissioning related to the Various Electrical General Services works shall be done in conformity with the requirements of RDSO/Railway Board Standards and standard Railway practices. Testing constitutes an essential obligation to satisfy the Railway System.

(2) These Employer's Requirements establish the overall procedure for the Contractor to follow for the Works that is related to the components manufactured off-site and supplied for installation in the Permanent Works. These requirements relate to their manufacturing, procurement, delivery, testing and installation in the system and associated activities.

(3) The Contractor shall establish procedures and controls that govern the procurement and manufacturing off-site of material/ equipment/ components required for the works and supply them for construction/ installation, assembling and wiring in the Permanent Works.

(4) The Contractor shall submit a comprehensive Testing Plan & Program for the project to the Engineer for his consent.

(5) Type Test shall be performed by the Contractor and shall be witnessed by Employer's Personnel and / or the Engineer.

(6) Factory Acceptance Test (FAT) including stage inspection shall be performed by the Contractor and shall be witnessed by Employer's Personnel and/ or the Engineer.

(7) Approval for witnessing the Tests shall be communicated by the Engineer to the Contractor after obtaining consent from the Employer.

(8) The material delivered to the Site and offered for Inspection shall be manufactured normally not earlier than one (1) year and their guarantee period shall cover the Defects Notification Period (DNP). However, the specified period of Manufacturer's Warranty shall commence from the date of commissioning of the Work and all the manufacturer's Warranties shall be in the name of the Employer.

(9) Manufacturing and testing of various equipment, components and fittings shall be as per approved technical requirement, Schedule of Guaranteed Parameters (SOGP) etc.

5.2 TESTING AND EQUIPMENT ACCEPTANCE

(1) The Contractor shall carry out all the tests and checks for good construction and the satisfactory operation of all power supply and other Electrical General Services installations. The Contractor shall co-ordinate and arrange testing equipment etc. required for testing purposes. The testing equipment shall be calibrated and calibration certificate shall be available at site.

(2) The various high, medium, and low voltage equipment will be subjected to all the tests required under equipment test sheets, (lists are not exhaustive) as per the relevant RDSO or IEC or other standards mentioned in the technical specification of each equipment or otherwise.

(3) The Contractor shall be responsible for assembly and installation of all pieces of equipment mentioned in this specification. The maintenance equipment and the special

tooling shall be delivered as soon as equipment installation is completed. The Contractor shall arrange and witness all the tests at commissioning and supervision after energising. These tests will enable checking the quality of the equipment and its compliance with the specifications.

5.3 FACTORY ACCEPTANCE TEST PLAN

(1) The Contractor shall prepare and submit for review by the Engineer the Factory Acceptance Test Plan detailing the Contractor's plan, documents, inspections and tests that shall be conducted to verify and validate the Works prior to delivery to the Site. The plan shall consist of a narrative description supported by graphics, diagrams and tabulations as required.

(2) (a) The Contractor's strategy for inspection and Factory Acceptance Tests of all constituent parts of the Works and Procurement Management & Manufacturing Plan.

(b) These quenching and interrelations of the inspections and tests including all Quality Hold Points and Quality Control Points.

(c) The type and extent of inspection and Factory Acceptance Tests to be undertaken and the parts of the Works to be proven by that testing.

(d) The objective of each inspection or test, what particular design and operating criteria the test or inspection will prove and how the success of the test or inspection will be demonstrated or measured.

(e) The plan for the production and submission of the inspection and test procedures shall be submitted to the Engineer for review including the submission of the inspection and test reports and records; and Type Tests, Routine Tests, First Article Inspections and any other tests constituting the Factory Acceptance Tests.

(3) This plan shall clearly demonstrate the logic of all related processes, the logical dependencies between the individual tests of the works, and shall also show the interfaces and dependencies with the Contractor's delivery program. The Factory acceptance Tests shall be carried out in OEM's Premises/ factory/ Manufacturing place.

(4) Factory acceptance Tests (FAT) shall include Type, Routine, Acceptance, Special Tests, as approved by the Engineer at Original Equipment Manufacturer's (OEM) factory or the Accredited Test lab / test house. The accredited Test lab or test house shall be approved by the Engineer. Routine tests shall include tests such as visual inspection, dimension check, electrical conductivity check, insulation check, calibration, mechanical and hydraulic tests and any other compliance tests etc. as per specification. Type tests shall be performed on a sample of the complete equipment of each type and rating etc. based on SOGP and agreed standards or specification. The FAT stage may also include some integration tests at the manufacturer's factory, which are performed to test the integration of the components that make equipment. Each software system shall be tested to simulate inputs and outputs including integration testing as possible, thereby reducing the overall integration risks to equipment at later stages. Each software FAT should take place in an environment as close as possible to the operational environment or suitably de-rated for application duty requirement.

(5) If type test of equipment, components or fittings of any manufacturer have already been approved in connection with the electrification of other sections of Indian Railways or Metro or RRTS or DFCCIL or High Speed Rail system then the type test of such equipment, components or fittings will be exempted from the tests. Such type test shall

not be more than 5 years old from the date of issue of Letter of Acceptance (LOA) of the contract and complete type test report shall be submitted to the Engineer.

(6) The FAT Plan shall include a comprehensive list of the tests with acceptable parameters, Tests to be witnessed by representatives of various parties i.e. the Contractors' representatives, the Employer and /or Engineer or their representatives, the duration of the test, Tentative dates etc. The Contractor shall give minimum 28 days prior notice period to all representatives to witness the test.

(7) The FAT Plan shall include details of inspection, testing and witnessing of the Contractor's and subcontractor's procurement and manufacturing activities at OEM's Factory, as a minimum, it shall include:

a. First Article Inspection;

b. Stage inspections;

c. Quality Hold Points;

d. Type Tests; and

e. Routine tests.

(8) The Contractor shall arrange for all equipment and systems manufactured for incorporation into the Permanent Works to undergo a Factory Acceptance Test (FAT) before shipment from the place of manufacture.

(9) The Contractor shall be responsible for re-inspecting and re-testing any failed inspection and Factory Acceptance Test including regression testing on previously passed items.

(10) Inspections and tests that are to be witnessed by the Employer's and /or Engineer's Personnel shall be grouped and scheduled so that as many inspections and tests as possible may be witnessed during a single visit.

(11) The Contractor shall prepare two copies of the inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer and/or the Engineer's Personnel. If the Employer's Personnel /the Engineer has witnessed the inspection or test, he may countersign the inspection or test **(**i.e. whether or not the equipment being inspected or tested has passed satisfactorily) contained therein. If the Employer's Personnel /the Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, or for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Engineer. In case the results of the inspection or test do not meet the requirements of the Specification, the Employer/ the Employer's Personnel/ the Engineer may call for a re-inspection or re-test.

(12) For standard equipment which is serial or bulk manufactured, manufacturer's type test certificates (or equivalent) may be acceptable, subject to review by the Engineer.

(13) Test equipment and instrumentation shall be subject to approved calibration tests within a properly controlled calibration scheme, and signed calibration certificates shall be supplied to the Engineer in duplicate. Such calibration checks shall be undertaken prior to testing and, if required by the Employer's Personnel/ the Engineer, shall be repeated afterwards.

(14) Materials and equipment shall not be released for shipment until all applicable inspections and tests including Factory Acceptance Tests have been satisfactorily

completed.

(15) The Contractor shall maintain records to demonstrate evidence of quality and accountability. These records shall include results of inspections, tests, process controls, certification of processes and personnel, discrepant material and other quality control requirements.

(16) Inspecting and testing records shall be in ISO format and as a minimum, indicate the nature of the observations made, the number & types of deficiencies found and action proposed to correct deficiencies. Also, records for monitoring work performance and for inspecting and testing shall indicate action taken for the correction of deficiencies.

(17) The Contractor shall submit to the Engineer a request for a “Notice of No Objection to Supply” the manufactured items along with all the relevant manufacturer’s test certificates and inspection certificates prior to shipping / transporting. However, the material which have been inspected and the testing of which has already been witnessed by the Employer’s representative, the “Notice of No Objection to Supply” may be issued directly by the Employer’s representative.

5.4 INSPECTION AND TESTING COST

(1) The witnessing of testing and inspection of the material shall be done by Employer’s and/or Engineer’s representative and all costs associated with the testing/inspection shall be borne by the Contractor including travel/lodging/boarding charges of Employer’s and/or Engineer’s representative. Employer may nominate any third party for testing and inspection of material also. Any testing/inspection charges to be paid to the Test Laboratories etc. shall also be borne by the Contractor.

(2) The Contractor shall bear all expenses of Employer’s and/or Engineer’s representative including hotel/travel/cost of witnessing the retesting/re-inspection (if any) caused by defects or failure of equipment to meet the requirements of the Contract in the first instance.

5.5 PACKAGING AND SHIPPING

(1) The packaging and shipping shall be done ensuring that the equipment and cables do not get damaged during transit. The Contractor’s quality control personnel shall verify the inspection and preparation for shipment.

(2) Each case, crate or package shall be of robust construction and suitable for the intended purpose. Packaging material that are likely to suffer deterioration in quality as a result of exposure to environmental conditions likely to be met during transit from the factory of origin to the Site shall not be used.

(3) Each case, crate or package shall be legibly and indelibly marked in large capital letters with the address, Contract number, 'right way up', opening points and other markings like “fragile”, “keep dry”, “handle with care” etc. along with visual display of internationally accepted symbols as necessary to permit material to be readily identified and handled during transit and when received at Site.

(4) Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents together with any relevant drawings. The second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case, crate or package. Distribution of additional copies of each packing list shall be in accordance with the requirements of the Engineer.

(5) Care shall be taken to prevent movement of equipment within containers by the provision of bracing, straps and securing bolts as necessary.

(6) Bags of loose items shall be packed in cases and shall be clearly identified by well-secured metal labels on which the quantity and name of the part and its index or catalogue number have been stamped.

(7) Spare parts shall be suitably packed for storage over an indefinite period without deterioration and shall be clearly identified showing full name and part number without any need to unwrap packaging. Electrical and other delicate items or equipment shall be cocooned.

(8) Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt, vermin or moisture.

(9) Tube ends and other similar openings shall be thoroughly cleaned and then blanked-off to prevent ingress of dirt or moisture.

(10) Particular care shall be taken to prevent damage to or corrosion of shafts and journals, where they rest on timber or other supports that may contain moisture.

(11) At such points wrappings impregnated with anti-rusting compositions shall be used, of sufficient strength to resist chafing under the pressures and movements likely to occur in transit.

(12) Care shall be taken to minimize risk of damage to ball and roller bearings and any fragile material in transit.

5.6 CABLE DRUMS

(1) Immediately after the tests at the place of manufacturing, both ends of every length of cables shall be sealed by enclosing them with approved caps, tight fitting and adequately secured to prevent ingress of moisture.

(2) The ends of the factory lengths of cable shall be marked “A” and “Z”, “A” being the end at which the sequence of core numbers is clockwise and “Z” the end at which the sequence is anti-clockwise.

(3) The end which is left projecting from the drum shall be consistently “A” or “Z”, and shall be protected against damage in such a manner that the enclosure cannot be easily removed during handling while in transit.

(4) Cables shall be supplied on drums in the longest possible lengths and within practical limits.

(5) The maximum allowable diameter of cable drum shall be 2000 mm. The use of cable drums with diameter in excess of 2000 mm shall be subjected to the review of the Engineer.

(6) The drums shall also be designed for use in conjunction with any special cable- laying equipment and accessories complete with spindles and cable drum braking gear, which shall be used to install the cables on Site.

(7) Each drum shall bear a distinguishing number and label “HRIDC”, either printed or neatly chiseled on the outside of a flange.

(8) Particulars of the cable, i.e. voltage, length, conductor size, number of cores, section and length, gross and net weights, shall be clearly shown on one flange of the drum.

(9) An arrow showing direction of rolling shall be shown. Both ends of the cables shall have heat shrinkable caps. The caps shall incorporate sealants which melt on heating

at temperatures well above outdoor ambient expected in HORC area.

5.7 HANDLING, STORAGE AND DELIVERY

(1) The Contractor shall ensure Comprehensive Test and inspection instructions for handling, shipping, storage, preserving, packaging, packing, marking, and shipping to protect the quality of the equipment and to prevent damage, loss, deterioration, degradation or substitution thereof.

(2) Handling procedures shall include the use of special crates, boxes, containers, transportation vehicles, equipment and facilities for material handling.

(3) The Contractor shall provide adequate and storage (covered) facilities, at its own cost, for storing in a safe and secure manner all the plant & equipment and manufactured items to be supplied and erected as part of the Contract.

(4) The Contractor shall make its own arrangement of covered space for storage facility and security of material in the store.

(5) Contractor shall take suitable measures for protection against deterioration or damage to equipment in storage. Where shelf-life of the equipment / material is limited, this shall be clearly stated on the shipment. Secure compound and covered storage for the high value items shall be integral part of the safe storage. Spares to be supplied shall also be kept safe and secure until handed over to the Employer at the time of Commissioning.

(6) The Contractor shall include the delivery activities in his Monthly Schedule Updates for submission to the Engineer.

(7) The Contractor shall ensure that the site is ready and in good conditions for delivery.

(8) The Contractor shall remove temporary fittings, if necessary, for delivery of items to site and shall restore the fittings to the original state and to the satisfaction of the Engineer.

(9) No dangerous goods shall be delivered to the Site.

5.8 GENERAL PRECAUTIONS

(1) Spare parts shall be suitably packed for storage over an indefinite period without deterioration and shall be clearly identified showing full name and part number without any need to unwrap packaging. Electrical and other delicate items or equipment shall be cocooned.

(2) Cable ends, cable entry points into equipment and other similar terminations and openings shall be sealed or blanked off to prevent the ingress of dirt, vermin or moisture.

(3) Tube ends and other similar openings shall be thoroughly cleaned and then blanked-off to prevent ingress of dirt or moisture.

5.9 WARRANTY CERTIFICATES FROM OEM

(1) All Original Warranty Certificates of OEMs of all Electrical system and equipment including contract spare, commissioning spare, DNP spares and Special tools & Test

and Measuring equipment shall be valid for three years or as specified in RDSO Specification of the equipment whichever is more and registered in the name of Employer. These warranty certificates received from the OEMs should be passed on to Engineer before final Taking over.

(2) Validity of period of Warranty Certificates shall start from date of Commissioning.

(3) Warranty period and defect liability support shall start from the date of Commissioning.

5.10 INSTALLATION METHOD STATEMENT

(1) Installation Method Statements shall be submitted to the Engineer for review at least 28 days prior to the installation activity commencing on site.

(2) The installation method statement shall include the details on the methods and procedures of installation, site arrangement, manpower resources, equipment and tools required. Drawings shall be included to illustrate the proposed installation details. Necessary safety items, first aid provision, emergency vehicles and means for evacuation of injured person to hospitals etc. in case of accident shall be incorporated.

(3) Prior to proceeding with installation, the Contractor shall submit, for the Engineer's consent, six copies of drawings showing all installations including dimensions, supports, hardware, installation methods and documents confirming the availability and location of special installation tools and equipment and all other pertinent data.

(4) The Contractor shall make certain that the installation of all supports, gaskets, hardware, etc., are accomplished so as to assure safe, accurate and trouble-free installation. The installation for major items such as important components and vital equipment such as transformers, Genset, HT panel, high masts, air-conditioning (VRV), fire fighting equipment, Lift items, pumps, motors etc. shall be undertaken preferably in the presence of the manufacturer's field service representative.

(5) Upon noticing or being advised of any inconsistencies between the installation drawings and documentation and the installed equipment, the Contractor shall notify his acknowledgement to the Engineer and correct such errors within two weeks.

(6) Equipment that is improperly installed shall be removed, checked, tested and reinstalled. Any damage caused due to improper installation and removal shall be rectified before reinstallation at no extra cost to the Employer.

(7) In case installation is proposed at night, necessary safety precautions, lighting arrangement etc. shall be made and prior consent of Engineer shall be obtained.

5.11 SITE ACCEPTANCE TESTS, COMMISSIONING AND TRIALS

5.11.1 Site commissioning tests: The Contractor shall ensure that:

(a) All equipment, cabling, distribution etc. is electrically and mechanically safe.
(b) All interlocks, isolators and door and cover securing mechanisms shall be properly fitted and adjusted.
(c) All exposed metal work is properly bonded and grounded and all connections and points required to be grounded for a safe and satisfactory operation shall be properly grounded in accordance with the manufacturer's requirements.

(d) All cables, cores and terminations shall be secure, properly fitted and correctly identified and colored.

(e) All phases, polarities, neutral and common connections shall be correctly switched / connected as required, so that the power is correctly available at all points and that the voltage and frequency at all equipment is correct and in accordance with the requirements for correct work.

(f) All supplies shall be properly fused or otherwise protected, to give successfully discrimination and safe disconnection under fault conditions.

(g) All contacts shall be properly aligned / adjusted and not subject to excessive wear or corrosion.

(h) Batteries shall be correctly installed, connected, fitted and checked that the battery chargers are working correctly.

(i) The insulation-resistance of all cabling and equipment shall not be less than specified.

(j) During the commissioning of major item like HT panel, Transformer, Gensets, lifts, pumps, VRV system, motors etc., the Contractor shall arrange expert Engineer of OEM of such item at respective sites. The expenditure for charges for the same including transport, lodging, shall be borne by the Contractor at no extra cost.

(k) All instruments and meters shall be energized with correct polarity and working properly.

(l) All fault indications and alarms shall be working correctly.

(m) In addition to all operational tests required for a successful hand-over, the operation of all interlocks, sequences and protections which are not utilized in normal operations shall be subject to the acceptance by the Engineer.

(n) The on-site commissioning tests shall be conducted under the supervision of the Engineer.

(o) The Contractor shall prepare the check lists, proforma etc. of each equipment for recording the test results, with the consent of the Engineer.

(p) On completion of the site acceptance tests, the Contractor shall forward the test results certified by him to the Engineer. When the Engineer has received the results and deems that the plant has successfully passed the tests, he will advise the Contractor accordingly.

5.11.2 Commissioning

(a) At least six weeks in advance of any particular site testing, the Contractor shall submit details of tests and details for the tests equipment proposes to use for that testing, to the Engineer for approval.

(b) All tests for statutory requirements and insurances including arrangements for such tests, inspections by Authorized bodies, persons or insurers, as necessary and the provision of certificates in the prescribed and approved forms necessary to enable plant and equipment to be put into service, shall be made by the Contractor.

(c) The commissioning tests for each part of the plant shall be carried out on site.

(d) As installation proceeds, the insulation resistance of cables shall be checked and recorded. The identification of the cores shall be confirmed from end to end of each cable end. In the case of communication, alarm and control-cabling, identification of the cores from end to end of each circuit shall be done. Tests on cables shall be completed and accepted by the Engineer before the testing of the associated equipment starts.

(e) All tests for statutory requirements and insurances including arrangements for such tests, inspections by authorized bodies, persons or insurers, as necessary and the provision of certificates in the prescribed and approved forms necessary to enable plant and equipment to be put into service, shall be made by the Contractor. On inspection by the concerned authority/ department, all checklists and observations shall be complied by the Contractor with no additional cost.

(f) The final acceptance tests shall be done after all on-site commissioning tests have been successfully completed and all defects detected during those tests have been rectified, which are accepted by the Engineer. The tests shall include full operation tests on the works as a whole and selected technical tests on some or all of the equipment.

5.11.3 Energization

1. The Contractor shall prepare operation safety rules and procedures for the review of the Engineer before Energization. The Contractor shall carry out all necessary checks to ensure safe Energization.
2. All power equipment shall be subject to inspection by inspectors from the Electrical Inspectorate of Engineer before Energization. The Contractor shall ensure that all Employer's Requirements are met. Contractor shall be responsible for reliable operation of all Electrical equipment.
3. Any of the observations during inspection of Electrical Inspectorate of Engineer shall be complied by the Contractor in all respect and no additional payment shall be made for the same.
4. All necessary documentation and checklist required for the inspection of Electrical Inspectorate of Engineer shall be done ready in the desired format and norms as per the requirement.

5.11.4 TRIAL OPERATION

(a) The trial operation shall be done with full responsibility of the Contractor. The trial operation shall take place after tests on completion.

(b) The trial operation shall show the evidence of a fully functional operation of the electrical system and that security is given during operation. Therefore, the trial operation shall occur without significant malfunctions. The Contractor shall test different operation cases during the trial operation (e.g., loss of different equipment etc.).

(c) The Contractor shall make all organizational measures during the trial operation, so that malfunctions can be rectified as soon as possible (within maximum 2 days).

(d) The Contractor shall commence extended period of trial run to prove that all technical systems work properly to the satisfaction of the Engineer/Employer and Commissioner for Railway Safety or any other Authorized Official and to allow all technical systems to settle and also to train staff to become conversant with the working procedures. The Contractor's personnel shall be available throughout the scope of work over the whole of this period. After successful Trial Run and obtaining statutory clearances / approvals from CRS / EIG and / or other relevant authorities, the Works shall be commissioned with the consent of the Engineer. The results of the different tests during trial operation shall be signed by the Contractor and the Engineer.

5.12 INTEGRATED TESTING

(1) Integrated Testing shall include the Work of other Contractor(s) also to ascertain that all systems work properly. The details of integrated tests to be performed shall be prepared by the Contractor and shall be submitted to Engineer for approval. The Contractor shall follow satisfactory completion of tests on works, equipment, sub-systems or system, perform, as approved by the Engineer. Program of tests to verify and confirm the compatibility and complete performance of works, equipment, sub-systems or system with the works, equipment, sub-systems or system provided by others.

(2) The Contractor shall submit to the Engineer the requirements and procedures in respect of the Contractor's scope of work for Integrated System Tests in conjunction with the other Contractors to demonstrate that the complete system provided under the Contract is fully operational and meets the specified performance criteria.

(3) Integrated Testing & Commissioning include all the tests undertaken in order to demonstrate that the various components of the railway systems operate satisfactorily between one another and meet all specified requirements for design, operability, safety, and integration with other systems.

(4) These tests shall be entirely within the requirements of one or more of the Project Contracts or they shall involve a multiplicity of Contract procedure. The final Integrated Testing and Commissioning shall be carried out after the SCADA system and OCC have become operational.

(5) Those systems that can be tested without depending on the running of trains, such as SCADA and Telecom system etc., will have their integration tests scheduled to commence as early as possible. It is preferable that any interface problem associated with these "trainless" system tests be identified and resolved prior to the commencement of test running.

(6) The Integrated Tests by the Contractor and other Contractors shall include a period of Trial Run.

(7) The results of the Integrated Testing and Commissioning shall be compiled and evaluated by the Contractor and shall be submitted to the Engineer.

(8) If the Works, or a part thereof, or a section, or a plant & equipment and manufactured item fail to pass Integrated Testing and Commissioning and the Contractor in consequence proposes to make any adjustment or modification to the Works or a part thereof, or a section, or the plant & equipment and manufactured item, the Engineer may, with the approval of the Employer, instruct the Contractor to carry out such adjustment or modification at his own cost to satisfy the requirements of Integrated Testing and Commissioning within such time as the Employer / Engineer may deem to be reasonable.

(9) If the Works, or a part thereof, or a section, or a plant & equipment and manufactured item fail to pass the Integrated Testing and Commissioning, the Engineer shall require such failed Test(s) to be repeated under the same terms and conditions with no additional cost. If such failure and retesting results due to the fault of the Contractor and cause the Employer to incur additional cost, the same shall be recoverable from the Contractor by the Employer and shall be deducted by the Employer from any money due or to become due, to the Contractor.

5.13 TEST RECORDS

5.13.1 Tests Reports

(1) The Contractor shall submit manufacturer's type test and routine test certificates and reports for each equipment and device. Complete test results are to be submitted in clearly identified and organized booklet, indicating item of equipment, make, model, type, date of tests and type of tests, descriptions and procedures. Test reports shall also include the Quality Assurance Certification, the standards to which the equipment comply, and the standards to which the equipment was tested.

(2) The Contractor shall submit to the Engineer for review, not less than three (3) months before testing and commissioning activities commence his proposed format for testing and the commissioning records. The records shall be appropriately sub-divided to make provision for the various parts of the Permanent Works covered by the Contract.

(3) The format of the records shall cover all tests, provide positive identification by serial number for assemblies and sub-assemblies of the Works and show modifications to Employer's drawings and diagrams or "As Built" data to be certified by the Engineer in the course of installation, testing and commissioning.

(4) The Contractor shall, during the execution of the Works, prepare such reports and record of design, manufacture, installation and testing, as may be required, in order that a license may be issued or statutory requirements may be met or approval given. Such reports or records shall be adequate to enable each part of the Permanent Works to be commissioned and to meet the requirements of the licensing authority or any standing statutory regulations and shall be reviewed by the Engineer.

(5) The Contractor shall obtain report of each inspection and/or test. Such report shall show the result of all the inspections and/or tests carried out and shall certify that the work has been inspected and/or tested in accordance with the requirements of the Contract and that the work complies with the requirements of the Contract.

(6) The Contractor shall prepare an inspection or test report immediately after the completion of each inspection or test whether or not witnessed by the Employer or the Engineer. If the Employer or the Engineer or Employer's Representative has witnessed the inspection or test, he may countersign the inspection or test report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily contained therein). If the Employer or the Engineer has not witnessed the inspection or test (i.e. if a waiver has been granted, or the Employer or the Engineer has not witnessed the inspection or test for some other reason in accordance with the Contract), the Contractor shall forward two copies of the inspection or test report without delay to the Engineer. The Engineer will countersign the report to indicate his review of the information and conclusions (i.e. whether or not the equipment being inspected or tested has passed satisfactorily) and return one copy to the Contractor. Where the results of the inspection or test do not meet the requirements of the Specification, the Employer/ the Engineer may call for a re-inspection or re-test.

(7) The Contractor shall carry out an analysis of the results and certify that the work has been inspected/tested in accordance with the requirements of the contract and the work complies with the requirements of the Contract.

(8) Authorized representative of the Contractor, who has been assigned the required authority under the relevant quality plan, shall sign each report of inspection and/or test.

(9) In addition to any other requirements, the report shall contain but not limited to:

(a) Material or part of the Works tested.

(b) Location of the batch from which the samples were taken or location of the part

of the Works.

(c) Place of testing.

(d) Date and time of tests.

(e) Weather conditions in the case of in-situ tests.

(f) Technical personnel supervising or carrying out the tests or inspection.

(g) Size and description of samples and specimens.

(h) Method of sampling.

(i) Properties tested or inspected.

(j) Method of testing or inspection.

(k) All relevant checklists and worksheets used during the inspection and /or test, including readings and measurements taken during the tests.

(l) Test results, including any calculations and graphs.

(m) Specified acceptance criteria; and

(n) Other details stated in the Contract.

5.13.2 After Commissioning of a part of the Works, the Contractor shall complete each commissioning record in the agreed format and shall forward copies of the record to the Engineer for review.

5.14 SPARES, TOOLS AND TEST EQUIPMENT

The Contractor shall supply at least six weeks before the start of Defect Notification Period, the Spares, Tools and Test Equipment for various Systems/Sub- Systems, which are essential for day to day use in both corrective and preventive maintenance and for workshop use in repairing of modules/units.

(1) The list of additional Tools and Test Equipment is as under and shall be supplied by the Contractor at the rate given in Price Schedule, if required by the Employer in addition to BOQ quantities:

S. No.	Description	Quantity
1	Digital earth testers	1 no.
2	Earth Leakage Detector 1000 V	1 no.
3	Digital Insulation Tester 2.5 kV	1 no.
4	Digital Insulation Tester 0 – 1000 V	1 no.
5	Digital Vernier Caliper	1 no.
6	Digital Multi-meter	2 nos.
7	Tool kit Box	1 no.
8	Portable Electric drill	1 no.

(2) The following spares shall be provided and rates of BOQ Price Schedule shall be applicable:

S. No	Description	Quantity
1	Cable 2 core, 10 sqmm copper cable	500 m
2	Cable 2 core, 16 sqmm copper cable	500 m
3	Cable 2 core, 35 sqmm aluminium cable	500 m
4	Cable 2 core, 70 sqmm aluminium cable	500 m
5	Cable 2 core, 95 sqmm aluminium cable	500 m
6	Cable 4 core, 120 sqmm aluminium cable	500 m
7	22 W LED tubular lamp	100 nos.
8	40 W LED light	15 nos.
9	60 W LED light	10 nos.
10	120 W LED light	10 nos.
11	Emergency light 240 Watt	1 nos.
12	200 watt LED flood light for high mast	5 nos.
13	Metal clad plug socket 20A single phase with 32A MCB	3 nos.
14	Metal clad plug socket 16A single phase with 20A MCB	1 nos.
15	MCCB 200A, 4 pole, 440 volt, 36kA with enclosure	1 no.
16	2 kVA, 240 V AC online UPS cum Inverter	1 no.
17	BLDC 1200 mm sweep ceiling fans, 5-star rated with regulator	5 nos.
18	BLDC 1400 mm sweep ceiling fans, 5-star rated with regulator	5 nos.
19	300 mm sweep 5-star rated exhaust fan	3 nos.

These spares shall be provided by the Contractor only after receipt of specific instructions for supply of such items from Engineer/Employer. The quantities of these items are tentative and may be increased or decreased. More items from BOQ with quantities may be added as per requirement.

5.15 THE KEY DATES (KD) SCHEDULE FROM COMMENCEMENT DATE:

Key Dates	Days	Description of Activities
KD-1	60	(a) Submission of works Programme for IMD Manesar Building and Manesar Station. (b) IMD Manesar Building: Submission of design and drawings for conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, raceways etc. (c) IMD Manesar Building: Submission of design and drawings for power supply arrangement i.e. Genset, Main LT panel with APFC, other LT Panels etc.
KD-2	120	(a) IMD Manesar Building: Submission of design and drawings for HT & LT cables, Street Lighting, Earthing & lightning protection, Pumps etc.

Key Dates	Days	Description of Activities
		(b) IMD Manesar Building: Submission of design and drawings for CSS, Lift, VRV Air-conditioning system, Fire Detection & Alarm System and Fire fighting & suppression system. (c) IMD Manesar building: Supply of material i.e. conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, raceways etc.
KD-3	210	(a) IMD Manesar building: Installation of material i.e. conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, raceways etc. (b) IMD Manesar building: Supply of Materials for Street Lighting, street light poles, VRV Air-conditioning system, Fire detection & Fire Fighting system, Lift, Main LT panel with APFC, other LT Panels, Genset, Pumps, HT & LT Cables, HDPE/ GI pipes, earthing etc. (c) Manesar Station: Submission of design and drawings for conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, Air-conditioning etc.
KD-4	300	(a) IMD Manesar building: Testing and Commissioning of conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, raceways etc. (b) IMD Manesar building: Installation, Testing and Commissioning of Genset, Main LT panel with APFC, Building LT panels, LT Cables. (c) IMD Manesar building: Installation of Lift, VRV Airconditioning system, Fire detection & Fire fighting system. (d) IMD Manesar building: Supply of CSS. (e) Manesar Station: Submission of design and drawings for power supply arrangement i.e. CSS, Main LT panel with APFC, other LT Panels, Genset etc. (f) Manesar Station: Submission of design and drawings for HT & LT cables, Lighting, High mast, Street light poles, Earthing & lightning protection, Pumps etc.
KD-5	400	(a) IMD Manesar building: Installation, Testing and Commissioning of CSS, HT & LT Cables, HDPE/ GI pipes, lighting, street light poles, earthing arrangement, pump etc. (b) IMD Manesar building: Testing & Commissioning and Local Authority inspection of Lift. (c) IMD Manesar building: Supply of BOQ items spares, measuring & testing equipment spares. (d) IMD Manesar building: Testing & Commissioning and Local Authority inspection & approval of Fire detection alarm system and fire fighting & suppression system.

Key Dates	Days	Description of Activities
		(e) IMD Manesar building: Testing and Commissioning of VRV Airconditioning system. (f) IMD Manesar building: Supply of Lift spares, measuring & testing equipment spares, other BOQ items spares.
KD-6	550	(a) IMD Manesar Building: As built drawings submission for Power supply system, fire detection, fire fighting & suppression, Airconditioning VRV system, lighting, cabling, earthing etc. (b) Training to Staff for IMD Manesar Building and Manesar Station Electrical works. (c) Manesar Station: Supply and installation of conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, Air-conditioning etc. (d) Manesar Station: Supply and installation of conduits, wiring, switch-sockets, lighting, fans, distribution boards, cable trays, Air-conditioning etc. for S&T Huts (2 nos.) and ALH (2 nos.). (e) Manesar Station: Supply of Materials for CSS, Genset, Main LT panel with APFC, other LT panels, HT & LT cables & HDPE/ GI pipes, Lighting, High mast, street light poles, earthing, pumps etc.
KD-7	700	(a) Manesar Station: Installation, Testing and Commissioning of CSS, Genset, Main LT panel with APFC, other LT panels, HT & LT cables & HDPE/ GI pipes, Lighting, High mast, street light poles, earthing, pumps etc. (b) Manesar Station: Supply of BOQ items spares.
KD-8	730	(a) Manesar Station: As built drawings submission for Power supply system, Airconditioning, lighting, cabling, earthing etc. (b) Completion of all works pertaining to Manesar Station.

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CHAPTER – 6 MAINTENANCE AND TRAINING

6.1 INTRODUCTION

6.1.1 (a) The Contractor shall provide comprehensive training and documentation to the Employer's staff in accordance with the Employer's Requirements and the chapter of General Specifications. The training of maintenance staff for Electrical system shall be organised considering RDSO, Railway standards, Railway practices and guidelines of equipment manufacturers.

(b) This training shall enable the staff to operate and maintain all the installations in the most efficient and safe manner to achieve the maximum reliability and economy required by such System. All type of Routine, Preventative, Schedule Maintenance and breakdown maintenance work will be carried out at regular intervals, based on latest SMI's/ Instructions/Guidelines issued by RDSO; Railway Board and equipment manufacturers' recommendations.

6.1.2 Maintenance Management

(**a**) The management of the maintenance process entails defining various levels of responsibility and enabling them to implement the strategic orientations.

(**b**) The management process helps to improve the performance of the maintenance work of different components with quality, on time and at low cost. It shall be implemented at three levels:

(i) At the level of human resources and management in the context of the scheduling of work, the allocation of human resources and the training of personnel.

(ii) At the skills level to ensure quality, safety and suitable working conditions.

(iii) At an economic and financial level to ensure responsible management of production, spare parts, purchasing and miscellaneous costs.

(**C**) The quality of this management depends on the capability of those entrusted with operation and maintenance responsibilities:

(i) To exploit the results of management within their field of responsibility.
(ii) To react in the event of any deviation from the action plans defined with a view to achieving the set objectives.

(d) The management control function ensures timely advice to be given to those with operational and maintenance responsibility:

(i) By placing at their disposal, the tools and information required for piloting and diagnosis.
(ii) By participating in carrying out this diagnosis.
(iii) By participating in the task of defining the objectives to be achieved.

6.1.3 Requirements of Facilities and Tools

(a) The achievement of the objectives assigned to the maintenance division about quality, safety and regularity for the lowest possible overall cost requires mobilisation of various

resources. The facilities and tools are essential part of the resources placed at the disposal of the maintenance division to achieve the set objectives.

(b) When determining these requirements, in-depth knowledge in the dedicated maintenance plan is needed while taking due account of the experience acquired in similar fixed installation which has been in service for several years.

6.2 SUPERVISION AND PLANNING OF MAINTENANCE

1 General

The Contractor shall make use of all relevant information to provide supervision of maintenance. According to the maintenance strategy, all equipment and infrastructure supplied for the 'Project' must be such as to ensure for minimum or no maintenance. Maintenance activities required must be capable of being performed with little or no impact on the train service. In addition, the maintenance work systems shall ensure safety of personnel and equipment.

The Contractor shall ensure that to supervise maintenance during the DNP (Defects Notification Period) personnel are always available with the relevant skills and level of competence.

The Contractor, upon noticing any defects, deficiency in quality and quantity of spares and materials shall without delay, arranges for alternative source of supply and submit his proposal to the Engineer for review.

2 Planned Maintenance

Routine preventative maintenance will be carried out at regular intervals based on condition, reliability, usage, and service history, SMI's issued by RDSO, instructions of Railway Board and equipment manufacturers' recommendations. The Operating and Maintenance Manual shall describe the different levels of planned maintenance.

3 Supervisory Staff

The Contractor shall provide supervisory Maintenance staffs who are expert in all the different levels of fault finding, maintenance and repair of the various relevant systems supplied under the Contract:

i. Electrical system
ii. Switchgear/ power supply arrangement
iii. Fire detection & Alarm System, Fire fighting and suppression system
iv. Air-conditioning VRV system
v. Lift
vi. Any other works

4 Maintenance Requirements

(1) **Testing and Commissioning of System and Equipment**

In the event of a failure requiring modifications to the System, the Contractor shall undertake any testing and re-commissioning required. Any such modification shall be submitted for Engineer review.

(2) **Temporary Alterations to Restore Service**

The Contractor shall undertake any temporary modifications necessary to maintain service. Any such modification shall be submitted for Engineer review.

(3) **Discrepancies between Installation and Design Records**

Should the Contractor discover inconsistencies between the maintenance drawings and documentation and the installed equipment, the Contractor shall correct all such errors within two weeks.

(4) **Communications**

The Contractor shall ensure that adequate communication facilities are provided to its staff during the DNP and maintenance period as per approval of Engineer.

(5) **Location of Staff**

The Contractor shall be responsible for locating staff such that the Contractor meets its contractual obligations and as per approval of Engineer.

(6) **Maintenance System**

(a) The Contractor shall provide document, and maintenance manuals to the Engineer for various schedule and preventive maintenance. The maintenance manuals shall be approved by the engineer. These manuals shall be followed by the Contractors during DNP.

(b) Corrective maintenance shall be available 24 hours per day, able to respond to all foreseeable circumstances**.**

(c) The maintenance system shall cover all parts and equipment of the system designed, installed and commissioned by the Contractor. The Contractor shall take into account the requirements of the operations and maintenance when determining and proposing its maintenance regime.

(7) **Scope and Hours of Coverage**

The schedule and corrective maintenance shall be robust in design. The Contractor shall provide full 24 hour On-Call coverage and shall be such that initial response and rectification of failure are in accordance with the following:

(i) Assistance to first level and corrective maintenance within 30 minutes, upon request of first line maintainer.

(ii) All elements of preventative maintenance shall be carried out and completed during non-traffic hours without interrupting train services.

(8) **Routine and Corrective Maintenance Procedures**

Routine and corrective maintenance procedures shall be supplied for all equipment. The format shall be as follows:

(i) Uniform format and layout irrespective of equipment supplier.
(ii) Colour coding for each activity.
(iii) Cross referenced to the Operation and Maintenance Manuals.
(iv) Document control information.

(9) **Maintenance Manuals**

The Contractor shall provide particulars of operating parameters, tools for dismantling and testing, methods of assembly and disassembly, tolerances, repair techniques and all other information necessary to set up a repair and servicing programme as per satisfaction of Engineer.

The Contractor shall provide documentation for all hardware and software for computer systems and other associated electronic equipment to meet the following requirements.

Such documents shall include but not be limited to:

(i) manufacturers' documentation supplied as standard with the equipment.

(ii) hardware configuration with details of expansion capabilities and options.

(iii) programme loading instructions, including runtime environment configuration.

(iv) programme listing including comprehensive 'comment statements' in hard copy and soft format for source code, compilers, and development tools necessary to modify and recompile software.

(v) flow charts, data flow diagrams and state diagrams as appropriate.

(vi) description of software modules including purpose, linkage with other modules, error routines and any special considerations.

(vii) memory maps for both internal and peripheral memory showing description of all programmes, data files, overlay areas, memory available for expansion and the like.

(viii) loading and operating instructions for diagnostic programmes and specifically developed debugging tools; and

(ix) Programming manuals relevant to operating systems, languages, development tools, etc.

The manual shall also include inspection/ overhaul procedure and periodicity of various inspection/ overhaul schedules in detail including the tools, special tools/ plants, and facilities required. The Operations and Maintenance (O & M) Manuals shall be prepared by the Contractor and shall be submitted to Engineer for review who shall obtain consent of Employer. The O&M manuals shall be supplied at least 3 months prior to taking over of works by the Employer. The O&M Manuals shall be supplied 10 copies in hard bound copies, two nos. in pdf, two nos in editable (word) format and pdf & word files shall be supplied in 2 nos. Hard Disc Drive (1 TB minimum capacity).

(10) **Inventory**

Contractor shall prepare exhaustive Inventory list of all the installed items at site. The inventory list shall be jointly checked with Engineer as per actually installed items at site. The inventory list shall be jointly signed with Employer's Representative/ Engineer.

6.3 TRAINING:

6.3.1 General

(a) During the contract period, the Contractor shall provide training manuals, as well as onsite training and classroom training courses to ensure that the Employer/ Engineer's staff associated with this project acquire full knowledge and understanding of all aspects of the design, day to day operations, breakdown and routine maintenance and fault diagnosis of the power supply, the surveillance and control equipment as well as the hardware and software.

(b) The Contractor shall provide comprehensive training to the Employer/ Engineer's personnel about all Electrical items, fire fighting, VRV air-conditioning, lift, etc. equipment in theoretical and practical way. The Engineer shall nominate members of staff, who shall be attending the training courses.

(c) The Contractor shall nominate qualified instructors for imparting training. The Contractor shall obtain prior approval of the Engineer for the instructor giving full details of instructor's qualifications and experience in each case. The Instructors shall have minimum 10 years experience in operation and maintenance of Electrical general services work and degree/diploma in Electrical Engineering.

(d) The Contractor shall provide all relevant and necessary facilities which are needed for complete and effective staff training (such as video, TV, slide, film-projectors and other tools) and the venue. Within three months after the signing of the contract, the Contractor shall submit detailed syllabus for the training courses for approval by the Engineer. Training shall be completed at least 3 months prior to the start of DNP.

(e) The training courses and/or sessions shall include system performance requirements and all major equipment and works designed by the Contractor.

(f) The training instructors shall be qualified and experienced to impart training. The assessment criteria for adjudging the knowledge of Employer/ Engineer's staff shall be developed by the Contractor and submitted to the Engineer for review at least three months before any course is conducted.

(g) The Contractor shall provide full-time on-Site management and co-ordination of the entire training programme to ensure the continuity of class-room classes and proper distribution of training materials, and be responsible for interfacing with the instructors. The training courses in hard bound copies shall be delivered to all Employer/ Engineer's staff, including instructors, operation and maintenance Engineering staff. The Contractor shall supply training material to Engineer in four nos. hard bound copies, two nos. softcopies in pdf and two nos. in word format and the pdf & word copies shall be supplied in 2 nos. Hard Disc Drives (1 TB minimum capacity).

6.3.2 Mock-Up for Training

The Contractor shall install mock-up equipment for system and any other facility(ies) considered necessary for the training of Engineer's staff. The training mock-up shall include but not limited to the following: -

(i) Clear Cut Section drawings/ photographs of various power supply equipment's such as Circuit Breakers, HT/LT panel, Power supply arrangement, Current Transformers and Potential Transformers, Submersible pumps, air-conditioners, fire fighting items, lift, Distribution boards, Genset, street light poles, high mast tower, pipes etc.

(ii) Cut Section drawings/ photographs of HT/LT cables.

(iii) Cut Section drawings/ photographs of Gas Insulated Switchgear and other types of panels.

(iv) Clear photographs of transformers, their windings, bushings etc.

(v) Samples of various item used in substations.

(vi) Clear drawings and photographs of Control panel, protection schemes, earthing and complete power supply arrangement system.

The Contractor shall submit full details of the training span and other mock up equipment, photographs etc. including proposed training activities and objectives.

6.3.3 Training of Employer/ Engineer's Training Instructors (ETI)

The objective of the training is to enable the Employer/ Engineer's Training Instructors to be competent to deliver future training courses for other employees of the Employer.

The Contractor shall provide training to the Employer/ Engineer's Training Instructors on the various Systems. Aspects covered shall include, but not be limited to the following:

(i) Configuration of the entire System, including interface with the Haryana Bijlee Vitran Nigam Limited (HBVNL) supply system at the feeding points.

(ii) Feature and functional principles of the entire System.

(iii) System design aspects including but not limited to design standards, design criteria and parameters, short-circuit and other calculations, insulation and protection co-ordination.

(iv) Details of major equipment and material including but not limited to voltage and current transformers, Electrical items, fittings, assemblies and protection relays, fire fighting, VRV air-conditioning, lift and cables of different types and their joints etc. used in the system.

(v) System operation and maintenance management and procedures.

(vi) Earthing arrangement, covering safety aspects of touch and step potential, safety to personnel, passengers and outsiders.

6.3.4 Operations Staff Training

The objective of the training is to enable the Engineer's operations staff to be familiar with the Systems, with focus on the operational aspects under normal and emergency conditions.

The training shall also enable the trainee to acquire full capability for identification, trouble shooting and rectification of faults in the specified duration. After classroom training which includes mock ups of equipment, the staff shall be trained in actual operation.

6.3.5 Training Requirements

Man-weeks of Contractor's Training Instructors for training the Employer's maintenance personnel shall be as under.

S.No.	Training	Man-Weeks
1	HT/LT Panels, Transformer, Circuit Breakers, Genset, AMF Panel, Switchgear and Cables, Capacitor bank, light fittings, Street light poles, High mast towers.	2

2	Electrical Wiring, Distribution boards, Pumps, Submersible pumps, UPS, Battery, water cooler, RO, Geyser, Conduits, fencing, cable trays, raceways, fans etc.	2
3	Air-Conditioning system	1
4	Fire detection & alarm, Fire Fighting and suppression system	1
5	Lifts	1
6	Electrical Safety & Earthing system and all other balance items.	1

6.4 DEFECTS NOTIFICATION PERIOD (DNP)

6.4.1 The Contractor shall be responsible for rectification of all the Defects and deficiencies during the Defects Notification Period of ONE YEAR from the date of taking over of works by the Employer. The Contractor shall repair or rectify all defects and deficiencies observed by the Employer/ Engineer during the Defects Notification Period within time period as may be determined by the Engineer in accordance with Good Industry Practice. In any case, the defect shall be removed within 4 hours. The defects attended or repairs done or material replaced during DNP by the Contractor should be acceptable to the Employer.

6.4.2 Contractor's Office During Defect Notification Period

Contractor shall establish and maintain the 'Maintenance office' manned with the supervisory and maintenance staff with a Dedicated Desk Officer to attend the calls of the Employer's Personnel and inform their Head of Maintenance who would promptly act to attend the emergencies/ maintenance calls including organizing of all the resources i.e. artisans and Material. The Contractor shall share the contact number of the staff manning the desk to receive calls and email. Only the space and electricity shall be provided by the Employer free of cost and all office infrastructure i.e. furniture, computers, printers, stationery, consumables etc shall be arranged by the Contractor. The Contractor shall Maintain a computer based Failure Reporting, Analysis, and Corrective Action System (FRACAS) to log all the events of Failure. Necessary transport vehicles shall be arranged by the Contractor. Monthly statement of defects shall be submitted to the Employer for review and record by the Contractor.

6.4.3 Man and Material Required During Defect Notification Period

The contractor shall provide the required staff, road vehicles, and Material during the Defect Notification period at their own cost for 24 hours all 7 days of every week to attend the Defects. The deployment of staff shall be approved by the Engineer. The Material, if any, used from the Employer's spares shall be made good by the Contractor within one month. The contractor shall arrange all the Tools & Plants needed to attend the defects during the Defect Notification period. The Contractor shall replace the defective systems/sub-systems/ equipment /modules/items/parts during the Defect Notification Period (DNP). For this purpose, the Contractor shall store adequate number of equipment/modules/items/parts so that the defect is rectified in the least possible time without adversely affecting the train operation. Contractor shall submit the list of DNP spares with types and quantity which Contractor intends to hold during DNP, at least six months before start of DNP, to Engineer

for review. The Contractor shall make good all the Employer's material (spares, tools etc.) taken during DNP from Employer 2 months prior to completion of DNP, with new material acceptable to the Employer.

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

APPENDIX-1: AIRCONDITIONING SYSTEM WITH VARIABLE REFERIGERANT VOLUME (VRV)

A: AIRCONDITIONING SYSTEM WITH VARIABLE REFERIGERANT VOLUME (VRV)

1. SYSTEM DESCRIPTION

(a) The Variable Refrigerant Volume (VRV) / Variable Refrigerant Flow (VRF) - R410a refrigerant system shall be air cooled, spilt type air-conditioning system consisting of modular condensing units suitable for cooling and heating application connected to multiple indoor units, each having the capability of individual set point control. Each modular condensing unit should incorporate at least one inverter / digital scroll/ twin rotary compressors to obtain 10% to 100% step-less capacity control for enhanced Power saving. The indoor units should be provided with Cordless Remote Control as a standard accessory. Necessary equipment, special reversing valves, electronic expansion valves (EEV), any other valves, etc. arrangement shall be provided in VRV system for ensuring cooling and heating effect. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements.

(b) The VRV / VRF units shall be capable of operating within a wide range of ambient temperatures. The Condensing units shall be capable to provide cooling within an ambient range of (-)5 Degree Centigrade to 50 Degree Centigrade and heating in range (-)10 Degree Centigrade to 15 Degree Centigrade (C). VRV/VRF units shall be capable of cyclic operation with settable controls.

(c) The refrigerant piping shall be extendable up to minimum 150 m with 50 m level without any oil trap.

(d) The system will operate at 440V, 3-Phase, 50 Hz, AC supply.

(e) The control rooms in the building shall have provision of air-conditioning with N+1 standby provision on a 24 hour basis.

2. OUTDOOR UNIT (ODU)

2.1 The outdoor unit (ODU) shall be a factory assembled unit suitable for cooling and heating application housed in a sturdy weather proof casing constructed from rust-proofed mild steel panels powder coated with 7 tank process. The ODU shall deliver 100% cooling capacity at 43 Deg. C ambient Temperature. The outdoor unit shall have multiple scroll/twin rotary compressors and be able to operate even in case of breakdown of one of the compressors. The noise level shall not be more than 68 dB(A) at normal operation measured horizontally 1m away and 1.5m above ground. The outdoor unit shall be modular in design and shall be allowed for side by side installation.

2.2 Compressor

The compressor shall be of highly efficient hermetic Inverter, Digital Vapor Injection Scroll, twin rotary capable of capacity modulation by time averaging method and Vapour injection Technology. Each ODU should have minimum 1 number variable compressor up to 16 HP capacity.

2.3 Heat exchange

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminium fins to form a cross fine coil. The aluminium fins shall be covered by anti-corrosion resin film. The system shall have sub-cooling heat exchanger further to Condenser to increase refrigerating effect in Indoor units. The condenser fins shall be coated with anti-corrosive treatment.

2.4 Fan motor speed control

The condensing unit fan motors to have at least two speed operations to maintain constant head pressure control in all ambient temperatures and modes of operation. The fan motor shall work on 240V, single-phase or 440 V, 3-phase, AC supply.

2.5 Refrigerant Circuit

The refrigerant circuit shall include an accumulator, liquid and gas shut off valves and a solenoid valves or pulse width modulation valve.

All necessary safety devices shall be provided to ensure the safety operation of the system.

2.6 Safety Devices

The following safety devices shall be part of the outdoor unit:

High Pressure Switch, Low Pressure switch, Fan Motor Safety Thermostat, Over Current Relay, Fusible Plugs, Fuses.

2.7 Oil Recovery System

Each unit shall be equipped, with an oil separator to ensure stable operation with long refrigerant piping**.**

3. INDOOR UNIT

3.1 Indoor units shall be mix-match of ductable type or Medium Static Pressure Duct type, Wall/ Ceiling/ Cassette mounted type. It shall have electronic control valve to control refrigerant flow rate in response to load variations of the room. The indoor units shall be suitable to work on cooling as well as heating mode. The fan shall be of the dual suction multi blade type and statically and dynamically balanced to ensure low noise and vibration free operation. The enclosure of all indoor units shall be galvanized sheet steel with powder coating. The capacity of Indoor unit in general shall be as under:

1.0 TR	318 CFM
1.6 TR	514 CFM
2.0 TR	600 CFM
3.18 TR	1090 CFM

The above capacities are approximate and there may be variation of 5 % on either side.

3.2 The address of the indoor unit shall be settable in case of individual and group control. In case of centralized control, liquid crystal remote controller shall set it. Individual indoor unit control shall be settable by remote controller.

3.3 Electronic Expansion Valve (EEV)

Each indoor unit shall be fitted with an electronic expansion valve to control the refrigerant flow in response to the load variations in the room. The electronic expansion valve shall be controlled via a computerized control sensing the return air temperature, refrigerant inlet and outlet temperatures. During the cooling operation the electronic expansion valve shall control the refrigerant superheat degree at the evaporator.

3.4 Indoor Unit Fans

The fans shall be direct driven of the DIDW (Double Inlet Double Wheel) multi-blade type, statically and dynamically balanced to ensure low noise and vibration free operation. The noise level shall not exceed 49 dbA. Fans will work on 240V, single-Phase, 50 Hz., AC Supply.

3.5 Cooling Coils

Shall be direct expansion, constructed from copper tubes expanded into aluminium fins to form a rigid mechanical bond.

3.6 Supply Air Discharge Louvres

The indoor units shall be provided with auto swing type supply air louvres for cassette and under ceiling type indoor units. The louvres shall be capable of providing continuous swing operation or to be fixed in any direction required.

3.7 Unit Control Board

It shall Include in the indoor unit a printed circuit board complete with, address switches for a variety of operation controls, emergency operation switch and fault / operation indication LED's. The fan motors shall be thermally overload relay protected.

3.8 Unit casing

The indoor unit casing shall be fully insulated and sealed to prevent condensation.

3.9 CABLING BETWEEN INDOOR AND OUTDOOR UNITS

The cable between indoor and outdoor units shall run in steel conduit. The work will include supply, installation, testing, commissioning of control cum transmission wiring of 2 core x 2.5 sq.mm copper FRLSH XLPE insulated in suitable GI conduits and accessories between indoor and outdoor units. Necessary securing arrangement of conduit shall be made by Contractor. Provision of supply and laying of GI conduits shall be in the scope of work.

4 REFRIGERANT PIPE WORK:

1.1 Scope of Refrigerant Piping work shall include supply, installation, testing and commissioning of all interconnecting pipe-work between the condensing unit and indoor units. Refrigerant quality seamless copper tubes with brazed connections and the appropriate distribution joints and headers shall be used. The piping should be routed at site in such a manner, that brazed Joints in the are kept to a minimum. Necessary securing arrangement of Refrigeration Piping shall be made by the Contractor. The VRV system shall either work in cooling mode or in heating mode using a 3-pipe system (liquid line, hot gas line and suction line) and special valving arrangements. The refrigerant pipe work shall include Y-joints, separation tubes, distributers and headers system wherever required.

1.2 Y-Joint Orientation:

Proprietary Distribution refrigeration pipe Y-Joints and headers shall be installed in an appropriate orientation to enable correct distribution of refrigerant. The distribution joints shall be factory insulated with pre-farmed sections of expanded Polystyrene/equivalent.

1.3 Cleanliness of Piping:

All pipe-work must be kept clean and free from contamination to prevent breakdown of the system. All pipe ends shall be kept sated until immediately prior to making a joint.

1.4 Pressure Testing:

After complete installation of refrigerant piping, it shall be pre-pressure tested and repaired, if necessary, and further pressure tested to 450 PSI, to hold for a minimum 24 hours with dry nitrogen prior to insulating the joints. After satisfactory testing, the refrigerant pipe shall be evacuated and dehydrated to (- 755 mm Hg) and held for one to four hours depending on the pipe length.

1.5 Refrigerant Charge:

Refrigerant charge must be calculated based on the actual length of the refrigerant pipe work. The refrigerant charging process must be carried out with an appropriate charging station and under supervision of the Contractor.

1.6 Piping Insulation:

All suction and liquid lines of the Refrigerant pipe work shall be insulated with Nitrile rubber/expanded polyethylene class O pipe sections to avoid condensation. The exposed piping insulation shall be painted with UV paint.

1.7 Fixing Pipe Work & Electrical Conduit:

The insulated refrigerant piping and electrical conduit shall run on GI tray properly supported by GI rods, nuts, bolts, washers, anchor fasteners, angles etc. as required. The exposed tray on terrace shall be covered by openable GI covers. After completion of work, wall and floor shall be repaired and brought to its original finish.

1.8 The outer dia. and wall thickness of copper refrigerant piping shall be as follows:

Size (outer dia.)	Wall thickness	Specification
6.35 mm	0.56 mm	C 1220T-O (ANNEALED)
9.52 mm	0.56 mm	C 1220T-O (ANNEALED)
12.70 mm	0.71 mm	C 1220T-O (ANNEALED)
15.88 mm	0.71 mm	C 1220T-O (ANNEALED)
19.05 mm	0.91 mm	C1220T-1/2H(HALF-HARD)
22.23 mm	0.91 mm	C1220T-1/2(HALF-HARD)
28.58 mm	1.22 mm	C1220T-1/2H(HALF-HARD)
34.90 mm	1.63 mm	C1220T-1/2H(HALF-HARD)
41.30 mm	1.63 mm	C1220T-1/2H(HALF-HARD)

5 DRAIN PIPING

5.1 The indoor/outdoor units shall be connected to drain of insulated GI pipe.

5.2 The drain pipes shall be laid in proper slope for efficient drainage of condensate water.

5.3 Darin pipe insulation (Pre-Insulated)

Drain pipes carrying condensate water shall be insulated with 6 mm Nitrile rubber having a 'K' value of 0.037 W/mk at a mean temperature of 20 degree Centigrade and a minimum density of 55 kg/sqm. The joints shall be properly sealed with synthetic glue to ensure proper bonding of the ends. Entire drain piping should be included in the scope of work .

6 TESTING

The units shall conform to ARI/AHRI standard and tested for capacity and COP (Coefficient of Performance) (minimum COP 3.8 at 100% load) as per ARI/AHRI (Air-conditioning, Hearting and Refrigeration Institute) conditions including deration or capacities at the specified temperature at Manufacturers premises before delivery. Employer/Engineer shall witness the tests in presence of Contractor and Manufacturers representative.

7 AIR DISTRIBUTION SYSTEM

The scope of work includes design, manufacture, supply, installation, testing and commissioning of air distribution system of VRV.

7.1 DUCT MATERIALS

(1) Raw Materials

The material shall be Galvanised Iron and Galvanizing shall be Class VIII - light coating of zinc, nominal 120gm/sqm surface area and Lock Forming Quality prime material along with mill test certificates. The material shall be got tested for thickness and zinc coating by the Contractor. All ducts shall be fabricated from galvanized steel of the following thickness:

Rectangular Ducts G. S.	**PRESSURE 500 PaPSI** Duct Section Length - 1.2 m		
Maximum Duct size	**Thickness mm**	**Joint Type**	**Bracing Spacing**
1 – 600 mm	0.56 mm	Cleat & tending S Cleat	Nil
601 – 750 mm	0.56 mm	GI Angle 25 x 3	Nil
751 – 1000 mm	0.71 mm	GI Angle 25 x 3	Nil
1001 – 1200 mm	0.71 mm	GI Angle 40 x 3	Nil
1201 – 1300 mm	0.91 mm	GI Angle 40 x 3	Nil
1301 – 1500 mm	0.91 mm	GI Angle 40 x 3	Nil
1501 – 1800 mm	1.22 mm	GI Angle 40 x 6	Nil
1801 – 2100 mm	1.22 mm	GI Angle 40 x 6	Nil
2101 – 2250 mm	1.22 mm	GI Angle 40 x 6	Nil
2251 – 2400 mm	1.22 mm	GI Angle 40 x 6	Nil
2401 – 2700 mm	1.22 mm	GI Angle 40 x 6	600

(2) All angle iron parts shall be galvanized and NO MS material shall be used in the ducting system.

(3) Distance of reinforcement/bracing from each joint shall be same. Bracing material to be same as of material used for joining of duct sections.

7.2 Duct Construction

(1) All ducts shall be factory fabricated and installed in workmanlike manner, conforming to relevant SMACNA/DW 144 codes with factory fabricated Transverse Duct Connection (TDC) flanges/GI angle.

(2) Ducts so identified on the Drawings shall be acoustically lined and insulated from outside. Duct dimensions shown on drawings, shall be overall sheet metal dimensions inclusive of the acoustic lining where required. The fabricated duct dimensions should be in accordance with approved drawings and care should be taken to ensure that all connecting sections are dimensionally matched to avoid any gaps.

(3) Ducts shall be straight and smooth on the inside with airtight longitudinal seams and at corners shall be with either Pittsburgh or snap button in accordance with IS/BW144 practice, to ensure air-tightness.

(4) All ducts up to 750 mm width within conditioned spaces shall have slip and drive (C&S/SS) joints. The internal ends of slip joints shall be in the direction of airflow. Care shall be taken to ensure that S/SS cleats are mounted on the longer side of the duct and cleats on the shorter side. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

(5) Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Air-turns (vanes) shall be installed in all bends and duct collars designed to permit the air to make the tum without appreciable turbulence.

(6) All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

(7) All sheet metal connection, partitions and plenums, required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS / 16 gauge

aluminium (GSS Galvanised Sheet Steel), thoroughly stiffened with 25mm x 25mm x 3mm galvanized steel angle braces and fitted with all necessary inspection doors as required, to give access to all parts of the apparatus. Access doors shall be not less than 450mm x 450mm in size.

(8) Plenums shall be shop/factory fabricated panel type and assembled at site. Fixing of galvanized angle flanges on duct pieces shall be with rivets heads inside i.e. towards GS sheet and riveting shall be done from outside.

(9) Self- adhesive Neoprene rubber 'UV resistant PVC foam lining 5mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.

(10) Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality expanded polystyrene around the duct and totally covered with fire sealant such as fire barrier mortar for complete sealing.

(11) All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, ductable units or blower coil units that cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connotations shall be constructed of flame retardant, water proof, silicon rubber impregnated flexible connecting at least 100 mm long securely bonded & flange bolted on both side. Sleeve shall be made smooth and the connecting duct work rigidly held independent support on both side of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation.

7.3 DAMPERS

(1) **Dampers:** All duct dampers shall be opposed blade louver dampers of robust 16 SWG GSS construction and tight fitting.

(2) Dampers shall be placed in duct at every branch supply or return air duct connection as required.

8. SPECIFICATION OF THERMAL AND ACOUSTIC INSULATION

The section deals with supply and fixing of thermal and acoustic insulation of ducts, pipes etc. as per the specification given in the section:

(1) MATERIAL OF INSULATION

The insulation material of the following kind shall be used for cold insulation.

(a) RESIN BONDED FIBER GLASS WOOL

The thermal conductivity valves in W/mK of fiber glass shall confirm to following:

Mean temperature °C For duct Lining	Density in Kg/Cum	Thermal Conductivity W/m.k
25°C	48	0.030
25°C	48	0.033

(b) CLOSED CELL CROSS LINKED POLYETHYLENE (XLPE) FOAM

Mean temperature °C For duct insulation	Density in Kg/Cum	Thermal Conductivity W/m.k
40°C	33	0.035

(2) INSULATION ON SHEET METAL DUCTING

The thickness of installation used on ducting shall be as detailed below:

		Conditioned space
a)	Supply Air Duct	13 mm thick Closed Cell Cross Linked Polyethylene (XLPE) Foam Insulated with factory Laminated AL PE Foil.
b)	Fresh Air Duct	13 mm thick Closed Cell Cross Linked Polyethylene (XLPE) Foam Insulated with factory Laminated AL PE Foil.
c)	Duct Collars	13 mm thick Closed Cell Cross Linked Polyethylene (XLPE) Foam Insulated with factory Laminated AL PE Foil.

(3) TECHNICAL SPECIFICATION OF CLOSED CELL, CHEMICALLY CROSS-LINKED POLYETHYLENE (XLPE) INSULATION

(a) The insulation material for the ducts, pipe and under-desk insulation shall be closed cell cross-linked fire retardant polyethylene foam. The thermal conductivity of the material shall not exceed 0.035 w/mk at an average temperature of 40°C.

(b) Thermal conductivity of the material shall not be affected by ageing, as per DIN 52616. The material must be tested for ageing effect in an accredited laboratory for a minimum period of five years to satisfy the ageing criteria.

(c) The material must be in a single layers upto 16 mm thickness and not formed by laminating several layers.

(d) The product will have bending trail and the dimensional stability as per DIN 51949 and DIN 53431 for an operating range of (-)40°C to (+)110°C. The density of material shall be 33(+/-3) Kg/M3 or 0.030 gm/cc.

(e) The material shall be rated as Class 1 as per BS 476 PART 7. The rating as per DIN 4102 shall be B1. The smoke density of the material as per AS-1530.3 shall not exceed 1. There shall be no toxicity in the emitted smoke, both under flaming and non-flaming conditions as per AITM 3.000 (1993).

(f) The water vapour permeability, as per DIN 52615, shall not exceed 0.15Ng/M.sec.pa.

(g) The material shall have a fire approval from CBRI/FIRE advisor (Govt of India)/Chief Fire Officer.

(h) For providing UV protection the insulation shall be cladded with minimum 30 micron aluminium PE foil. The cladding shall be factory finished to avoid site work The minimum thickness shall be as per specifications.

(4) INSULATION OF DUCT

The duct surfaces shall be thoroughly cleaned prior to applying the insulation. Adhesive of suitable grade shall be uniformly applied on the insulation and cured, before sticking to the duct. The insulation can be wrapped around the duct as one piece, where size does not permit, the same shall be cut to exact width/height of duct.

9 Design of VRV system:

The Contractor shall submit entire design of VRV system mentioning each and every item with all technical details along with drawings to Engineer for approval.

B. SPLIT DUCTABLE AIR CONDITIONERS

1. GENERAL

1.1 The Contractor shall supply and install split system air-conditioner wherever indicated and capacity shall be 1.5 TR and 2.0 TR. The system shall be complete in all respects and comply with the BEE 5-star rating and as per specifications. The system will work at 240V, Single Phase, 50 Hz, AC supply. The unit shall be operated by remote control and shall show temperature on the cooling units. Ducts shall be provided wherever required.

2. CONDENSING UNITS

2.1 Each condensing unit shall be complete unit with hermetically rotary/scroll compressor's, air cooled condenser, condenser fans with motors, internal piping, switches and internal wiring and shall be enclosed in a weatherproof outdoor type housing.

2.2 The compressor shall be hermetic, with enclosed gas cooled motor. The compressor shall be suitable for R-22 (or latest type of refrigerant).

2.3 The condenser coil shall be air cooled type with aluminium sine wave fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 12.7 mm OD.

2.4 The condenser air fans shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified outdoor conditions.

2.5 The casing shall be fabricated from galvanized steel and finished with powder coated paint. The casing shall make the whole unit fully weather proof suitable for outdoor installation.

2.6 The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

3. COOLING UNIT

3.1 The cooling unit shall be matched to the respective condensing unit and shall consist of cooling coil, blower, filters, outer casing, drain pan, accessories etc.

3.2 The cooling coil shall have copper tubes of not less than 12.7 mm OD and continuous aluminium sine fins with integral collars. The tubes shall be staggered in the direction of the air flow.

3.3 The fan section shall comprise 1 No. statically and dynamically balanced centrifugal blower, motor, drive package, mounting arrangement etc.

3.4 The unit shall include a remote control assembly with thermostat and starter and speed control switches.

3.5 The unit casing shall be made of galvanized steel, the casing shall be insulated to lower the noise level and eliminate condensation.

3.6 Suitable drain pipe properly fixed and clamped shall be provided.

4. REFRIGERANT PIPING

4.1 The condensing unit and evaporator unit shall be interconnected by type 'L' seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit. This includes the entire piping work as required.

4.2 The suction and liquid line shall be insulated with 13 mm thick expanded polyethylene/nitrile rubber insulation. The refrigerant piping and cabling shall run in fire retardant PVC sleeves with GI supporting structures.

4.3 Necessary chases and holes in walls and floor etc. for laying the piping work shall be done by contractor and after completion of work necessary repair work shall be done by the Contractor and brought to its original finish.

4.4 The refrigerant pipes shall be properly connected to the outdoor and indoor units and shall have no refrigerant leakage.

5. MISCELLANEOUS

5.1 The unit shall have control panel, housing the starting switches, contactor, relays etc.

5.2 Isolated pads shall be provided under the units.

5.3 Insulated drain line shall be provided from indoor unit up to drain trap.

5.4 Suitable GI channel supporting frame, as approved by the Engineer, shall be provided for the condensing unit and supporting arrangement for the indoor units.

5.5 Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit.

5.6 PVC flexible sleeves shall be provided to cover the insulated refrigerant piping and electrical cabling from indoor to outdoor units.

6. INSTALLATION

6.1 The split type air-conditioner shall be mounted on vibration isolators and installed in accordance with the manufacturer's recommendation such that no disturbing vibration or noise is being transmitted to the nearby structure.

6.2 Refrigerant pipes that are exposed to outdoor shall be covered with UV coating to protect insulation from direct UV exposure.

6.3 All galvanized support beams, galvanized legs, galvanized hangers, anchor bolts, vibration isolators, ductworks and shall be provided for the installation of the units.

7. TESTING AND COMMISSIONING

7.1 After installations, all air handlers shall undergo test run. Any adjustments that are needed, shall be made to assure that all air handlers will operate at the required performance. Report forms to contain following minimum data listings shall include design and actual conditions for each Item mentioned below:

- Date and time of test.
- Air handling unit and fan coil unit make, type, name and serial number.
- Fan rpm.
- Fan motor amperage.
- Rated motor amperage, starter number and ampere rating.
- Fan CFM.
- Fresh air CFM in case of ductable units.
- Outside conditions (DB and WB).
- Entering coil conditions (mixing) (DB and WB).
- Leaving coil conditions (DB and WB).

7.2 During test run, the air filters of testing sets shall be used.

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CHAPTER – 7 TECHNICAL SPECIFICATIONS

APPENDIX-2: FIRE FIGHTING HYDRANT AND SPRINKLER SYSTEM

TECHNICAL SPECIFICATION OF FIRE FIGHTING HYDRANT AND SPRINKLER

1. GENERAL

The scope of this section comprises the design, supply, installation, testing and commissioning of the entire fire fighting system. The applicable norms laid down by National Building Code – 2016, relevant Bureau of Indian Standards and CPWD specifications for Electrical works Part-5 shall be followed. All GI pipes and other accessories shall be cleaned thoroughly before application of primer coats, two coats of enamel paints shall be applied. Each enamel paint coat should be given minimum 24 hours drying time. No thinner shall be used. The work should be done in professional manner and to the satisfaction of the Engineer. No extra amount shall be paid for this work and price may be included with the relevant item itself. All items provided in this specification shall be provided by the Contractor and no extra payment shall be made. All power and control cables in the fire system shall be Fire Retardant Low Smoke low halogen (FRLSH) cables. The Contractor shall make openings in the walls, floors, slabs or modifications in the existing openings wherever required for carrying pipe lines, cables etc. or erection of panels etc. The Contractor shall obtain approval from Local Fire Department and no extra amount shall be paid for this work. All nuts, check-nuts, bolts, washers etc. shall be of Galvanized iron for fitment of pipes, valves and other accessories unless and otherwise specified. All pipe work in the fire fighting system shall be galvanized Iron (GI) only.

2. FIRE PROTECTION SYSTEM

2.1 SCOPE

The scope of this section consists of following but is not necessarily limited to Design, Supply, Installation, Testing and Commissioning of the fire protection system. The working of the system shall be as follows:

(1) The Fire Suppression System shall comprise the Fire Hydrants System, the Sprinkler System (Wet type). Water from the underground two nos. RCC Fire Water Storage Tank, of 150,000 litre capacity each, shall be supplied for the use of Fire Hydrant System (Pressurized) both for the external hydrants, the internal landing valves and the hose reels at landings. One tank shall be in working condition and one tank shall always be spare. RCC water storage tank shall be constructed by the Civil Contractor.

(2) The Hydrant System and the Sprinkler System, under normal conditions, shall be pressurized by means of the electric motor driven Jockey Pump.

(3) The Hydrant System and Sprinkler System shall be provided with two electric motor driven main pump (1 Working + 1 Standby).

(4) The starting and stopping of the Jockey pump shall be automatic based on the pressure switches at preset low and high pressure.

(5) The electric motor driven Hydrant Pump starts automatically at preset pressure by means of a pressure switch. As soon as the Hydrant Pump starts, the Jockey Pump stops. If for any reason the electric motor driven Hydrant Pump does not start at the preset pressure or is unable to maintain the pressure, the standby electrical driven Hydrant starts at the preset pressure.

(6) The hydrant pump, electric motor driven shall be stopped only manually.

(7) Contractor shall ensure that all false ceiling voids greater than 800 mm are provided with sprinklers.

(8) Contractor shall ensure Hydro Testing for the complete system.

(9) The Contractor shall include submission and obtain necessary approval of relevant drawings, schemes and documents from local / fire authorities and also obtain all necessary permissions and NOC for execution of work as well as getting final approvals from the concerned fire officers along with relevant “NOC” for occupation of building. No extra payment shall be made on account of getting the approval.

2.2 FIRE PUMPS

2.2.1 Electrical motor driven pumps

(1) The Chapter Covers the general requirements of water pumps for main fire pump and jockey pump. The pumps shall be centrifugal type direct driven with a 3 phase, 440 V ± 10%, 50 Hz, A.C motor. The main fire pumps will be horizontal split casing (HSC) pump with operating speed not exceeding 1500 rpm for main fire pump and 3000 rpm for jockey pump. The head shall be suitable for the system and shall take into consideration the pressure drops across various components, bends and friction losses.

(2) RATING

The Main fire pump and jockey pump shall be suitable for continuous operating in the system. The Main Fire pump shall have discharge of 2500 lpm at 90m head and pressure at the highest and farthest point shall not be less than 3.5 kg/sqcm. The Jockey pump shall have flow of 180 lpm and 90m head. The head shall be suitable for the system and shall be take into consideration the pressure drops across the various components in the water circuit as well as the frictional losses.

(3) MATERIAL AND CONSTRUCTION

The centrifugal pumps shall conform to IS 1520. The pump casing shall be of heavy section close grained cast iron (grade FG 200, IS: 210) and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required. The impeller shall be of bronze or gunmetal. This shall be shrouded type with machined collars, wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key. The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump. The shaft sleeve shall be of bronze on gunmetal. The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water. The shaft seal shall be mechanical type, so as to allow minimum leakage. A drip well shall be provided beneath the seal. The pumps shall be directly coupled to the motor shaft through a flexible coupling protected by a coupling guard. The pump and motor shall be mounted on a common base plate fabricated from mild steel section. The base plate shall have rigid, flat and true surfaces to receive the pump and motor mounting feet. The pump will be perfectly aligned with the motor so as to avoid any vibration during operation.

(i) MOTORS

The motors shall be squirrel cage AC induction type. The motors shall be suitable for continuous duty and rating necessary to drive the pump at 150 percent of its rated discharge with at least 65 percent rated head. The motor shall be totally enclosed fan cooled type confirming to protection clause IP 55 of IS : 4691. The class of insulation shall be 'F'. The synchronous speed shall be 1500/3000 rpm as per requirement of the pump. The motor shall conform to IS : 325.

(ii) ACCESSORIES

Each pump shall be provided with the following accessories :-

(a) Butterfly/Sluice valves on suction and discharge (If positive suction is not provided butterfly valve at suction is not to be provided)

(b) Reducers, as may be required to match the size of the connected pipe work.

(c) Non-return valve at the discharge.

(d) Pressure gauge at discharge side between pump and the non-return valve.

(iii) RUBBER MAT

Rubber mat shall be provided in front to cover the full length of all panels. Where back space is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel. 1000 mm wide as required for 1100 voltage. The rubber mat payment shall be made in the designated BOQ item.

(iv) ANTI VIBRATION MOUNTING

Suitable anti vibration mounting duly approved by Engineer shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

(4) OPERATING CONDITIONS FOR FIRE & SPRINKLER PUMPS

Description	Cut in	Cut out
Operating pressure	7.0 Kg/sqcm	
Jockey pump	6.50 Kg/sqcm	7.0 Kg/sqcm
Fire Electric Pump-1	5.75 Kg/sqcm	Manual
Fire Electric Pump-2 (Standby)	4.50 Kg/sqcm	Manual

(5) INSTALLATION

(i) The pump and motor assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or to the pipe work.

(ii) The pump and motor assembly shall be installed on suitable RCC (M-25 grade) foundation. The length and width of the foundation shall be such that 100 mm space is left all around the base frame. The height of foundation shall be so decided that the total weight of foundation block is minimum 2 times the operating weight of the pump assembly. The foundation shall be isolated from the floor by vibration isolating pads. GI frame of size 35 mm x 35 mm x 3 mm shall be provided on the top edges of the foundation with suitable fasteners. All foundation drawings and design shall be provided by the Contractor as per OEM standards and design.

(iii) More than one pump and motor assembly shall not be installed on the single base or cement concrete block.

(iv) The suction/discharge pipe shall be independently supported and their weight shall not be transferred to the pump. It should be possible to disconnect any pump for repairs without disturbing the connecting pipe line.

(v) A minimum clearance of 1 m. around the main pumps shall be provided.

(6) DRAINAGE PUMP

Drainage sump pump shall be vertical type suitable for drainage and solids up to 12 mm size. Pumps shall be wet pit/submersible type, grease lubricated and having ample support arrangement for suspension from sump top slab. Pumps shall have the capacity of 400 lpm discharge of water at 10 m head. Impeller shall be cast iron with open vanes. Pumps shall be provided with necessary support plates and GI sections. Pumps shall operate with high water level in sump and stop at low water level by means of an electronic level controller or auto float.

Pump shall have all accessories suitable for operation on 230 V, single phase /440 V, 3-Phase, 50 Hz AC supply complete with starter for automatic operation including water level sensing device, inter connection with submersible cable etc. common electrical panel with alternative operation of pumps including all cabling, wiring etc. The scope will also include GI piping work including bend connectors, etc. for drainage, complete in all respects.

2.2.2 Diesel Engine pump

(1) Supply, installation, testing and commissioning of Diesel Engine driven fire pump suitable for automatic operation conforming to BS 649/IS 10002 all amended up to date. The pump shall be Horizontal, end section/split casing, high pressure single / multistage centrifugal pump. The installation shall be complete with flexible coupling and coupling guard as required. Fire pump shall have C.I. casing, CS diffusers, bronze impeller (hard finished and dynamically balanced) and SS (304) shaft with mechanical seal, gland packing seal, capable for delivering 2850 LPM at outlet head of 90m to ensure a minimum pressure of 3.5 Kg/Sqcm at the farthest or topmost hydrant.

(2) The installation shall be complete with necessary pressure gauge with gun metal shut off cock on delivery side. Pump shall be capable of furnishing not less than 105% of rate discharge capacity at a head of not less than 65% of the rated head. The shut off head shall not exceed 140% of rated head. The pump shall be tested for bench mark duty point test at factory and shall be got approved by the Engineer.

(3) Diesel Engine shall be with heat exchanger/ Radiator cooled (secondary cooling) with necessary piping connections & fittings, flexible coupling, coupling guard & exhaust pipe connection complete as required. The engine speed shall be 1500 RPM and with automatic starting mechanism and other accessories. The fuel tank (fabricated from 3 mm GI sheet or stainless steel material, and painted with two coats of synthetic enamel paint. The fuel tank capacity shall be adequate to sustain pump operation for 8 hours continuous working. The fuel tank shall be fitted and magnetic oil level indicator, MH with cover, drain valve, air vent including structure supports (painted with approved shade) and copper pipe from fuel tank to diesel engine. The pumpset shall be provided with 2 nos. x 12 volt battery for automatic start. The diesel engine pumpset shall be mounted on a common GI base plate and GI channel of required size. Suitable reinforced concrete cement foundation (M-25 grade minimum) with plaster (1:4) shall be provided. All foundation drawings and design shall be provided by the Contractor as per OEM standards and design.

(4) Suitable anti vibration mounting duly approved by Engineer shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

(5) The design and drawing of the whole system shall be provided by the Contractor and approval of the Engineer shall be obtained.

2.3 PIPE WORK

The requirements of pipe work in fire fighting installations shall be as under:

2.3.1 FIRE HYDRANT DESIGN

Various GI pipe size of dia: 200mm, 150mm, 100mm, 80mm, 65mm, 50mm, 40mm, 32mm and 25mm shall be used and these are purely for Contractor's guidance. The Contractor shall be responsible for selection of size as per detailed engineering to be done by him. Fire fighting piping and accessories design to be done by the Contractor, shall incorporate the following :

(i) (a) Butterfly/ sluice valves shall be provided at suction and delivery sides of pumps (If positive suction is not provided, valve at suction is not to be provided) (b) External hydrant (c) Fire service connection/ inlet (d) Test valve (e) Drain connections.

(ii) For testing the system healthiness and automatic operation on daily basis, one test pipe with butterfly/ sluice valve shall be provided in common discharge header. For avoiding wastage of water, this pipe shall discharge water in the tank.

(iii) Non return value shall be provided at the delivery of each pump and fire service inlet. This shall be of swing type.

(iv) Air release valves with ball valve shall be provided in the piping system for venting tarred air with a size of 25 mm for pipes up to 100 mm and 40 mm for larger pipes.

(v) Fire fighting piping drawings showing the sizes of pipe, valves, layout and other details shall be prepared and shall be got approved from the Engineer before the execution of the Fire fighting work.

2.3.2 PIPE MATERIALS

All the pipes used in fire fighting system shall be of Galvanised iron (GI). The pipes shall be heavy class conforming to IS:1239 for sizes up to 150 mm. The pipes of sizes greater than 150 mm shall conform to IS:3589 (heavy duty) and these pipes shall be factory rolled and fabricated from minimum 6 mm thick Steel Sheet for pipes up to 350 mm dia and from minimum 7 mm thick Steel sheet for pipes of 400 mm dia and above. Cadmium plated steel nuts, check-nuts, bolts, washers etc. shall be used.

2.3.3 PIPE JOINTS

(i) Electric welding joints shall be provided in the GI pipe work. Flanged joints shall be provided for connections to valves, pumps, air vessels etc. and also on straight lengths at suitable points to facilitate erection and subsequent maintenance.

(ii) GI steel flanges shall be in accordance with table – 17 of IS : 6392 "Plate Flanges for Welding" and flange thickness shall be as under. Gasket thickness shall not be less than 3 mm.

Pipe dia	Flange Thickness
200 mm	24 mm
150 mm	22 mm
100 mm and 80 mm	20 mm
65 mm and 50 mm	18 mm
40 mm and below	16 mm

All hardware items such as Nuts, check-nuts, bolts and washers shall be of G.I and appropriate size. Washers shall be used on both sides of the bolt.

2.3.4 VALVES

Butterfly valve conforming to IS: 13095 shall be provided. All valves suitable to withstand the pressure in the system and rating shall be PN. 1.6. All valves shall be right handed (i.e.

handle or key shall be rotated clock wise to close the valve), the direction of opening and closing shall be marked and an open/shunt indicator fitted.

(i) The material of valves shall be as under :

Body	-	cast iron
Disc	-	Cast Bronze or Stainless Steel
Seat	-	Either integral or Nitrite rubber
O-ring	-	Ring- Nitrite/ Silicon

(ii) Non return valves shall be swing check type in horizontal run and lift check type in vertical run of pipes.

(iii) Air release valves shall be of gunmetal body.

2.3.5 NON-RETURN VALVE

Non-Return valves shall be cast iron double flanged with iron body and gunmetal internal parts conforming to IS: 5312 and IS: 778.

2.3.6 PRESSURE RELIEF VALVE

Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type.

2.3.7 PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The housing shall be die cast aluminium, with SS 316 movement, pressure element and socket. The set pressure shall be adjustable.

2.3.8 PRESSURE GAUGE

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 150 mm dia gunmetal bourdon type with gun mental isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at appropriate height for easy readability.

2.3.9 EXCAVATION

Excavation for pipe lines shall be in open trenches to levels and grades as required at site. Pipe lines shall be buried with a minimum cover of I meter. Wherever required, the Contractor shall support all trenches or adjoining structures with adequate supports, shoring and strutting. On completion of testing in the presence of the Engineer and pipe protection, trenches shall be backfilled in 150 mm layers sand/earth and consolidated properly. Contractor shall dispose off all surplus earth within a lead up to 1500 m as directed by the Engineer. After completion of work the area will be property dressed up.

2.3.10 ANCHOR/THRUST BLOCK

Contractor shall provide suitably designed anchor blocks in cement concrete(M-25 grade)/steel support to cater to the excess thrust due to work hammer and high pressure. Thrust blocks shall be provided at all bends, tees and such other location as determined by the Engineer. Exact location, design, size and mix of the concrete block/steel support shall be as shown on the drawings or as directed by the Engineer prior to execution of work.

2.4 FIRE HYDRANTS

2.4.1 Hose Cabinet

Hose Cabinet shall be provided for all internal and external fire hydrants. External Hose Cabinets shall be fabricated from 3 mm thick aluminium coated sheet for fully welded construction with hinged double front door partially glazed (4 mm glass panel) with locking arrangement, stove enamelled fire red paint (shade No. 536 of IS: 5) with "FIRE HOSE" written on it prominently (size as given in the schedule of quantities).

Internal Hose Cabinet

Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet door shall be made of 2 mm thick GI sheet (or powder coated with 7 tank process) and spray painted to shade No. 536 of IS: 5. The hose cabinet shall be of size to accommodate the following:

(i) Landing valves (Single / double headed).
(ii) Hose pipe.
(iii) Hose reel (45 m).
(iv) Branch pipes, nozzles (2 sets).
(v) Fire man's axe and hand appliances.
(vi) Universal locking arrangement

2.4.2 External Hose Cabinet 900x600x450 mm

External Hose cabinets shall be fabricated from 3 mm thick aluminium powder coated sheet for fully welded construction with hinged double front door partially glazed (4 mm glass panel) with locking arrangement, stove enameled fire red paint (shade No.536 of IS: 5) with "FIRE HOSE" written on it prominently (size as given in the schedule of quantities).
The hose cabinet shall be of size to accommodate the following:

(i) Single I Double headed yard hydrant valve.
(ii) Hose pipe (2 lengths of 15 m).
(iii) Branch pipes, nozzles (2 sets).
(iv) Fire man's axe (suitable for 20,000 volts for a period of 60 sec. as per IS : 926).
(v) Universal locking arrangement fabricated from 3 mm thick aluminium sheet and postal red coated with 6 mm thick plain glass in front.

2.4.3 STRAINERS

Stainless steel strainers shall have minimum 1 mm thick screen with 3 mm perforations. Strainers shall be provided with flanges.

2.4.4 ORIFICE PLATES

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points form Riser Main. The diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50 mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3 mm for pipe size upto 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag. The orifice plate shall fit not less than two pipes internal diameters down stream of the outlet from any elbow or brand. Contractor shall submit the design and identify location on drawing before installation.

2.4.5 INSTRUMENTS

(i) Pressure gauge of appropriate range 150 mm. dia size shall be provided.
(ii) The pressure gauge shall be duly calibrated before installation and shall be complete with shut off valve.

2.5 AIR VESSEL TANK

(1) Air vessel tank shall be provided on top of each riser and shall be fabricated out of 6 mm thick sheet (galvanized or stainless steel). The ends shall be dished fabricated out of 8 mm thick sheet (galvanized or stainless steel). This shall be of 450 mm dia, 2 m high and installed vertically on suitable legs. The legs shall be provided with GI Plate of size 75 mm x 75 mm x 5 mm at the bottom so that the legs do not puncture the roof. The legs shall be grouted in Cement Concrete (M-25 grade) foundation. Flange connection shall be provided for connection with wet riser pipe. Air release valve and pressure gauge with shut off valve shall be provided. The air vessel shall be tested at 25 kg/cm^2 pressure before installation.

(2) Air vessel tank shall be provided with inlet & outlet flanged connections pressure switches with valve to operate per operating sequences including 80 mm dia (GI or stainless steel) drain valves air release valve with stop cock on the top duly painted with two coats of anticorrosive primer and two coats of postal red enamel outside of approved make complete as required.

2.6 INSTALLATION

(i) The installation work shall be carried out in accordance with the detailed drawings prepared by the contractor and approved by the Engineer. The Contractor shall submit method statement for installation of all items for review by Engineer and installation shall be carried out as per method statement.

(ii) In pipe above ground level, expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.

(iii) Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

(iv) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.

(v) Piping installation shall be supported on or suspended from structure adequately. The contractor shall provide clamps and hangers etc. as required. Proper lines and levels shall be maintained while installing exposed pipes.

(vi) Pipe supports in pump house shall be floor mounted and shall be of GI. Spacing of GI pipe support shall not be more than that specified below:-

Nominal Pipe Size (mm)	Spacing (m)
20 and 25	2.00
32 to 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes. All fire fighting pipes, accessories and equipment shall include all the GI supports including angles, rods, clamps, nuts, washers etc. as required. No extra cost shall be paid for the supports, including angles, rods, clamps, nuts, washers etc. for fire fighting system installation works.

(vii) Anti vibration pads, springs or liners of resilient and non-deteriorating material shall be provided at each support, so as to prevent transmission of vibration through the supports.

(viii) Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.

(ix) Vertical risers shall be parallel to walls and column lines and shall be straight and in plumb. Risers passing from floor to floor shall be supported at each floor by clamps as required.

(x) The space in the floor cut outs around the pipe work shall be closed using cement concrete (M-25 grade) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibrations to the structure.

(xi) Riser shall have suitable supports at the lowest point.

(xii) Where GI pipes are to be buried under ground, the same shall be treated before laying. The top of the pipes shall be not less than 100 cm below the ground level. Where this is not practicable, permission of the Engineer shall be obtained for buried the pipes at lesser depth. Masonry (with 1:4 plaster i.e. cement or sand) or C.C. (M-25) blocks shall be provided for supporting the pipes at specified intervals approved by the Engineer. After the pipes have been laid, the trench shall be refilled with the excavated soil in layers of 200 mm and rammed and any extra soil shall be removed from the site of work by the Contractor.

(xiii) Underground pipe shall be laid at least 2 m away from the face of the building preferably along the roads and foot paths. As far as possible laying of pipes under road, pavement and large open spaces shall be avoided. Pipes shall not be laid under building and where unavoidable, these shall be laid in masonry trenches with removable covers.

(xiv) To facilitate detection of leak and isolation of defective of pipe, valves shall be provided in underground pipe at suitable locations. As far as possible such valves shall be provided over ground. If the valves are to be provided below ground, suitable masonry chamber with cover plate shall be provided with the approval of the Engineer. Locations where vehicles can pass shall be avoided for provision of valve below ground.

(xv) Pipe over ground shall be painted in red colour shade no. 536 of IS: 5. Suitable identification shall be provided to indicate the run of underground pipe wherever the route of underground pipe cannot be ascertained from the location of yard hydrant/isolating valves.

(xvi) It shall be made sure that proper noiseless circulation is achieved in the system. If proper circulation is not achieved due to air-bound connections, the contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification, including the tearing up and refinishing of floors, walls etc. as required.

(xvii) Class designation of bricks shall not be less than 10 wherever provided. The plastering shall be with 1:4 i.e. cement & sand and concrete grade shall be minimum M-25.

2.7 PRESSURE TESTING

(a) All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kg/sqcm for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer.

(b) Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

(c) System may be tested and after testing such sections shall be securely capped.

(d) Pressure gauges may be capped off during pressure testing of the installation.

2.8 ANTI-CORROSIVE PROTECTION ON UNDER GROUND PIPE

Corrosion protection tape shall be wrapped on pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic Fiber and minimum 4 mm thick and conforming to requirement of IS: 10221-Code of practice for coating and wrapping of underground pipes. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same Manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15 mm and 250 mm shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated in-situ after the pipe line is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall pre-heated until it is warm to touch and traces of moisture are removed and

then primer shall be applied and allowed to dry. All this work shall be done in the presence of Engineer's representative.

2.9 PIPE SUPPORTS

For installing pipes vertically or horizontally inside the building, standard GI pipe supports of reputed make shall be used. Following supports shall be used:

(i) Split pipe support clamps with lining for vertical, horizontal and roof hanging.

(ii) Clevis hangers for horizontal supports to adjust varying heights.

(iii) Sprinkler hangers for horizontal supports for pipes from 15 mm dia to 150 mm dia.

Fasteners and fully threaded GI rods shall be used for installing the pipe supports. The sizes of pipe supports and installation shall be in accordance with manufacturers' recommendations. Typical supports shall be as per CPWD specification part V (Wet Riser and Sprinkler System).

For pipes of size 100 mm and above, with the prior approval of Engineer, GI 'U' clamp with dash fastener may be used for supporting horizontal pipe from ceiling. All fire fighting pipes, accessories and equipment shall include all the GI supports including angles, rods, clamps, nuts, washers etc. as required. No extra cost shall be paid for the supports, including angles, rods, clamps, nuts, washers etc. for fire fighting system installation works.

2.10 AIR CUSHION TANK

Air cushion tank shall be provided on top of each wet riser and shall be fabricated out of 6 mm thick GI sheet. The ends shall be dished fabricated out of 8 mm thick GI sheet. This shall be of 200 mm dia., 1.2 m high and installed vertically on suitable legs. The entire tank shall be hot dipped galvanized. The legs shall be provided with GI plate of size 75 mm x 75 mm x 5 mm at the bottom so that the legs do not puncture the roof. The legs shall be grouted in M-25 grade CC foundation. Flange connection shall be provided for connection with wet riser pipe. Air release valve and pressure gauge with shut off valve shall be provided. The air vessel shall be tested at 25 kg/sqcm. pressure before installation.

Air GI cushion tank shall be provided with air release valve, stop cock flanged inlet connection and drain arrangement with 25 mm dia valve, pressure with gun metal stop cock complete with all accessories as required and conforming to IS 4736-1968 painting tie vessel piping etc. with two coats of anticorrosive primer inside and outside, epoxy paint inside, two coats of postal red enamel outside of approved make.

2.11 MEASUREMENT

Measurements of fire fighting piping work shall be on following basis:

(a) Piping shall be measured along the center line of installed pipes including all pipe fittings and accessories but excluding valves and other items for which quantities are specifically indicated in the schedule of work. No separate payment shall be made for fittings and accessories.
(b) The measurements for piping work shall include all wastage allowances, flanges pipe supports, hangers, excavation, refilling, testing, nuts and check nuts, vibration isolators, suspension where specified or required, and any other item required to complete the piping installation. None of these items will be separately measured.

3 FIRE FIGHTING ACCESSORIES

This covers supply, installation, testing and commissioning landing valves, first aid hose reels, hose pipes, branch pipes etc, which are vital tools for fire fighting.

3.1 LANDING VALVE

Landing valves are provided in the system for connection of hose pipes for discharging water for fighting fire by fire brigade or trained personnel. The landing valves shall be as per I.S.:5290. The landing valves are of single and double head outlet types.

(1) Material of construction:

(i)	Body, outlet and cap etc.	-	stainless steel
(ii)	Spindle	-	stainless steel for stainless steel body
(iii)	Hand wheel	-	cast iron

(2) The water discharge shall be not less than 900 lpm for single head and 1800 lpm for double head valves at 7 kg/cm^2 pressure.

(3) Installation

(a) The landing valve shall be fitted to a T connection of the riser at the landing in such a way that the valve is in the centre of the internal hydrant opening and at a height of 1 m. from floor level.

(b) The valve base shall be vertical and the valve facing outside. There should be no hindrance in operation of the handle.

3.2 FIRST AID HOSE REEL

(1) First Aid Hose Reel is meant for delivering small quantity of water in early stage of fire and can be operated even by untrained personnel, and thus provides a most effective fire fighting facility. It consists of a length of 45 meters and 25 mm dia mm (nominal internal) hose tubing warped around a reel with inlet pipe, stop valve and 7 mm shut off nozzle. The entire assembly is mounted on a wall bracket and can swing 180 degree. The water inlet is connected to the riser pipe by means of 37 mm socket and valve. The hose tube can be pulled out easily for the purpose of discharge of water on fire. The First aid hose reel shall be as per IS- 884. The coupling, branch pipe and nozzle shall be as per IS:8090.

(2) Material of Construction:

SN	Item	Material
(i)	Hub and sides	GI
(ii)	Wall Bracket	GI
(iii)	Hose tube (25 mm) (Nominal Internal dia)	Thermoplastic (Textile Reinforced Type-2) as per IS-12585
(iv)	Nozzle with branch Pipe	Stainless Steel.
(v)	Stop Valve (Ball Valve)	Gun Metal.

Normally GI construction shall be used. Other corrosion resistant material may also be used in areas having corrosive atmosphere.

The water flow rate shall be not less than 24 lpm and the range of jet shall be not less than 6 m.

(3) Installation

(a) first aid hose reels shall be installed with internal hydrant within in fire hose cabinet space for which is provided as per architectural drawing. First aid reel drum and brackets (GI or powder coated) etc. shall be painted with two coats of enamel paint of shade No. 536 of IS: 5. The size of the fire hose cabinet shall be

such that there is no obstruction in swinging the hose reel. The location of cabinet shall be such that it does form an obstruction in passage/escape route.

(b) The length of hose tube shall be such that the nozzle of the hose can be taken into every room and within a range of 6 M from any part of the room.

(c) There shall be no obstruction in swinging the hose reel and should be installed above landing valve where provided.

(d) The inlet valve shall be at 900 mm above floor level.

(e) Hose reel bracket shall be firmly grouted on the wall with the help of rawl bolts.

3.3 FIRE HOSE DELIVERY COUPLING, BRANCH PIPE AND NOZZLES

These are important accessories used for fire fighting operations.

(1) Material of construction: Stainless steel.

(2) Delivery Hose Couplings

The delivery hose couplings consist of male half coupling and female half coupling. Groves are provided on outer side on both coupling for binding hose pipes with wires. In female coupling spring loaded cam tooth is provided for holding male half coupling in position. Male half and female half coupling are provided on both sides (ie. on one side male and on other side female) of hose-pipes. Two or more pipes can be joined together with the help of these couplings instantaneously. These are available in two sizes i.e 63 mm and 70 mm.

(3) Branch Pipe and Nozzle:-

Branch pipes with nozzle are mounted at the end of hose pipe. Branch pipe shall be properly finished and free from sharp edges. During operation, a fireman has to hold the branch pipe. One end of branch pipe is fixed with hose coupling and the other end is threaded to fit the nozzle. Nozzle is tapered pipe with one end threaded internally which is fixed on branch pipe. The size of other end i.e. nozzle shall be 20 mm (nominal internal diameter).

3.4 FIRE SERVICE INLET AND FIRE SERVICE CONNECTION

These are provided for connection of fire service hose pipe for either directly pressurizing the system with their pumps or filling water in the tank from a distance. In the first case non return valve with butterfly valve shall be provided for holding water pressure. Fire service inlet shall be provided with each wet riser/down corner and the ring main. The typical arrangement shall be as per CPWD specification part V (Wet Riser and Sprinkler System). These are fixed to 150 mm dia pipe and located in GI or powder coated box made of 2 mm thick sheet with open able glass cover. These shall be as per IS:904. Material of construction shall be stainless steel.

3.5 HOSE PIPES

(1) Hose pipes shall be rubber lined woven jacketed and 63 mm in diameter. They shall conform to Type B of IS: 636. They shall be flexible and capable of being rolled. Length of hose pipe shall be 15 m.

(2) The hose pipe shall be complete with male and female coupling at the ends.

(3) Beside keeping hose pipe with internal hydrant and yard hydrant spare hose pipes along with branch pipes shall be kept in fire control mom/pump room.

4 AUTOMATIC SPRINKLER SYSTEM

4.1 This chapter covers the general requirement of selection, design, supply, installation, testing and commissioning of automatic sprinkler system for fire fighting in buildings used for other than industrial and storage purpose. The system shall be as per IS:15105 (Design and

Installation of Fixed Automatic Sprinkler, Fire Extinguisher Systems - Code of Practice) and IS:9972 (Specification for Automatic Sprinkler Heads for Fire Protection Service).

4.2 DESIGN CONSIDERATIONS

Fire fighting installations are operated manually. Delay in undertaking manual operation due to late detection and/or response, may result in spread of fire. In automatic sprinkler system, sprinkler heads are provided throughout the areas to be protected at specified locations such as roof or ceiling, walls, between racks, below obstructions and fitted with water supply lines permanently charged with water under specified pressure. The sprinklers operate at pre-determined temperature to discharge water over the affected area below and provide an adequate distribution of water to control or extinguish fire. Only those sprinklers which are in the vicinity of fire become sufficiently heated, operate. Operation of sprinkler results in flow of water which initiates fire alarm. Thus sprinklers perform two functions i.e. first to detect fire and then to provide an adequate distribution of water to control or extinguish it. Water distribution from ceiling level, cools down the hot gas which forms beneath the ceiling of enclosure in which fire is developing. This will prevent spread of fire to adjoining areas and contain damage to limited area. Typical layouts of sprinklers shall be as per CPWD specification part V (Wet Riser and Sprinkler System).

(1) **Extent of Sprinkler Protection:-** The sprinklers shall be provided in the entire building. The sprinklers shall not be provided in :

(a) rooms where the water discharged from a sprinkler may pose a hazard.
(b) Stair case and lift well.
(c) Wash rooms, toilets, W.C.
(d) Rooms where electric switch gear, transformer, Gensets and A.C. plants have been installed.

(2) The water discharge shall be at least 5 litre/Min/m^2 over an assumed area of operation covering 360 m^2.

(3) **Sprinkler Spacing, Arrangement and Locations:-** Sprinkler heads shall be installed on ceiling and or side walls. For selection of number of sprinkler and their location in a given area, following factors shall be considered.

SN	Description	Value
(i)	Maximum Area Coverage per Sprinkler	
	(a) side wall sprinkler	9 m^2
	(b) ceiling sprinkler	12 m^2
(ii)	Maximum Distance between Sprinklers.	
	(a) side wall sprinkler	3.4 m
	(b) ceiling sprinkler	4 m
(iii)	Minimum Distance between Sprinklers	2 m
(iv)	Maximum distance between Sprinklers and Boundary	2 m

Typical layout of side wall sprinklers shall be as per CPWD specification part V (Wet Riser and Sprinkler System).

(4) **Spacing Below Sprinkler Heads:-** Clear minimum space of 0.5 m shall be maintained below the deflector of sprinkler head.

(5) **Location of Sprinkler in relation to Building Structure:-**

(i) Ceiling sprinklers Deflector shall not be less than 150 mm and more than 300 mm below the ceiling.
(ii) Side wall sprinkler defector shall not be less than 100 mm. and not more than 150 mm. below the ceiling.
(iii) If depth of a beam in an area is less than 450 mm. the distance at (i) and (ii) shall be maintained and provision of beam shall not be considered. If the depth of a beam in an area is more than 450 mm, then the beam shall be regarded as a boundary.

(6) Pipe Sizing and Design:- Sprinkler heads shall be connected with pipe lines permanently charged with water. Depending upon location of sprinkler heads and site conditions, sprinkler heads may be with range and distribution pipes. The pipes connecting the sprinkler heads shall be sized depending upon number of sprinkler heads and arrangement of their connection. Main elements of a sprinkler installation shall be as per CPWD specification part V (Wet Riser and Sprinkler System). Various pipes connecting the sprinkler heads shall be termed as under:

(a) Range Pipe.
(b) Distribution Pipe.
(c) Main Distribution Pipe.
(d) Riser.

Sizes of pipes are to be calculated from various tables and hydraulic calculations given in IS: 15105. Some guidelines are given below:

(i) Pipe less than 25 mm. dia shall not to be used.
(ii) There shall not be more than 6 (six) sprinklers in any range.
(iii) Range and distribution pipe nominal sizes are to be selected from Table A and Table B respectively as below:

Table – A

RANGE PIPE NOMINAL SIZES FOR VARIOUS PIPE LAYOUTS IN INSTALLATIONS

	Range pipe layout	**Pipe nominal bore (mm)**	**Maximum number of sprinklers to be made by pipe of size listed.**
	(1)	**(2)**	**(3)**
(a)	Ranges at remote end of each distribution pipe spur:		
	(1) last two ranges in two end-side layout.	25 32	1 2
	(2) last three ranges in their end-side layout.	25 32	2 3
	(3) last ranges in all other layouts.	25 32 40	2 3 4
(b)	All other ranges	25 32 40	3 4 6

Table – B

DISTRIBUTION PIPE N0MINAL SIZE IN INSTALLATIONS AND MAXIMUM NUMBER OF SPRINKLERS.

	Range pipe layout	Distribution pipe nominal bore (mm)	Maximum number of sprinklers to be made by pipe of size listed.
	(1)	(2)	(3)
(a)	Two end side	32 40 50 65	2 4 8 16
(b)	All other types	32 40 50 65	3 6 9 18

(7) Components of sprinkler system: Following types of valves shall be used in the installation:

(a) Stop Valve.
(b) Test Valve
(c) Drain Valve
(d) Flushing Valve
(e) Check Valve
(f) Installation Valve And Alarm Valve
(g) Pre Action Valves
(h) Subsidiary Valves
(i) Alarm Device
(j) Pressure Gauges.

The location of above valves shall be as under.

(a) **Main stop valve:-** Only one main stop valve shall be provided immediately after main alarm valve at a location which is readily accessible.

(b) **Test Valve :-** For testing hydraulic alarm or electric alarm by drawing water from down stream side, test valve shall be connected with down stream of the water flow alarm.

(c) **Drain Valve :-** For drainage of system, drain valve 50 mm. dia shall be provided down stream of installation valve/stop valve or any subsidiary stop valve.

A common valve can perform the functions of test and drain. The outlet shall be connected with a 50mm dia G.I. drain pipe along with riser pipes shall be as per CPWD specification part V (Wet Riser And Sprinkler System).

(d) **Flushing Valve :-** If the water used for sprinkler is not portable, flushing valves shall be provided at the end of a distribution pipe. The valve size shall be same as distribution pipe. Valve outlet shall be fitted with a brass plug and extended to not more than 3 m above floor.

(e) **Check Valve :-** Check valve shall be provided where more than one water supply is available and same shall be fitted on ach water supply pipe.

(f) **Subsidiary Stop Valve :-** Subsidiary stop valve which shall be of the same dia as the pipe line in which they are fitted shall be provided to control water supply to sprinklers of highly sensitive areas like computer rooms.

(g) **Installation and Alarm Valve :-** A sprinkler installation shall be fitted with suitable main installation valve to control water supply to the installation. The valve set shall comprise of the following:

(i) A main stop valve.
(ii) An alarm valve.
(iii) A Water monitor alarm gong.

The main stop valve shall be placed in the vicinity of the main entrance of the protected area at an easily accessible place. The valve shall be secured open by a pad locked and protected against damage. A location plate shall be fixed near the valve bearing the following words in raised letters:

- **SPRINKLER**
- **STOP VALVE**

Alarm valve shall be fitted on the main supply pipe immediately after the main control valve and before any connection is taken off to supply any part of the installation.

(h) **Alarm Device:** Water monitor alarm suitable for sprinkler service shall be provided very close to the installation and Alam valve. This alarm shall be provided on the outside of an external wall. Strainer shall be fitted between the motor nozzle and the alarm valve connection. The water outlet shall be positioned so that any flow of water can be seen. The alarm device shall provide audibility level of 85 dB above the back ground noise level.

(i) **Pressure Gauges:** Pressure gauges shall be provided at each of the following points.

(a) Immediately down stream of the alarm valve.
(b) Immediately up stream of the main stop valve.

Stop cock shall be provided before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS:3624.

(j) **Pre action Valve:** Pre-action valve body, all threads, inlet & outlet shall be as per BS4504:16/11 R.F. suitable for a maximum working pressure of 16 bar. Material of construction shall be Cast Iron as per BS1452 Grade 260.

4.3 SPRINKLERS TYPE

Sprinklers shall be as per IS : 9972 and following types:

4.3.1 According to type of discharge as per CPWD specification part V (Wet Riser and Sprinkler System).

(a) Conventional pattern.
(b) Spray pattern.
(c) Side wall pattern.

4.3.2 According to mounting pattern.

(a) Pendent sprinkler.
(b) Upright sprinkler.
(c) Horizontal sprinkler.
(d) Ceiling sprinkler.

4.3.3 According to Release Mechanism.

(a) Fusible element sprinkler.
(b) Glass bulb sprinkler.

4.3.4 According to Orifice Size.

(a) 10 mm.

(b) 15 mm.
(c) 20 mm.

4.3.5 According to Temperature Rating, Sprinkler shall have one of the following temperature rating and shall be correspondingly colour coded.

(a) Fusible Link Type

Temp. Rating °C	Colour code
68/74	Natural
93/100	White
141	Blue
182	Yellow
227	Red

(b) Glass Bulb Type

Temp. Rating °C	Colour code
57	Orange
68	Red
79	Yellow
93	Green
141	Blue
182	Maroon
204/260	Black

4.4 SELECTION OF TEMPERATURE RATING

Temperature rating of a sprinkler shall not be less than 30^0 C more than the highest anticipated temperature of the location of installation. Under glazed roofs or where there are roof sheets of PVC or similar plastic material, sprinkler shall be rated 68 / 79^0 C.

4.5 SELECTION OF ORIFICE SIZE

In moderate hazard applications, sprinklers or orifice size 15 mm. shall be used.

4.6 INSPECTION AND TEST VALVE ASSEMBLY

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve and orifice assembly as per approved drawing.

4.7 FLOW SWITCH

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring in the Annunciation Panel. The flow switch shall have IP: 55 protection.

The flow switch work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a "Retard" to compensate for line leakage or intermitted flow. The contractor shall provide conduit for flow switch cable wherever required as part of fire fighting system.

4.8 PROTECTION OF SPRINKLERS

Any sprinkler installed in a position of risk or accidental damage shall be fitted with a metal guard suitable for sprinkler service:

4.9 WATER SUPPLY ARRANGEMENT FOR SPRINKLER

Water Storage Tank- The water storage tank shall be combined with fire fighting system and sprinkler installation and shall be two nos. of 150,000 litres capacity.

4.10 ANNUNCIATION PANEL AND ALARM FOR SPRINKLER

Electrically operated alarm shall be provided for indication of operation of sprinkler in an area. Water flow switches shall be installed in main distribution pipes which shall be wired to sprinkler annunciation panel. In the event of operation of a sprinkler, the flow switch will operate and give signal to the annunciation panel to indicate operation of sprinkler in the area. This will initiate an electrically operated alarm. The system shall be independent of fire alarm system.

4.10.1 CONSTRUCTION DETAILS

(i) The Annunciation Panel shall be fabricated out of not less than 2 mm thick MS sheet powder coated after 7 tank treatment process and shall be totally enclosed dust damp and vermin poof. Suitable knockout be provided for the entry of cables. The panel shall be designed such that the equipment for power supply, battery charging are housed in intendant components. Sealed maintenance free batteries shall also be accommodated inside the panel.

(ii) Indicating lamps control switches, buttons and fuses shall be suitably located in the front and properly labeled.

(iii) The indicating lamps shall be LED type of following colours. The flow switch operation conditions shall be indicated by twin lamps.
- (a) Red to indicate flow switch operation.
- (b) Amber to indicate fault condition.
- (c) Green to indicate healthy condition.

(iv) The test buttons to test indication lamps shall be provided.

(v) The panel shall be solid state type or microprocessor type.

(vi) The primary function of the panel shall be to respond automatically to the operation of one or more flow switches to give alarm and to indicate area/areas where the device has activated. The operation or one or more flow switches shall result In simultaneous alarm given by the following:-
- (a) External alarm hooter(s).
- (b) A visible indication on panel.
- (c) Audible alarm on panel itself (common for all zones).

(vii) The panel shall indicate the fault within the system and immediate fault warning shall be given by an audible and visible signal on the panel in case of open circuit, short circuit and earth fault in cable between flow switch and annunciation panel.

(viii) The panel shall be complete with mimic diagram for the areas covered by different flow switches. The layout of mimic diagram shall be got approved from Engineer.

(ix) Battery backup with trickle cum boost charger shall be provided for operation of the system. Indication of mains failure and low battery voltage shall be provided. The batteries shall be sealed maintenance free. The capacity of the battery shall be 12 Volt 2 Nos. 40 AH each. Both batteries of 12 V shall be connected in series to make it 24 V. All standard accessories shall be provided.

4.11 INSTALLATION

4.11.1 The Installation, Testing and Commissioning shall be carried out as per details given in tender document. Following points shall also be considered for sprinkler installations:

(1) For fixing sprinkler heads, 15 mm. dia GI Socket is to be welded to range pipes at the locations as per drawings. Dead plug shall be fixed in the socket.

(2) If sprinkler head is to be provided away from range pipe, GI Pipe nipple of suitable size be used to extend the sprinkler head and is at desired location.

4.11.2 After section-wise completion of work, pressure testing at 7.5 kg/cm^2 pressure shall be carried out for 24 hrs.

4.11.3 After completion of the entire work pressure testing of entire pipe work shall be carried out for 24 hrs. at a pressure of 7.5 kg/cm^2. The drop of pressure up to 0.5 kg/cm^2 shall be accepted.

4.11.4 The lines shall be flushed before completion of building work so that any foreign matter which might have entered the system is taken out. The pressurization pump (Jockey Pump) be operated and valves opened at different locations.

4.11.5 During occupation of the building, sprinkler heads shall be provided in place of dead plugs. Teflon tape shall be used on threaded portion. The sprinkler heads shall be properly tightened in the socket.

4.11.6 When all sprinklers heads are installed, pressure shall be built up in the system by pressurization pump slowly and in case no leak is found, desired pressure shall developed and maintained. In case any leak is detected, the same shall be attended before pressurizing the system further.

4.12 COMMISSIONING

As soon as the work is complete, the Automatic Sprinkler System shall be commissioned and made available for use.

5 Specification of welding electrodes & quality control for welding.

5.1 Quality Control for Welding

5.1.1 Welding machines shall be in good working and shall have proper control for regulating currents. Adequate spares shall be kept in stock (at site during the execution of the work for routine maintenances. Location of the welding machines and the distribution boards to be connected with them shall be decided in consultation with site electrical supervisor to avoid overloading of the distribution boards, cable & electrical power sources.

5.1.2 For executing site fabrication/ welding the electric cables, distribution boards & connections for machines shall be carefully checked once a week and maintained in length. The cables shall be carefully examined and repaired as necessary every day.

5.1.3 All welding shall be performed strictly in accordance with the welding requirements detailed in approved WPSs and ASME boiler and pressure vessel code Section IX suitable WPSs to be provided.

5.2 Welding Electrodes

Generally all welding shall be performed using shielded metal arc welding (SMAW) process with low hydrogen basic coated electrodes (i.e. E 7016 or E 7018 type). However, use of cellulosic- coated electrode (E 6010 type) will be permitted for welding root run of full penetration groove welds and at least two runs with E 7018 electrode shall be made on socket weld and fillet welds.

5.2.1 Storing of welding Rods

Welding electrodes shall be stored indoors free from moisture. The package of the welding electrodes shall not be opened until immediately before use.

5.2.2 Drying of welding Electrodes:

All low hydrogen welding electrode shall be dried in an electrode oven accordance with the manufacturer's recommendation. After baking, the electrodes shall be stored in a holding oven or heated quivers. Welding electrodes not consumed in a day a shall be baked by the same method, with only two rebakings permitted.

5.2.3 Tack welds may be done either with full penetration or as bridge tacks. If full penetration tacks are made, the ends shall be ground to featheredge and inspected for presence of any defect. If tacks are cracked, these shall be completely removed by grinding and the area shall be inspected by Dye penetrant examination to ensure freedom from defects.

5.3 CONTROL OF WELDERS

Qualified and certified welders only shall do the welding. All welders assigned to the work shall be qualified by test and approved by the Engineer. Welders deployed for welding piping Joints shall have qualifications in Shielded metal arc welding (SMAW) process.

Welders procedure and other related requirements should be fully explained to each welder and fitter prior to welding work. Welding shall not be started if bevel preparation and fit up of the base material is not correct.

5.4 BOLTING PROCEDURE:

All flanged joints shall be fitted so that the faces of the flanges meet evenly with the gaskit and then the bolts shall be tightened in a sequence to ensure uniform bolt stress. In bolting flanged joints, the bolt shall be tightened in a proper manner to compress the gasket to build up compression suitable for the type of gasket used flanges shall be faced and have jointing of rubber insertion or asbestos compound. All bolts shall extend completely and uniform through their nuts. Bolts loads shall be in accordance with the manufacturer's recommendation.

5.4.1 Flanges

Material/construction specification -- carbon steel as per IS: 2004 class 2 & 3.
Dimensional standard as per IS: 6392 Table -17, raised face , serrated finish.

5.4.2 Bolts

Materials/ Construction specifications as per IS: 1367
Dimensional standard as per IS: 1367

5.4.3 Nuts

Materials/construction specification as per IS: 1367
Dimensional standard as per IS: 1367

5.4.4 Gaskets

Compressed asbestos fibre jointing (CAF) as per IS: 2712 Grade W/3
Dimensional standard as per IS: 6392 Table-17

5.5 INSPECTION

5.5.1 Inspection before welding

(a) Dimension and orientation of spool assembly and installed spool and/or piping components shall be checked as per the piping drawings.
(b) Width of root opening, bevel angle and alignment of components shall be checked on each joint fitted up.
(c) Surfaces to be welded shall be checked to ensure that they are clean and free from foreign material such as grease, oil, paint, scale, etc. for a distance of at least 25mm from bevel ends.

5.5.2 Inspection During Welding

Crack in welds, alignment, welding slag, inter-run cleaning, welding current conditions and bead finish shall be checked. Any discrepancy or defects found shall be rectified immediately.

5.5.3 Inspection of completed welds

(1) All welds shall be visually inspected during and after welding by QA/QC engineer/engineer in-charge. Finished welds shall be visually inspected for parallel and axial misalignment. Cracks, bead appearance, incomplete penetrant, undercut, weld reinforcement, lack of fusion, un-paired burn-through , size of fillet welds dimensions and surface defects. After clearance of visual inspector. Dye penetrant examination, radiography shall be selected for radiography wherever radiography percentage is less than 100%.

(2) Liquid penetrant inspection

(a) All the root welding shall be 100% liquid penetrant tested.
(b) 10% of the total finish welding shall be liquid penetrant tested.
(c) Liquid penetrant or magnetic particle examination shall be performed in accordance with section V of ASME code.

5.5.4 Repair and removal of defects.

Defects, which are not within the acceptable limits, as revealed in visuals and NDT shall be removed from the joint completely by air-arc gouging, chipping or grinding. If gouging is done, the gouged surface shall be ground to smooth white metal, prior to re-welding. The excavated groove after removal of defects shall be suitable for welding & one re-welding and re-welding shall be done in accordance with the WPS adopted for original weld.

6. ELECTRICAL WORKS

6.1 SCOPE

The scope covers design, supply, installation, testing and commissioning for the electrical works associated with fire fighting installations, namely, motors, switch boards, power cabling, control wiring, earthing and remote control-cum-indicating panels etc.

6.2 GENERAL

(i) Unless otherwise specified in the tender specifications, all equipment and materials for electrical works shall be suitable for operations on 440 V / 240 V ± 10% (3 phase/single phase), 50 Hz. AC system.

(ii) All electrical works shall be carried out complying with the Indian Electricity Rules, 2003 as amended to date.

(iii) All materials and components used shall conform to the relevant IS specifications amended to date.

6.3 POWER SUPPLY

The power supply 440 Volt, 3-phase, 50 Hz shall be made available for fire-fighting installations from sub-station.

6.3.1 Power cable of adequate size shall be laid from the sub-station to the switch board of pumps. Independent supply shall be provided for water supply pumps, if installed in the same pump house. The power supply for fire fighting is not to be used for any other purpose.

6.3.2 If the fire pump house, is away from the sub-station building, the route of the cable shall not pass under the building or permanent structure. Cable shall be laid along the route which is safe from fire.

6.3.3 Sufficient spare power shall always be available to drive pumping sets at all times throughout the year. Suitable capacity ACB/MCCB/Fuse Switches/Switch Fuses shall be provided in the electrical panel for extending supplies to fire pumps. Such switch shall be suitably marked with "FIRE SWITCH" and shall not be switched Off without permission/intimation to appropriate authority. In case any maintenance work is to be carried out on the electrical panel from where supplies to fire pumps have been extended, alternative arrangement shall be made to ensure that power supply to fire pumps continue to be available for operation at any time.

6.4 MOTOR STARTER

(i) The motor starter shall conform to IS: 1822 "Motor starters of voltage not exceeding 1000 volts" and shall be air insulated and suitable for 440 V, ± 10%, 50 Hz., 3 phase AC supply and shall be integrated in the panel.

(ii) Starter for the motor shall be direct online (D.O.L) for motors up to and including 5.0 KW rating and automatic star-delta type for motors of higher ratings unless otherwise specified in the tender specifications.

(iii) Each starter shall be provided with the following protections: -
   (a) Thermal overload on all the three phases with adjustable settings,
   (b) Independent single phase preventer. (Current sensing type).

(iv) Adequate number of extra NO/NC contacts for interlocks, indicating lamps, remote operation etc. shall be provided on the starter / contactor.

(v) Under voltage/No volt trip shall not be provided.

6.5 SWITCH BOARDS

(i) The main switch board shall be floor mounted, free standing or wall mounted cubical type and shall be factory built fabricated by one of the approved switch board manufacturer. The board shall be fabricated from 2.0 mm. thick CRCA sheet and powder coated after 7 tank treatment process. The board shall be fabricated with IP 42 degree of protection. It shall be suitable for termination of the incoming cable(s) from bottom.

(ii) The capacity of switch gear shall be suitable for the requirements of motor fed/controlled. Starting currents shall be duly considered.

(iii) Switch fuse units shall be used up to and including 32 A and Switch Disconnector Fuse Unit (SDFU) shall be used for 63 A and above. ACB shall be used for 630 A and above ratings. Alternatively, MCCBs of appropriate fault level may be provided.

(iv) All switch fuses/SDFU (Switch Disconnector Fuse Unit) shall be of AC 23 duty as per IS: 4064-1978 as amended up to date. They shall be complete with suitable HRC cartridge type fuses.

(v) Switch boards shall house starters for motors with independent current sensing type single phase preventer for each starter.

(vi) Voltmeter with selector switch, a set of indicating lamps and fuses for voltmeters and lamps shall be provided. Ammeter with CTs, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a class index not higher than 1.0. The instruments and accessories be provided whether or not specifically indicated in the tender specifications.

(vii) The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer.

(viii) The layout shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit.

(ix) Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.

(x) Where terminations are done on the bus bars by drilling holes there in, extra cross section shall be provided the bus bars. Alternatively, terminations may be made by clamping.

(xi) Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switchboard.

(xii) Identification labels shall be provided against each switchgear and starter compartment, using aluminium engraved labels.

(xiii) Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.

6.6 SYSTEM CONTROLLER

For controlling operation of pumps and indicating fault, system controller shall be provided. The system controller shall consist of relays timer, contactors etc. and shall be designed to operate the fire pumps with interlocking and fault induction. Annunciation window shall be provided to indicate following faults:

(i) Low water level in terrace tank.
(ii) Main pump failed to start.
(iii) Main pump filed during operation.
(iv) Supply to Main Pump failed.
(v) Supply to Terraced Pump failed.

Suitable sensors, differential pressure switches, monitors shall be provided at respective location. The control system shall be operational on 12 Volt / 24 Volt DC batteries. Battery chargers shall be provided to ensure that the batteries remain, charged. Batteries shall be sealed maintenance free type.

6.7 REMOTE INDICATING PANEL

(i) The remote indicating panel shall be provided in the fire control room. This panel shall have necessary status indication of all electric motors.

(ii) Back indication to show the status of operation of all the motors and also pressure in the system, water level in underground and over head tank etc. shall be provided.

(iii) Panel shall be fabricated from not less than 2.0 mm thick CRCA sheet and powder coated after 7 tank treatment process. The panel shall be dust, damp and vermin proof. This shall be of wall mounting type. This shall be complete with necessary termination arrangements, multicore cables, tag blocks control transformer, designation plastic.

(iv) Labels, double earth studs etc. as required.

6.8 POWER CABLING

(i) Unless otherwise specified, the power cables shall be FRLSH XLPE insulation, armoured cables 1100 V grade. The power cables shall be of 2 cores for single phase for sizes up to and including 50 sqmm, 4 core for sizes higher than 50 sqmm for 3 phase.

(ii) Power cables shall be of sizes to meet the starting and running current of motors fed and shall be as approved by the Engineer, after taking into consideration the load, voltage drop and the length of cabling.

(iii) Cables shall be laid in suitable GI trays suspended from ceiling, or mounted on walls. Cable ducts shall not be provided in pump rooms. Cable trays shall be of perforated GI sheet with adequate structural strange and rigidity. Necessary supports and suspenders for cable trays shall be provided by the contractor as required. All tray/ suspender material shall be stainless or GI. The payment of the GI cable trays shall be made in the designated BOQ item.

6.9 CONTROL WIRING

(i) Control wiring shall be done using ISI marked FRLS PVC insulated and PVC sheathed, 2.5 sqmm, 1100 V grade, armoured multi-core copper conductor cable. The control cable shall also be laid in the same manner as power cable.
(ii) Runs of control wires within the switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.
(iii) Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer.

6.10 EARTHING :

All equipment will be connected on main earth terminal of Electrical works by 40x6 mm GI flat. The payment of the GI flat shall be made in the designated BOQ item.

6.11 PAINTING

All Hydrant and Sprinkler pipes shall be painted with post office red colour paint. All GI pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat two or more coats of enamel paint shall be applied. Each coat shall be given minimum 24 hours drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as “TO RISER NO.1" etc. Painting shall be expertly applied, the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

7 INSTALLATION, TESTING AND COMMISSIONING

The installation, testing and commissioning of the fire fighting system shall be as under:

7.1 PREPARATION AND APPROVAL OF DRAWING

7.1.1 The contractor shall prepare working drawings and submit to the Engineer for approval. The work is to be executed as par approved drawings. All drawings should be carefully and critically examined before approval. Generally following points shall be taken care of while preparing the drawings:

(1) Site survey should be carried out in detail.

(2) In addition to building plans, layout plan along with landscape plan/ horticulture plan and other services plans should be consulted while deciding route of underground pipes from pump house and around the building.

7.1.2 As far as possible, underground pipes are not to be laid under road, pavement, building and long open space. The locations along road, foot path in earth may be preferred.

7.1.3 The locations of yard hydrants, fire service inlet and fire service connection are to be decided based on distance as per fire hazard norms. However, necessary adjournments are to be made so that these components do not become hindrance in vehicular movement and entrance to the building. Requirement of other building services are also to be given due consideration. Symmetry should be maintained for aesthetic considerations.

7.1.4 **Electrical Panel:** Complete wiring drawing layout etc. are to be examined to ensure that provisions of agreement are incorporated in the drawing. Sizes of various panel and mounting arrangement may be decided keeping in view ease of operation and aesthetic consideration as well.

7.2 INSTALLATION:

The following precautions are to be taken during execution of the work.

7.2.1 The pump and motor/engine are to be perfectly aligned on the base plate so that there is no vibration during operation. All nuts, bolts, washers shall be of adequate size and galvanized.

7.2.2 The pipe supports should be decided in a way that the weight of pipes and valves are not transferred to the pumps and supports do not cause hindrance in movement inside the pump house. As far as possible, floor supports may be provided in pump house.

7.2.3 All valves shall be installed at a height and in a position that their operation by right hand is conveniently possible.

7.2.4 All pressure should be installed so that the dial is vertical and is visible while entering the pump house.

7.2.5 Electrical panels should not be installed at floor level. The panels shall be sufficiently raised above ground level. If panels are to be mounted on wall, a GI frame shall be provided so that at least 75 mm space is left behind the panels. The panels shall be easily approachable.

7.2.6 Cable trays are to be used for laying of power and control cable inside pump house. No cable is to be laid at floor level/ in trench. Cable tray layout should give neat appearance. All cable tray shall be adequately supported from the ceiling/ floor.

7.2.7 While excavating for laying of external pipes, suitable sign board/ barricading shall be provided to ensure that no person falls in the trench.

7.2.8 The width and depth of trench shall be adequate for laying the pipe 1 m below ground level.

7.2.9 No earth or any other matter is to be allowed to enter the pipes. The ends shall be closed always.

7.2.10 The anticorrosive treatment is to be applied on the entire length pipe & fittings. The treatment is not to be damaged.

7.2.11 Pressure testing is to be carried out in sections before filling the earth back in the trench.

7.2.12 The earth filling is to be done in layers of 20 cm each and properly rammed (compaction not below 95%) so as to avoid possibility of settlement. Surplus earth/ malba shall be removed from the site by the Contractor.

7.2.13 Where pipes crossing road likely to have heavy traffic, additional protection over pipe shall be provided to ensure that pipe is not damaged.

7.2.14 External hydrants and fire service connection/inlet shall be located parallel to the nearby road/ foot path so as to give proper appearance. Foundation shall be raised from below ground level and shall be properly plastered in plumb. The hydrants shall be facing the road/approach. There shall be no obstruction in approaching the hydrants for operation.

7.2.15 Risers shall be parallel to the wall and in plumb. Adequate supports shall be provided from the wall. Opening around the pipe in slab shall be filled with CC and finished with plaster.

7.2.16 Internal hydrant shall be provided in the center and facing outside for ease of operation. Sufficient space shall be provided around the handle for operation. There shall be no hindrance in moving the first aid hose reel.

7.2.17 Terrace pipes shall be supported on Cement Concrete (M-25 Grade concrete) pedestals of adequate height. The pipe route shall be such as no hindrance is created in movement at the terrace. Pipes shall be sufficiency raised above terrace. It is to be ensured that water proofing is not damaged during laying of pipes.

7.3 TESTING

7.3.1 Initial Testing

(1) During laying of pipes, the same shall be subjected to 10 kg/cm^2 hydraulic pressure for a period of 24 hours, in sections.

(2) After completion of the work, all valves/ fittings shall be installed in position and entire system shall tested for 24 hours at a pressure of 10 kg/sqcm or 1.5 time the rated pressure. The drop of pressure up to 0.5 kg/sqcm shall be accepted.

7.3.2 Final testing

(1) After completion, all operation checks (as per CPWD specification part V - Wet Riser and Sprinkler System) shall be carried out for automatic operation of the systems. For this purpose, landing valves may be opened at different locations. The exercise shall be repeated couple of times to ensure trouble free operation of the system.

(2) **Flow test:** The design flow of pumps shall be checked. The pump shall be operated after opening a number of landing valves at different locations. Design pressure is to be maintained in the pump house. Water discharge is to be measured by drop in level in UG tank for a certain period. All pumps shall be tested one by one. The flow rate shall be not less than specified while maintaining the design pressure in pump house.

7.4 INSPECTION BY LOCAL FIRE OFFICER

After completion of the work and testing to the satisfaction of Engineer, the installation shall be offered for inspection by Chief Fire Officer or his representative. Testing as desired by the Fire Officer shall be carried out. The contractor will extend all help including manpower, measuring instruments etc. during testing. The observations of the Chief Fire Officer which are a part of the agreement shall by attended by the Contractor and compliance shall be given to the Engineer.

7.5 PRECOMMISSIONING

On completion of installation of all pumps, piping, valves, pipe connection, insulation etc. the Contractor shall proceed as follows:

a. Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

b. All strainers shall be inspected and cleaned out or replaced.

c. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:
   (1) Remove oil, grease and foreign residue from the pipe work end finings.
   (2) Pre-condition the meal surfaces to resist reaction with water or air.
   (3) Establish an initial protective film.

d. After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.

e. Details and procedures of the pre-treatment shall be submitted to the Engineer for approval.

f. Check all clamps, supports and hangers provided for tie pipes.

g. Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the vales are functioning properly. Thereafter conduct hydro test of the system.

h. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

7.6 FIRE PROTECTION SYSTEM

(1) Check all hydrant valves by opening and closing: any valve found to be open, shall be closed.
(2) Check all the piping under hydro test.
(3) Check that all suction and delivery connections are properly made for all pumps sets.
(4) Check rotation of each motor after decoupling and correct the same, if required.
(5) Test run each pump set.
(6) All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

7.7 COMMISSIONING AND TESTING

(a) Pressurize the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump.

(b) Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close bypass valve.

(c) Open hydrant valve and allow the water to now into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However, the jockey pump shall cut-out as soon as the main pump starts.

(d) When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage.

(e) check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the contractor. Each landing valve shall also be checked by opening and closing under pressure.

(f) Check all annunciations by simulating the alarm conditions at site.

7.8 COMMISSIONING

7.8.1 **Flushing the system :-** Before commissioning, the entire system shall be flushed to ensure that any earth/foreign matters which might have entered during installation are taken out. For this, pump may be operated and valves opened at different locations.

7.8.2 As soon as the work is complete, the system shall be commissioned and made available for use. Requirement of fire fighting installations is equally important during occupation of the building. If the building is to be occupied in part, fire fighting system of building completed shall be commissioned by isolating the system of under construction portion of the building.

7.8.3 The fire fighting system shall be maintained and manned from the very first day of its commissioning.

7.8.4 Any defects noticed during the warranty period shall promptly attended by the Contractor and availability of the system at all time is to be ensured.

Fire Fighting Works: List of sources

SN	Description of Item	Sources
1	PRESSURE GAUGE	FIEBIG / H.GURU / NEWAGE / SUKAN /WAAREE / WIKA
2	PIPES (GI)	TATA / JINDAL HISSAR
3	FITTINGS	
	a) GI FORGED STEEL FITTINGS	VS / GURU / B&M /EQUIVALENT
	b) GI BUTT WELDED ERW FITTINGS	DECCAN METAL / EQUIVALENT
4	SUNMETAL/STAINLESS STEEL VALVES (FULL WAY & CHECK VALVES)	
	a) CLASS I	ZOLOTO / LEADER
	b) CLASS II	LEADER / SANT
5	PAINTS FOR EXPOSED PIPES	ASIAN PAINTS / BERGER / SHALIMAR
6	ANCHOR FASTENERS	HILTI / HI-TECH SUPPORTS / FISHER
7	WRAPING & COATING	I W L (PYPKOTE) / EQUIVALENT

SN	Description of Item	Sources
	MATERIALS FOR UNDER GROUND PIPES	
8	PRIMER / PAINTS FOR PAINTING FOR ABOVE GROUND PIPES	SHALIMAR BITUMANSTIC PAINTS / EQUIVALENT
9	FOOT VALVE WITH STRAINER	KIRLOSKER / LEADER / ZOLOTO /SARKAR
10	WATER MOTOR GONG & TRIMS	HD FIRE / MATHER & PLATT / SPRAYSAFE / CENTRAL
11	AIR RELEASE VALVE	NEWAGE / KIRLOSKAR
12	BALL VALVE	TBS /IBP / EQUIVALENT
13	CAST IRON NON-RETURN VALVE DOUBLE FLANGED	KIRLOSKAR / LEADER / KALPANA
14	RUBBER GASKET	REPUTED MAKE AS PER IS SPECIFICATION SUBJECT TO APPROVAL BY ENGINEER
15	WELDING ELECTRODE	ADVANI OERLIKAN (ADOR WELDING) / L & T

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

Appendix-3: Fire Detection and Alarm System

1.0 General

This specification includes design, supply, installation, testing and commissioning of a complete, operative, coordinated microprocessor controlled, analog addressable fire detection and alarm system and components thereof.

2.0 Standards

The following Standards and codes shall be applicable to the fire detection and alarm system and components thereof. The latest issue (irrespective of year mentioned below) of the standards and codes shall be applicable:

NBC - 2016	National Building Code of India
IS: 2189	Code of Practice for Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System
IS: 11360	Specification for smoke detectors for use in automatic electrical fire alarm system
NFPA-01	Uniform Fire Code
NFPA-10	Standard for Portable Fire Extinguisher
NFPA-13	Standard for the installation of Sprinkler System
NFPA 70	National Electric Code
NFPA-72	National Fire Alarm Code
NFPA-88 A	Standard for Parking Structures
NFPA 90 A	Smoke Control System
NFPA-92 B	Standard for Smoke Management System in Large Area
NFPA-101	Code for safety to Life from Fire in buildings
NFPA-130	Standard for Fixed Guide way Transit System
UL 864	Underwriters Laboratories for Inc. (UL)
BS EN 3	Standards for Portable Fire Extinguishers
BS EN 54 Part 1- 24	Standards for Fire Detection and Alarm System and Components
BS EN 15004-1:2008	Fixed Fire Fighting systems Gas Extinguishing Systems.
BS 5266	Standard for Emergency Lighting Systems
BS 5306- 3:2009	Standard on Installation, Commissioning & Maintenance of Portable Fire Extinguishers
BS 5499- 10:2006	Code of practice for the use of safety signs, including fire safety sign.
BS 5839- 1:2008 + A2:2008	Standard for Fire Detection & Alarm System
BS 5839- part 8:2008	Code of practice for the design, installation, commissioning, and maintenance of voice alarm system
BS 5839- part 9:2003	Code of practice for the design, installation, commissioning, and maintenance of emergency voice communication systems
BS 7671	Requirement for Electrical Installations
BS 9999: 2008	Code of practice for fire safety in the design management and use of buildings

Equipment shall be tested in accordance with the relevant EN or UL Standard and test certification issued by VDS and UL for the respective equipment shall be furnished by the Contractor.

3.0 System

The automatic intelligent addressable fire detection system shall be built in accordance with the requirements of the applicable standard and shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies and wiring and complete with licensed software to operate and maintain the overall system.

3.1 System Capability

The system shall be rated for:

(a) Minimum 99/125/150 addressable detectors and devices per loop
(b) Loop length of up to 1000 metres

3.2 System Parameters

The Fire Alarm System:

(a) Shall be intelligent in operation with decentralized intelligence technology.
(b) Shall fulfil the demanded performance features without restrictions.
(c) Shall be microprocessor-controlled and monitored.
(d) 2- wire technology with power for initiating devices from the main fire alarm control panel.
(e) Shall be designed on loop technology with signal transmission within the campus via a multiplex communication network.
(f) Automatic and non-automatic detectors input and output modules shall be directly connectible to a loop circuit.
(g) The assignment, re-assignment and interconnection of detectors into detector zones shall be possible from any position on the loop circuit, regardless of the position.
(h) Subsequent extensions of a detector zone should be simple to implement and should not require that the addresses of other detectors be changed or that the other detectors require reprogramming.
(i) Automatic reprogramming in case of change of location of any Detector.
(j) Detectors zones can consist of detectors connected to different modules/loop circuits or control panels.
(k) Detectors which are connected to different modules and sub control units can be linked.
(l) Two detectors dependency programmable.
(m) Free allocation of detector groups and single detectors.
(n) Programmable “pre-alarm” condition when a detector is at 80% of its alarm threshold in a 60 second period.
(o) Every detector and every controller module shall constantly check its own status and send status information to fire alarm control panel (FACP).
(p) False alarm shall be filtered out by backed-up digital data transmission between detectors and the fire alarm control panel.
(q) Faulty detectors and modules as well as short circuits or wire breaks shall be precisely located and the information sent to control panel.
(r) Each intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The FACP shall keep a count of the number of times each detector has entered the

verification cycle. These counters may be displayed and reset by the proper operator commands.

(s) During maintenance, interchanging or removal of detectors shall not cause system failure.

(t) System configuration saved using flexible flash memory technology.

3.3 System operation

3.3.1 Alarm/ Fault Operation

When a fire alarm/ trouble/ supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

(a) The respective system alarm/ trouble/ supervisory LED in the Control panel shall flash.

(b) A local piezo-electric audible device in the control panel shall sound a distinctive signal.

(c) The 600 plus character backlit LCD display shall indicate all information associated with the fire alarm/ trouble condition, including the type and its location within the protected premises.

(d) All system outputs assigned via preprogrammed equations for a particular point in alarm/ trouble shall be executed, and the associated system outputs (alarm notification appliances and/ or relays) shall be activated.

(e) All magnetic door holders to doors to adjacent zones on the floor from which the alarm was initiated shall be released.

(f) The ventilation system or close associated control dampers as appropriate shall be shut down.

(g) Printing and history storage equipment shall log and print the event information along with a time and date stamp.

3.3.2 Smoke Control System Operation:

(a) On/Auto/Off switches and status indicators (LED) shall be provided for monitoring and manual control of each fan, stairwell pressurization fan, and smoke exhaust fan. The control system shall be field programmable.

(b) The off LED shall be Yellow, the ON LED shall be Green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/fault indicator shall indicate a trouble in the control and/ or monitor points associated with that switch.

(c) Each group of eight LED shall have a local Acknowledge/Lamp Test momentary switch.

(d) Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch positions. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.

(e) It shall be possible to meet the requirement mentioned above utilizing wall mounted custom graphic annunciators.

3.4 System Operational Controls

The following shall be adjustable/ operated from the fire alarm control panel(FACP):

(a) Supervise and monitor all intelligent/ addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

(b) Supervise all initiating signaling and notification circuits throughout the facility.
(c) Detect the activation of any initiating device and the location of the alarm condition.
(d) Operate all notification appliances and auxiliary devices as programmed.
(e) Visually and audibly annunciate any trouble, supervisory or alarm, condition on operator's terminal, panel display, and annunciators.
(f) Disablement of individual detectors.
(g) Smoke detector sensitivity of all addressable detectors.
(h) Daytime/ Nighttime operation mode, for each detector zone and each individually selectable.
(i) Automatic Day/Night sensitivity adjust (high/low).
(j) Device Blink Control (turn of detector LED strobe).

3.5 System Reliability

All components of the system shall be fully operational and not compromised in the event of any of the following:

(a) Fault in the control panel or in peripheral devices.
(b) Any error in any electronic item or external device.
(c) A fault in an operating group or a detector.
(d) A failure, a short circuit, or a wire break in a detector or in the fire alarm system cable.
(e) The fault shall be detected and displayed whilst the system continues to function fully.
(f) Recognition and evaluation of the status of detectors (contamination).
(g) Permanent automatic cyclic tests of parts of the fire alarm system and programs.
(h) Automatic restart function of the fire alarm system.

3.6 System Programming

The system shall be programmable, configurable and expandable in the field without the need for special tools for the following:

a) Individual addressing and disablement of detectors, I/O modules, as well as operating zones.
b) Individual programmable alarms, faults, disablements and actuations messages with date and time.
c) Combination of functions and dependencies of fire controls units should be freely programmable by software.
d) Actuations can be programmed by flexible assignment of inputs and outputs.
e) Software-controlled two zone dependency or two detector dependency for alarm notification and controlling of devices.
f) Software controlled free assignment and combination of the detectors with control functions.

4.0 Control Panel

4.1 Main Fire Control Panel

The main fire control panel shall communicate with and control all intelligent addressable detectors and modules, local and remote operator terminals, printers etc

and shall conform to all operational and functional requirements as per specifications including but not limited to the following:

(a) Corrosion protected surface mounted cabinets constructed with 2 mm thick CRCA sheets with key operated hinged front door with a transparent opening for viewing all indicators.
(b) 32 bit microprocessor based central processing unit (CPU)
(c) Modular installation
(d) All wiring terminal block shall be the plug-in/removable type.
(e) 9 free slots for detector/notification appliances
(f) Audible and visual alarms for all faults
(g) Alarm delay mode
(h) Intervention mode
(i) Self-activating, cyclical control panel testing system, with fully automatic fault reporting
(j) System status Reports
(k) Alarm Verification, by devices, with tally
(l) Non-Fire Alarm Module Reporting
(m) Upload/Download System Database to PC Computer
(n) Protection against RFI (Radio Frequency Interference) and (Electro Magnetic Interference) EMI compliance to EN 50082-2 (Emissions for Industrial Environments).
(o) Emergency power supply with batteries for a supply interruption period of continuous 24 hours.

4.2 Operating Panel Built in the Control panel cabinet.

(i) Integrated LED operating for status of the following

Power On	Power Off	Fault	Fire Alarm
	Sounder Fault	Earth Fault	System Fault
Delayed Mode	Disablement	Relays Disabled	Sounder Disabled
	Alarms Silenced	Acknowledged	Test

(ii) Operator control switch for:

Sound Alarms	Silence/ Resound	Mute	Acknowledge/ System Reset

(iii) Alarm counter

4.3 Alphanumeric Display for Indication Purposes shall conform to

(a) Membrane alphanumeric keypad
(b) 4 line
(c) 20 characters per line
(d) Plain text indication for all system status
(e) Display of following:

Device Status	Device Type	Custom Device Label	Software Zone Label
Device Zone Assignment	Detector Analog Value		
All alarm messages	All fault messages	Disablements	All program parameters
Smoke	Smoke Detector		

Detector Pre alarm Indicator	Maintenance Alert		
Contaminated Detectors	Removal, disconnection, or failure of any control panel module		
Individual and group display for all status of alarms			
Indication of definable additional text			

(f) If the capacity of the alphanumeric display unit does not permit all messages, faults, disablements, and alarms to be simultaneously displayed, then the total number of fire alarms, faults, disablements, and actuations shall be individually displayed in a separate display.

(g) Failure of the alphanumeric display unit or of individual elements shall not precipitate the loss or misinterpretation of individual messages and this shall be transferred to the printers.

4.4 External operating panel/ Repeater Panel

Function	Repeat display of fault alarms from Main Fire Control Panel
Specifications	(a) External menu based operating repeater panel Membrane keypad; (b) Four line LCD display Indication of all system status as on main Control panel Indication of all conditions alarm, fault, disablement etc. (c) Locating at distance up to 500 meters from Main Control Panel.
Power Supply	240 volt, AC with in built battery for 24 hour operation and with self contained battery charger
Protection	IP 30

5.0 Batteries and Battery Charger

Battery	Completely sealed maintenance free, 24 volt
Battery Rating	Minimum twenty-four hours on continuous operation
Battery Charger	240 Volt, AC, 50 Hz source. Completely automatic, with constant potential charger
Charger Rating	Rated to fully charge a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
Protection	Prevent discharge through the charger. For overloads and short circuits on both AC and DC sides.

6.0 Networking

(a) It shall be possible to network multiple fire alarm systems by means of serial data interfaces.

(b) Communication between the multiple fire control panels shall be with redundantly (duplicated) constructed loop circuit, so that the connection still

remains fully functional even in the event of three simultaneous connection faults.

(c) The centralized structure should allow the serial data connection of as many fire alarm control panels as required at any time, even subsequently.

7.0 Software

The software for controlling the fire alarm system through an external Personal Computer (PC) shall provide interactive control with history logging, manual override control through on screen tough switches and display status of each detector/ zone and its location. The Contractor shall provide PC and software along with UPS for the Personal Computer.

- Operating system: Windows 10.0 or latest
- Hardware should be: Pentium Gold Processor with 64 GB RAM VGA Graphics card and supporting 1280x 1024 resolution in 256 colours mode

8.0 System Integration and External Connectivity

(a) Integration with Public Address and evacuation system
(b) Provision for external PC
(c) Provision for Serial Printer

9.0 Addressable Devices

9.1 Detectors – General

All Intelligent Addressable Detectors shall comply to the following general technical specification in addition to the relevant clauses as under:	
Specification	• Microprocessor based intelligent(analog) addressable. • Internal identifying type code to identify the type of device (PHOTO, THERMAL). • Address-setting with a microprocessor • Permanent self-monitoring
Short Circuit Isolator	**I**ntegrated or external with each detector and module
Signal Transmission	Serial biphase data transmission, 2 wire technology
Mounting	Inserted into or removed from the base by a simple push-twist mechanism to facilitate exchange or cleaning and maintenance
Indication	LEDs flashing under normal conditions steady illumination indicating an alarm condition. External remote alarm LED output connection in the base
Protection	IP 44
Ambient Temperature	(-)10℃ to +60℃
Relative air humidity	Short term, no condensation 95% Long term, no condensation 70%
Case material	ABS (Acrylonitrile Butadiene Styrene) / PC, FR90

RFI and EMI	High immunity against RFI and EMI and compliance to relevant specifications

9.1.1 Addressable Multi Criterion Detector

Function	Dual function photoelectric cum heat detector having light scattering type photoelectric smoke sensor (two independent thermistors for combined rate of rise/fixed temperature heat detectors).
Specifications	• Provision for disabling either element at site • Smoke detectors element shall respond to invisible and visible smoke • Time based algorithms to dynamically examine values from the two sensors simultaneously and initiate an alarm based on that data. • Totally free of radioactive components. • Air velocities up to 0-2.54 m/sec without requiring specific duct detectors housings. • Reversed polarity or faulty zone wiring shall not damage the detector.
Settings	Smoke detector element shall respond to invisible and visible smoke with smoke Obscuration per foot alarm field selectable set point over five sensitivity setting ranging from 1.0% to 3.5%. Temperature change of 35 Deg C or reaches a fixed temperature alarm set point of 57 Deg Centigrade nominal.
Compensation	Light source intensity shall automatically self-adjust to compensate for possible effects of dirt and dust accumulation in the sensor/lens. Automatic self-adjust Compensation against environment effects of dirt, smoke, temperature, age and humidity temperature.

9.1.2 Intelligent Addressable Heat Detectors

Function	Two independent thermistors for combined rate of rise/fixed temperature heat detectors
Specification	• Automatic compensation for changes in ambient conditions • Reverse polarity or faulty zone wiring shall not damage the detectors.
Setting	Temperature change of 35 Deg C or reaches a fixed temperature alarm set point of 57 Deg C nominal.
Compensation	Automatic self-adjust compensation against environment effects of dirt, smoke, temperature, age and humidity temperature.

9.1.3 Standard detector base

Function	Suitable for mounting different types of fire alarm detectors
Specification	• Surface mounting • Bayonet fitting of detector to base • Complete with removable dust cover to protect the contact area during installation and construction phase • The detector contact points shall be designed to ensure uninterrupted contact when exposed to continuous severe vibrations.
Protection	IP54 with Detector inserted

9.1.4 Intelligent addressable Manual call point

Function	Intelligent addressable manual release of a fire alarm for indoor use Installation directly on the loop
Construction	Case material: Plastic, reinforced with fiberglass. The word FIRE shall appear on the front of the manual call box in raised letters, 50 mm or larger.
Operation	Smashing the glass panel and pressing the button which shall remain locked
Signal Transmission	Serial data transmission, 2 wire technology
Indication	Actuated state shall be indicated by means of a built-in LED
Protection	IP24
Location	Height 1400 mm above floor level

9.2 Notification Devices

9.2.1 Addressable Dry Contact Monitor Module

Function	Connect one supervised IDC (Initiating Device Circuit) zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs (Signalling Line Circuit).
Mounting	100 mm square, 55 mm deep electrical box.
Indication	LED flashing under normal conditions

9.2.2 Addressable Control Module

Function	Supervise and control the operation of one conventional Notification Appliance Circuit (NAC). The relay coil shall be magnetically latched to ensure that 100 % of all auxiliary relay or NACs may be energized at the same time on the same pair of wire.
Mounting	100 mm square 55 mm deep electrical box.
Indication	LED flashing under normal conditions.

9.2.3 Isolator Module

Function	Automatically isolate wire-to-wire short circuits. Automatically reconnect the isolated section when fault is removed. No reset/ replacement required after its normal operation.
Mounting	100 mm square 55 mm deep electrical box.
Indication	LED flashing under normal conditions and Steady to indicate fault/ alarm

9.2.4 Addressable Audio Loop siren

Function	• Direct connection to the loop. • Output sound level of at least 90 dBA measured at 3 m from the device. • Multiple selectable tones: • Adjustable volume by means of a DIP-switch
Mounting	100 mm square 55 mm deep electrical box.
Indication	LED flashing under normal conditions and Steady to indicate fault/ alarm

9.2.5 Response Indicator

Function	Remotely indicate status of loop technology detectors
Mounting	100 mm square 55 mm deep electrical box.
Indication	LED flashes Red when detector is set off. Flashing frequency 1.8 Hz to 3.4 Hz.

9.2.6 Addressable Loop Flashlight

Function	• Optical indication of a fire alarm inside rooms • Direct connection to the loop technology.
Mounting	Integrated with Detector base
Indication	• Adjustable flash rate and light intensity by means of DIP-switch. • Flash frequency: 0.5 Hz (slow) or 1 Hz (fast).

9.2.7 Strobe Lights

Strobe lights shall meet the requirements of the relevant Standards and shall have a maximum pulse duration of 2/10 of one second.

10 Fire Alarm Cabling

The contractor shall supply and erect the Fire survival cable for all fire protection system/ fire alarm related works, which conform to the following:

(i) Detector cable loop shall be based on Class-A wiring as per NFPA-72D. The Contractor shall submit calculation on the overall current consumption and voltage drop in each detection loop in normal and alarm condition to substantiate their equipment selection.
(ii) All detector loops/network wiring shall be minimum size of 1.5 sqmm twisted pair, screened, fire survival cables complying with BS-7846 category CWZ.
(iii) All 24V DC power supply lines shall be minimum size of 2.5 sqmm fire survival screened cable complying with BS-7846 category CWZ.

Cables are to be supplied along with all accessories, crimped termination etc. Cable shall be laid by the Trained and Experienced personnel only.

10.1 The type of conduit for laying of cables and the service shall be as under:

- Embedded in walls & slabs: GI conduits and accessories.
- Exposed/ surface run: GI conduits and accessories.

11 Approvals

The material shall conform to the latest standards to which the equipment complies and the Contractor shall obtain all approvals from concerned fire authorities.

12 Installation and Testing

12.1 Installation

(a) Installation shall be in accordance with the applicable codes.
(b) All equipment and components shall be installed in strict compliance with each manufacturer's recommendations.
(c) All Equipment shall be attached to wall and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.
(d) The main fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20A. This circuit shall be labelled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 4.0 sqmm Fire Survival Screened cable complying with BS-7846 category CWZ. The control panel cabinet shall be grounded securely to the system earthing.
(e) All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
(f) Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

12.2 Testing

Prior to energizing the system, the manufacturer of the fire alarm equipment shall technically supervise and participate during all of the following adjustments and tests:

(a) Check correct connection of all cables & wires and test for short circuits, ground faults, continuity, and insulation.

(b) Open initiating device circuits and verify that the trouble signal actuates.
(c) Open signaling line circuits and verify that the trouble signal actuates.
(d) Open and short notification appliance circuits and verify that trouble signal actuates.
(e) Ground initiating device circuits and verify response of trouble signals.
(f) Ground signaling line circuits and verify response of trouble signals.
(g) Ground notification appliance circuits and verify response of trouble signals.
(h) Check alert tone and pre-recorded voice message to all alarm notification devices.
(i) Check installation, supervision, and operation of all intelligent smoke detectors using walk test.
(j) Introduce all faults and verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.

12.3 Final Inspection

At the final inspection, a factory trained representative of the manufacturer of the major equipment shall demonstrate that the system function properly in every respect. The final inspection report shall be prepared after joint testing with the Engineer's representative and each test conducted shall be mentioned.

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

Appendix- 4: PORTABLE FIRE EXTINGUISHERS

1 SCOPE

The scope of work covers the supply and installation of portable fire extinguishers. The following types are envisaged in these specifications and provided as shown in the schedule of portable fire extinguishers:

1 Dry powder extinguisher.
2 Carbon-dioxide extinguisher.

2 Standards

The following standards and rules and regulations shall be applicable:

(a)	Fire protection manual of the Tariff Advisory Committee, Fire Insurance Association of India	
(b)	IS:4308 – 2003	Portable fire extinguisher dry power type
(C)	IS:2878 – 2004	Portable fire extinguisher carbon-dioxide type
(d)	Local Fire Brigade/Authority	

3 Extinguishers

3.1 **Dry powder type :**

The extinguishers shall be of 2, 5 and 10 kg capacity, cartridge type unless otherwise specified. The body shall be of cold rolled carbon steel grade D, 1.5mm thick up to 5 kg and 2mm thick for 10 kg. The construction shall be similar to 'Soda Acid type' but of the following dimensions:

Capacity (kg)	Outside diameter (mm)	Filler opening (mm)
2	100	45
5	150	45
10	175	45

(a) The discharge fitting shall be with 500mm, 10mm diameter hose up to 5 kg and 750 mm, 12.5 mm diameter for 10 kg with a trigger controlled nozzle capable of discharging 85% of the contents as follows:

Capacity	Time (sec)	Throw (m)
2	8 – 10	2
5	15 – 20	4
10	23 – 30	6

(b) A carbon dioxide cartridge conforming to IS: 4947 - 1985 shall be fitted in a cartridge holder with an inner shell. A spring loaded piercing device shall be provided in the cap for piercing the seal of the gas cartridge. A siphon tube of copper or PVC shall be provided for upright operation. The cap and neck ring shall be similar to Soda Acid type extinguisher.

(c) All internal and external components and surfaces shall have anti-corrosive coating of not less than 12 microns applied uniformly as indicated below:

(a)	Body	Mild Steel	Tin alloy
(b)	Cage for acid bottle and spring	Brass sheets	Lead or Tin alloy
(c)	Discharge fittings	Leaded-tin bronze	Tin alloy
(d)	Stainer	Brass sheets	Lead or Tin alloy

3.2 **Carbon dioxide type.**

(a) The extinguishers shall be rated for 4.5 kg and 9 kg by weight of carbon dioxide, unless otherwise stated. The contents shall be with a filling ratio not exceeding 0.667.

(b) The discharge head shall be simple and to operate conforming to IS: 3224 - 2002 with a safety release as per IS: 5903 - 1970 set to 18.0 to 20.0 N/mm^2. A siphon tube of copper or PVC shall be fitted. A non-conducting discharge horn and a high-pressure hose (27.5 N/ mm^2 pressure) shall be fitted with each extinguisher.

(c) The discharge system shall be to designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	Time (sec)
4.5	10 – 18
9	15 - 36

4 **GENERAL REQUIREMENTS**

4.1 All extinguishers shall be standard products, approved by the Tariff Advisory Committee and Local Fire Authority, manufactured and tested strictly in accordance with the relevant Indian Standard. All markings and test results shall be stamped in the appropriate colour markings according to the Indian Standards.

4.2 All Extinguishers shall have a structurally designed galvanized steel handle and a suitable wall-mounting bracket.

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

Appendix- 5: Technical Specification for Compact Substation (CSS – 250kVA)

1 GENERAL:

The scope include design, supply, installation, testing and commissioning of Compact Sub-Station (CSS) (11/0.44 kV) consisting of 11 kV load break switch, 11 kV Compact VCB panel, load break switch, air insulated BUS PT metering module, CT/PT for metering system & relay, with DRY type Transformer, ACB, and LT Switchgear with all HT & LT inter- connections, accessories, fittings & auxiliary equipment inside GI enclosure etc.

2. DESIGN CRITERIA

(1) Package substation consisting of 4 way, SF6 insulated switchgear 630A at 11 kV vacuum circuit breaker, 11kV/440V, 250 kVA dry type transformer, 440V, 630A VCB incoming with all connection, accessories, fitting and auxiliary equipment in an enclosure to supply low voltage energy from high voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base).

(2) The prefabricated package substation shall be designed for (a) compactness, (b) fast installation, (c) maintenance free operation, (d) safety for worker/ operator.

(3) The switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

(4) The continuous operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible value stipulated in the relevant standard and/ or of this specification.

(5) The enclosure of high voltage switchgear-control gear, low voltage switchgear-control gear and transformer of package substation shall be designed to take minimum space for the installation including the space required for approaching various doors and equipment inside.

3. SYSTEM DETAILS

3.1 (a) The main components of prefabricated substation are transformer, high voltage switchgear-control gear, low voltage switchgear-control gear and corresponding interconnections (cable, flexible busbars) and auxiliary equipments. The components shall be enclosed by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IEC standards.

(b) The enclosure shall be made of 2 mm thick CRCA sheet powder coated 7 tank process for all weather conditions. The metal base shall ensure rigidity for easy transport & installation. The protection degree of the enclosure shall be IP23 for LT & HT switchgear compartment and transformer compartment. Proper/ adequate ventilation aperture shall be provided for natural ventilation by way of Louvers etc. The doors shall be provided with proper interlocking arrangement for safety of operator.

(c) The LV outgoing of the transformer shall be connected to incomer of the Low Voltage Switchgear by means of Cables / Flexible Copper Busbars.

3.2 Internal Fault:
Failure within the package substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided. The design for internal arc fault shall be tested for 20KA as per IEC 61330/ 62271-202.

3.3 Covers and Doors: Covers and doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. Additional GI/stainless steel wire mesh shall be used with proper danger board for safety of the operator. All covers, doors or roof shall be provided with locking facility.

3.4 Earthing: All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/ strips and lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include:

(a) The enclosure of the package substation,
(b) The enclosure of high voltage switchgear and control gear from the terminal.
(c) The transformer tank
(d) Frame of substation.

3.5 There shall be an arrangement for internal lighting activated by associated switch for HV, transformer and LV compartments separately.

3.6 Labels: Labels for warning, manufacturer's operating instructions etc. shall be durable & clearly legible on aluminium or alloy plate..

3.7 The Circuit Breaker shall control 11kV/ 440V transformer of rating 250 KVA and relay settings shall be selected accordingly.

3.8 General Finish: Totally enclosed, metal clad, vermin and dust proof suitable for tropical climate use as detailed in the specification.

3.9 Ratings: The busbars shall have continuous rating of 630A. Circuit Breaker shall have a continuous rating of 630A in accordance with relevant IEC standard. Switchgear shall be complete with all connections, busbars etc.

3.10 Breaking and Making Capacity: Circuit Breaker shall be capable of having rupturing capacity of 20 kA symmetrical at 11 kV.

3.11 Isolator (Load Break Switch): The Isolators shall conform to IS: 4710/9920 (latest version). The isolator shall be ON load type, triple pole, spring assisted, hand operated, non-automatic type with quick break contacts and fault indication. The operating handle shall have three positions 'ON', 'OFF' and 'EARTH' which shall be clearly marked with suitable arrangement to padlock in any position. A safety arrangement for locking shall be provided by which the isolator operation shall be prevented from 'ON' position to 'EARTH' position or vice versa.

3.12 Vacuum Circuit Breaker (VCB):

3.12.1 The Unit shall consist of 630A, 11kV, 3-phase spring assisted three position, three pole vacuum circuit breaker, with integral fault making/ dead breaking earth switch. The function shall be naturally interlocked to prevent the main and earth switch from being switched 'ON' at the same time and the VCB shall not be allowed to trip in 'Earth On' position. The selection of the main/ earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

3.12.2 The manual operation of the vacuum circuit breaker shall not have an effect on the trip spring. This should only be discharged under a fault (electrical) trip condition. The manual reset operation should recharge the trip spring and reset the VCB mechanism in 'main off' position.

3.12.3 Protection Relay: The CB shall be fitted with self-powered relay inside the front cover to avoid any tampering. The relay should be 3 Over Current and 1 Earth Fault, fed by protection CT mounted in the cable box.

3.13 Air Circuit Breaker (ACB):

3.13.1 The Unit shall consist of 630A, 440V, 3-phase, tee-off spring assisted three position, three pole air circuit breaker, with integral fault making/ dead breaking earth switch. The function shall be naturally interlocked to prevent the main and earth switch from being switched 'ON' at the same time and the ACB shall not be allowed to trip in 'Earth On' position. The selection of the main/ earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

3.13.2 The manual operation of the air circuit breaker shall not have an effect on the trip spring. This should only be discharged under a fault (electrical) trip condition. The manual reset operation should recharge the trip spring and reset the ACB mechanism in 'main off' position.

3.14 Cable Box:

The VCB shall be provided with suitable and identical cable boxes in front for connecting single run of 3 core X 120 sqmm, 11 kV cable from vertically below. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work. The height available for cable termination should be minimum 500 mm. The Cable termination shall be done by heat shrinkable termination method so adequate clearances shall be maintained between phases for termination.

3.15 Locking Arrangement: Suitable padlocking arrangements shall be provided as stated below.

(a) CB manual operating handle in the "OFF" position.
(b) Each feeder Panel operating handle in 'Closed', 'Open" or 'Earth' position.

3.16 Ratings:

	Vacuum Circuit Breaker (VCB)	
1)	**Circuit Breaker**	
a)	Type	Vacuum Circuit Breaker

b)	Rated voltage	11 kV, 3-phase
c)	Load Breaking current	20 kA
d)	Making current	50 kA
e)	Rated current	630 amp
f)	No. of poles	3
g)	Operating mechanism.	Trip free & free handle type with mechanically operated and pad locking
2)	**Busbars:**	
a)	Material	Copper
b)	Rated Current	630 Amp
c)	Short time rating for 3 Sec.	20 kA
3)	**Isolator**	
a)	Type	Load break switch
b)	Rated current	630 Amps
c)	Rated breaking capacity	630 Amps
d)	Fault making capacity	50 kA peak
e)	No. of poles	3
f)	Operating mechanism	Operating handle with ON, OFF, Earth position with arrangement for padlocking in each position.
4)	**Isolator**	
a)	Type	Off Load break switch
b)	Rated current	630 Amps
c)	Rated breaking capacity	630 Amps
d)	No. of poles	3
e)	Operating mechanism	Operating handle with ON, OFF, Earth position with arrangement for padlocking in each position.

4 11kV/440V, CAST RESIN DRY TYPE TRANSFORMER SPECIFICATION

SN	Descriptions	Unit	Specification
1	Service		Continuous
2	Type		Cast Resin Dry Type
3	Rating	kVA	250
4	Rated frequency	Hz	50
5	Number of Phase		
	HV Side		3
	LV Side		3
6	Rated Voltage		
	HV side	kV	11
	LV side	kV	0.440
7	Vector Group		Dyn 11
8	Type of Cooling		AN (Air Natural)
9	Class of insulations		Class F
10	Method of earthing- LV		Solidly Earthed
11	Duty		Continuous
12	Taps		
	a) Range	**%**	+5% to -5%
	b) No. of Steps		Five
	c) In steps of		2.5
	d) Tapping Provided on HV		Taps Provided on HV side

	Side		
13	Tap Changer Type		Off Circuit Tap Links
14	Reference Standards		IS 2026/IS 11171
15	Fittings and Accessories		
	a) Off circuit tap links		Yes
	b) 02 nos. Earthing Terminal		Yes
	c) Rating and Diagram Plate		Yes
	d) Lifting Lugs for Complete Transformer		Yes
	e) Cover Lifting lugs		Yes
	f) Rollers		Yes

5 Low Tension (LT) Panel:

(a) **Nominal voltage**: 3 Phase, 440V, 50 Hz

(b) **Neutral:** Solidly earthed at substation**.**

(c) **Busbar:** 630A copper

(d) **Circuit Ways:** 630A, 3-pole, Air Circuit Breaker (ACB), fixed type with Over Current, short circuit and Earth Fault Releases (Microprocessor based).

(e) **Earthing:**

(i) Earthing arrangement shall be provided for earthing of each armoured cable, neutral busbar, chassis and framework of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked. The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

(ii) Neutral bus bar strip shall be connected to Earthing terminal with help of GI strip of suitable capacity & GI nut, bolt, washer arrangement.

6 **ROUTINE TESTS FOR THE PACKAGE SUBSTATION COMPLETELY ASSEMBLED**:

(a) Routine Tests: The routine tests shall be made on each complete prefabricated substation. These tests shall include but not limited to the following:

(i) Voltage tests on auxiliary circuit.
(ii) Functional test.
(iii) Verification of complete wiring.
(iv) VCB, ACB, busbars etc

(b) Test Certificates:

The test reports of all the tests carried out at the works shall be furnished in three (3) copies to the Engineer.

7 CODES AND STANDARDS

(1) All equipment and material shall be designed manufactured and tested in accordance with the latest applicable IEC standards. The 11 kV package substation design shall be as per IEC- 61330.

(2) The package substation offered shall in general comply with the latest issues including amendments of the following standards:

Description	Standard
High voltage low voltage prefabricated substation	IEC-61330/ 62271-202
High voltage switches	IEC-60265
Metal enclosed high voltage switchgear	IEC-60298/ 62271-200
High voltage switchgear	IEC-60694/ 62271-100
Low voltage switchgear and control gear	IEC-60439/ 60947
Power transformers	IEC-60076

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

Appendix- 6: TECHNICAL SPECIFICATION FOR GENERATOR SET (GENSET) WITH AMF PANEL

1. Generator set:

1.1 The scope include supply, installation, testing and commissioning of 2 nos. of 250 kVA (1 no. each for IMD Manesar and Manesar station) Generator set (Genset) (440 volt, 3-phase, AC, 50 Hz, unity power factor) suitable emergency operation at full load with acoustic enclosure and all other accessories. The Genset shall be with Auto Mains Failure (AMF) panel for automatic start of the Genset in case of failure of main power supply. Commission for Air Quality Management (CAQM) directions (latest) shall be followed. All tests including type test shall be carried. The Contractor shall obtain type approval from statutory agencies and shall also comply with conformity of emission limits (latest).

1.2 Genset shall be complete with radiator cooled heat exchanger, turbo charged, battery start, 1500 rpm, diesel engine, 110% engine over speed set etc. conforming to BS-5514, ISO-3046, SAE J1349, IS-10000 and as applicable. The Diesel Engine at 75% rating shall produce alternator output of 250 kVA at unity power factor. The alternator shall be copper wound (insulation H class) with suitable rating as per manufacturer, salient pole, synchronous, 440V, 3-phase, 50 Hz, short circuit ratio not less than 0.5, brushless exciter, air cooled, star connection with isolated neutral terminals, fast acting solid state voltage regulator, anti-condensation heater etc. conforming to IS-1271, IS-2253, IS-4722, IS-4728, IS-4889, IS-6362, IS-7132, IS-7306, IS-7816, IS-12065, IS-12075, IS-12802, IS-13364, IS-13118, IEC-60034 and as applicable.

1.3 Genset shall be provided with minimum protection of over-current relay, under voltage protection, under frequency protection, reverse power protection, field failure relay, single element over voltage relay with timer, PT fuse failure relay, over speed protection and any other protection required for proper functioning of Genset.

1.4 The Genset shall include battery set i.e. battery of 12V DC with 180AH capacity along with suitable battery charger and 2 core, 70 sqmm copper XLPE insulated cable between battery and starter shall be provided.

1.5 Fuel tank (400 litre capacity or more) of GI or stainless steel material with all other accessories/ equipment's/ protective devices, copper fuel pipe etc. shall be provided. Fuel tank capacity shall be sufficient for storing fuel for continuous operation of Genset for 24 hours. First filling of lubricating oil, supply of High Speed Diesel oil, of each Genset, required for testing, commissioning at site etc. shall be provided. The fuel pump for transfer of fuel from one container to fuel tank shall be provided.

1.6 The construction of plinth shall be with materials as per OEM recommendations and approved drawing. Foundation shall be with RCC M-25 grade (minimum). The material shall conform to CPWD specification Part-VII: Gensets (2013) and all the relevant and applicable IS/ IEC standards. Necessary anti-vibration pads, and supports shall be provided. All documents and design shall be submitted to Engineer for approval.

1.7 Noise level shall be less than 75-dBA averages or as per latest CPCB norms whichever is less. The emission pollution level shall be as CPCB 4-Plus norm. Suitable exhaust with insulation shall be provided.

2. Auto Mains Failure (AMF) control panel

2.1 The Auto Mains Failure (AMF) control panel shall be provided. AMF panel shall be capable of starting Genset automatically in the event of unhealthy conditions of main power supply including power (MAINS) failure, single phasing or voltage going below 85% of bus bar of main panel and shall switch over essential load from main power supply to Genset. The Genset will start automatically within 10 seconds of main supply failure.

2.2 The AMF control panel shall be fabricated with CRCA, 2 mm sheet, 7 tank process powder coated. AMF panel shall include incoming 4 pole, 630A ACB (MDO) for Genset, copper bus-bars, 4 pole, heavy duty contactors, multifunction panel meter for display of current and voltage on phases and lines, power factor, frequency, KWH, MD etc., LED indications lights including connections with single core 1.1 kV grade LT XLPE insulated copper conductor control cable between LT panel, AMF panel and alternator for auto and manual operation etc. The synchronising logic shall be achieved through MICRO PROCESSOR based circuitry to monitor engine control, with an online MIMIC giving status. The generator set shall be capable of starting and taking up the load with-in-time stipulated in data sheet. The Genset will have protection / annunciation system conforming to latest standards like BS/ IEC or IS with soft control and touch resets shall be designed comprising complete protection/ annunciation requirement (overload, high temperature, alarms, earth fault, low battery voltage, fault indication alarm, fuel low level, metering indication etc.). The sequence of operation of synchronization of Genset and Utility power (if required) shall be provided as per standard.

2.3 The Genset AMF panel shall be provided with all interface items for remote monitoring by SCADA (from OCC). Necessary interface with SYS-1 Contractor shall be made for SCADA monitoring of Genset.

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

Appendix-7: MACHINE-ROOM LESS ELEVATOR

1 INTRODUCTION

HORC system shall be equipped with machine-room less elevator (Lift) being used in transportation establishments for passengers including differently able and elderly persons and HRIDC staff. The elevator will be subject to rigged use as per requirement. This elevator shall be six (G+5) landing type at IMD Manesar building.

2 GENERAL REQUIREMENTS

2.1 Elevator shall have its own driving machine. The method of drive shall be electric Traction with Gear-less motor having VVVF Control and regenerative braking (supporting detailed calculation of energy saving viz-a-viz cost saving shall also be submitted)

(i) The system, including all sub-system and equipment shall be of proven design.
(ii) The elevator sub-system and equipment proposed by the Contractor shall have been in use and have established their performance reliability over a sufficiently long period of time. In support of the performance certificate from the client/ user of the system shall be submitted.

2.2 The elevator shall be capable of operating satisfactorily and smoothly at a rate of 120 motors starts per hour or above for a period of not less than 20 hours per day, seven days a week, within the environment condition as stated in the General Specification and at the location where the elevator is to be installed. The elevator shall be designed for minimum 6,00,000 (Six lakh) operations per year and with minimum failures as defined in specifications.

2.3 The design of the elevator shall be such that no replacement of major component shall be necessary for a period of 20 years from the date of issue of Certificate of Taking Over. This is based on the requirements that detailed inspections and maintenance are carried out as necessary. The elevator shall be designed for minimum life cycle cost. Detailed life cycle cost analysis shall be submitted. The necessary data shall be collected by the Contractor on his own end without any additional cost to HORC. Life of all components shall be clearly mentioned in the bid. Major components shall be:

Major components shall mean replacement of car frame, car enclosure, car and landing doors, elevator shaft wiring (except travelling cables), guide rails, drive machine and driving sheave but parts attached to these components which are subjected to normal wear and tear are excluded.

2.4 The reliability, availability and maintainability requirement of elevator follows:

(a) Reliability Requirements

The Reliability requirements of this specification shall be subsidiary to the Availability and Maintainability requirement of specification. The reliability of equipment shall be of level that it does not result in passenger trappings in the elevator due to equipment failure. Any claim/ damage/ compensation claimed by the affected passenger/ elevator user on account of equipment failure shall be recovered from the Contractor. In addition, HORC shall impose a penalty @ Rs. 20,000/- (Rs Twenty Thousand Only) per case and shall be applicable during entire DNP.

The Reliability measure for the Elevator shall be the Mean Time Between Maintenance Action (MTBMA). This covers both preventive as well as corrective maintenance.

The Elevator shall achieve a MTBMA not less than 7 days.

(b) Availability

Service Availability Targets:

(i) The System shall be designed to ensure that failure of any major equipment, caused by an external accident or negligence of internal staff, will not lead to unavailability of the whole system, other than temporary outage of the failed equipment.
(ii) All elements of the system shall be able to be maintained during out-of-traffic hours to avoid interrupting passenger train services.
(iii) If elevator is kept out of service for more than 24 hrs. due to non-availability of spares or due to lack of proper attention. HORC shall impose a penalty of Rs. 20,000/- (Rs Twenty Thousand Only) per day for each such case. The penalty shall be applicable during DNP.
(iv) The Employer will assess the reasons for the equipment not being in service, accordingly, the penalty will be imposed. The Employer decision shall be final. The measure for Availability for the Elevator shall be based on call out ratio:

$$\frac{\{(365 \times 20 \text{ hrs.}) \times (\text{No of lift population}) - (\text{Total Availability}) = \text{Unavailability hrs. in one year}\}}{\{(365 \times 20 \text{ hrs.}) \times \text{Number of lift population in section}\}}$$

The Elevator shall achieve minimum availability of 99.9% as per above calculation. For the purposes of Availability calculation, the Contractor shall assume the service operating hours are 20 hours per day (04:00 hours to Mid Night), for 365 days a year for the design life.

(c) Maintainability

(i) The Contractor shall undertake maintainability analysis to assess the preliminary maintainability targets of the systems.
(ii) The Contractor shall state the 'maintainability requirements and demonstrate that System maintainability is sufficient to support the claimed system reliability and availability performance. The Contractor shall demonstrate that maintenance errors have been considered, and as far as is practicable, the risk of maintenance-induced faults has been mitigated by the appropriate design.
(iii) The equipment supplied by the Contractor shall be designed for minimum or no maintenance. Maintenance activity required must be capable of being performed with minimum or no impact on the train service.
(iv) Maintenance activities may be classified into two areas, routine preventative and corrective, both of which affect service availability. Other maintenance strategies such as condition monitoring may be incorporated.
(v) Routine/ Preventive maintenance periods shall be limited to non-operational maintenance hours during the night or if essential during off peak periods.
(vi) To optimize speedy corrective maintenance, techniques employing automatic diagnostics test points, and rapid repair facilities shall be provided.

The MTTR time measurement shall include on site diagnostics and rectification of the failure up to point that the system is restored to full functionality. In the event that the failure cannot be rectified, the measurement shall include the time necessary to remove the failed piece of equipment from the system and replace it with a functioning module.

The maintainability shall be measured by fault rectification time which should not exceed 4 hours since its reporting to the Contractor call centre or his representative by HORC.

(d) Call out ratio

Failure: Elevator not available for more than one hour for passenger/staff service shall be registered as a failure provided:

(1) Failure is attributable to –

(i) Design defect.
(ii) Equipment failure / replacement.
(iii) Manufacturing defect.
(iv) Wrong Erection.
(v) Maintenance lapse (during DNP & AMC by the contractor).

or

(2) "Mantrap" resulted because of any of the above defect.

The call out ratio i.e. engineer visits to the site for non-schedule maintenance for the failures as defined above, should not exceed 2 on any one of the elevators in a year. The period one will commence from date of Taking over. If the visit of engineer for non-schedule maintenance exceed 2 per lift per year, a penalty of Rs. 20,000/- (Rs Twenty thousand Only) shall be imposed for each such visit per lift.

2.5 The design of the Elevator shall take into consideration fire prevention, elimination of dust and dirt traps, and easy accessibility for cleaning and routine maintenance.

2.6 (1) The gearless drive machine shall be mounted on guide rails accommodated within the elevator shaft. The power switch gear and main control equipment shall be suitably located inside or near the Elevator shaft, the location of which is to be decided in coordination with the Civil Contractor. No separate machine-room will be provided for machine-room-less elevator.

(2) The function of 13 persons (884 kg) Elevator shall be primarily for the movement of passengers including differently able and elderly persons and HORC staff. The reliability of the Elevator shall, therefore, be of paramount importance.

(3) Elevator intended to be provided shall have a carrying capacity (rated load) of at least 13 persons (884 kg). The nominal speed for the Elevator shall be 1.0 m/s in either direction.

(4) Shaft dimension for 13 persons elevator shall be approximately 2500 mm (Width) x 2100 mm (Depth). The Contractor shall take all necessary measures to accommodate the elevator in the shaft dimensions. The Contractor shall interface with the Civil Contractor for all matters related to shaft size. Any minor change in the shaft size shall have to be accommodated in the design by the Contractor by way of provision of suitable guide brackets/stainless steel channels without any additional cost to HORC. The construction tolerance shall be +200/(-)50 mm. The Contractor shall be responsible for any delay on this account.

2.7 Elevator car shall have minimum internal dimensions of 1600 mm (Width) X 1400 mm (Depth) for carrying the rated load of 884 kg/13 persons. The false Ceiling height of the Elevator car shall not be less than 2300 mm. The Elevator and door shall be so configured that it is feasible to handle a person on a wheel chair.

2.8 Both the car and landing entrance clear opening width shall not be less than 1000 mm and height shall not be less Ihan 2100 mm. The door shall be of center opening type.

2.9 The approximate headroom of 4800 mm and pit depth of 1800 mm shall be provided in the shaft for 13 persons elevator. The Contractor shall submit in their technical packages the requirement in respect of reaction load on the walls and in the pit and other relevant shaft requirements. The Contractor is required to interface with Civil Contractor in respect of the Elevator shaft requirement. The Contractor shall co-ordinate with the Civil Contractors to finalize all the details. The pit depth and overhead dimensions shall be such as to confirm the requirement of bottom and top clearances as per relevant IS.

2.10 The levelling accuracy shall be within ± 5 mm of the finished floor level.

2.11 The running clearance of each Elevator between the Elevator car threshold and landing door sill shall not be less than 15 mm but not more than 30 mm.

2.12 The software for elevator should be so designed that:

(i) The problem of man-trap and safety related requirements are completely addressed and the software enables the doors to open in all type of faulty situation.

(ii) Suitable provisions shall be made in hardware/software so that there should not be loss of any data due to power failure or any type of power disturbance etc.

Various fault situations covered by 'the software shall be reviewed at design stage.

2.13 The above specifications are summarized below:-

SN	Item	13 persons
1	Weight	884 kg
2	Motor starts/hr	120
3	Shaft Dimension (approx) (mm)	2500(Width)x2100(Depth)
4	Car Dimension (appx) mm	1600(Width)x1400(Depth)
5	Landing entrance opening width (in mm)	1000 mm
6	(Head room) in mm	4800 mm
7	False ceiling height(mm)	2300 mm
8	Pit depth	1800 mm

3 Electric Traction Drive System

3.1 Traction Machine

The construction of all Elevator machines shall conform with IS-15785, EN-81.

3.2 Motor

(a) Driving motor shall be, of the AC synchronous/asynchronous axial type designed for special duty cycles required for Elevator operation with no slip rings. It shall have a high starting torque, high power factor, efficiency not -less than 85% and low energy consumption. As per IEC 60034-1, Motor shall be suitable for duty cycle S5-60%.

(b) For the elevator, the motor shall be capable of not less than 120 starts per hour without excessive temperature rise.

(c) The maximum temperature rise of the winding shall not exceed 50℃ above ambient temperature when operated under normal condition.

(d) Provision shall be made to enable the speed to be checked at main Control cubicle.

(e) The motor shall carry a nameplate giving full details of its ratings and characteristics.

(f) The motor used shall have Class 'F' Insulation and shall. be designed for 110% of rated load.

3.3 **Brake**

(a) The Electro-magnetic brake shall be of the spring applied and electrically released type.

(b) The brake shall be capable of stopping and holding the Elevator car in its downward travel to rest with 125% of its rated load from the maximum governor tripping speed. In this condition the retardation of the car shall not exceed that resulting operation of the Safety gear or stopping on the buffer.

(c) Springs to apply the brake shoes (two nos.) shall be in compression and adequately supported. Power coating or other alternative anti-corrosion measures to be ensured.

(d) Brake linings shall be of renewable incombustible materials and shall be secured to the brake shoes that normal wear shall not weaken their fixings. Band brakes shall not be used.

(e) No earth fault, short circuit, or residual magnetism shalt prevent the brake from being applied in the event of loss of power supply to the Elevator motor and control circuit.

(f) A means of adjusting the brake plunger stroke and releasing the brake in emergency shall be provided.

(g) The Elevator machine shall be fitted with a manual emergency device capable of having the brake released by hand and requiring a constant effort to keep the brake open. The manual emergency device shall be handle operated. The handle shall be robust and able to bear the human intervention. It will be evaluated during detailed design stage. The termination of the brake cable at handle of manual emergency device shall be double securing and fail safe.

3.4 **Driving Sheaves**

(a) The sheaves shall be manufactured in steel or Spheroidal Graphite (SG) iron and fitted with seal for life lubricated bearings.
(b) The sheaves shall have machined rope grooves that can be reworked for future wear.
(c) Adequate provision shall be made to prevent any suspension ropes leaving groove due to rope slack or introduction of foreign objects.

3.5 Alignment

(a) The brake plunger, collar, sleeve, motor, sheaves and all bearings shall be mounted and assembled so that proper alignment of these parts is maintained.
(b) The assembly shall be reviewed and rectified when excessive noise is emitted during operation.

3.6 Anti-Vibration Supports

The whole traction machine shall be mounted on appropriate anti-vibration supports to minimize noise and vibration. The train design speed is 180 kmph and, therefore, Contractor shall design and install the Elevator accordingly. Any failure on the ground of the vibration, Contractor shall rectify the damages at their own cost and ensure no damages further.

4 Hoisting Rope/ Belt

4.1 At least three (3) sleet wire ropes or coated steel belts specially manufactured for Elevator use shall be employed for the suspension of Elevator car and counterweight. The diameter/dimension and specification of rope/coated steel belts for the car and counterweight shall conform to latest version/ amendments of IS: 14665 (Part 4/Sec. 8) and IS: 15785.

A plate giving the number, size and ultimate tensile strength of the rope or steel/coated steel belt used shall be permanently fixed to the crosshead. Steel rope/coated steel belt of adequate size and number is to be provided whose capacity/ strength will be verified at design / test stage. The coated steel belt shall be provided with continuous operating fatigue monitoring system as per IS-15785.

4.2 Before installation, manufacturer's certificates shall be supplied for each set of hoisting ropes/Belts with the data not limited to following: -

(a) The type of wire rope.
(b) The diameter in mm.
(c) The manufacturer's rated breaking strength.
(d) The month and year the manufacture of ropes.
(e) The manufacturer's name.

Note: One set of tools to measure the wear and tear of grooves shall be provided to the Employer and its cost shall be considered to be included in the cost of Elevator. Critical limits of grooves shall be defined during the design stage.

4.3 The factor of safety based on maximum static load for car and counterweight ropes shall be at least 12.

4.4 The ropes/belts shall be attached to dead-end hitch assemblies, fitting to supporting beams, car frames, counterweights by means of suitable rope/belt termination. A locking device or anti-twist rope device shall be fitted to the roping system. Alternately approved arrangement for wedge type rope fastening may be used.

4.5 Compensation ropes or chains or any other arrangement shall be provided, if necessary, to achieve the levelling required and smooth starting. If chains are provided, they shall be galvanized and enclosed in canvas hose or other accepted means to reduce noise.

5 Counterweight

5.1 Guide rollers shall be provided as per specification. The counterweights shall be made of cast iron/ wrought iron/ Steel and shall be appropriately secured and housed. They shall be of uniform density and physical dimensions. Counterweights shall be guarded by means of a rigid, galvanized steel sheet screen extending from a position 300 mm above the pit floor to a position at least 2.0 m above the pit floor.

5.2 The counterweight shall be balanced to 40% to 50% (±3%) of the rated load.

6 Clearances and Run-By for Car and Counterweight

6.1 The top clearance of the car and counterweight shall be as stated in IS Standards.

6.2 The bottom run by of car and counterweight shall be as per relevant IS Standards.

6.3 When the car rests on its fully compressed buffer, there shall be a vertical clearance of at least 600 mm between the pit floor and the lowest structural or mechanical part, equipment or device installed beneath the car platform except guide rollers, safety-jaw assemblies and platform aprons, guards, or other equipment. However, when the car rests on its fully compressed buffer, no part of the car or any equipment attached thereto shall come into contact with any part of the pit or any part of the equipment located therein.

6.4 The clearance between the car/counterweight and the hoist way enclosure shall be at least 20 mm except on the side for loading and unloading.

6.5 The clearance between the car and the counterweight shall be at least 25 mm. The clearance between the counterweight and the counterweight screen shall be at least 20 mm.

7 Guides and Fixings

7.1 Planed steel tees shall be provided as guides for the Elevator car and counterweight, as appropriate, erected plumb and fixed securely to the Elevator shaft by steel brackets. The bracket shall be solidly fixed with the RCC beam/bonds or welded with steel structure as applicable. The guide rails shall be connected by steel fish plates.

7.2 The rail contact surfaces of the connecting rail plates and back of the guide rail ends shall be accurately machined and fitted at site to form smooth joints.

7.3 The stem sections of all guides shall be tongued and grooved to provide matched joints. The guides and their fixings shall be able to withstand the forces imposed by a fully loaded car traveling at or higher than the tripping speed of the governor, due to the application of the safety gear, without permanent deformation or bending due to the uneven loading of the car. The guide rail brackets shall be hot- dipped galvanized.

7.4 Guide rail brackets shall be of steel and bolted securely to the building or structure steelworks. The brackets shall be designed and located such that the rail shall not deflect more than 5 mm under normal operation. There shall be a minimum of two brackets per piece of guide rail and the distance between brackets shall not be more than half the length of each piece of guide rail. The bracket should be fixed to steel structure or PCC blocks or RCC beams as applicable. This particular requirement shall be ensured during interface with designated civil contractor. It shall be the sole responsibility of the elevator Contractor to Interface with Civil Contractor, to satisfy himself about the shaft strength (as per latest standards) before taking up Lift Installation and get the strength of the shaft wall certified from Civil Contractor.

7.5 The fixing of guide rails to their brackets and to the building structure shall permit compensation, either automatically or by simple adjustment, due to normal settling of the building or shrinkage of concrete.

8 Elevator Car

8.1 Guide Rollers

(a) Adjustable guide rollers shall be provided and properly fitted at the top and bottom on each side of the car frame.

(b) Roller guides shall comply with the following requirements:

(i) Each roller guide shall consist of three wheels tyred with polyurethane or durable resilient material, each rotating on ball bearing having sealed-in lubrication, assembled on a substantial metal base. They shall be so mounted as to provide continuous contact of all wheels with the corresponding rail surfaces under all conditions of loading and operation. The wheels shall run on finished rail surfaces. The Contractor shall provide a means of adjustment of spring pressure and of play between Rollers and guide rails.

(ii) The roller guides shall run on dry guide rails. Sheet metal guards shall be provided to protect the wheels on top of the car and counterweight. The roller wheels for the car shall not exceed 500 rpm and the roller wheels for the counterweight shall not exceed 1000 rpm at rated speed.

(iii) The car and the counterweights shall be statically balanced following fitting of all its equipment and finishes prior to fitting the guide shoes.

8.2 Car Frame

A suitable car frame fabricated from galvanized cold rolled steel, bolted, or welded together to form a rigid structure shall be provided. The deflection of the members carrying the platform shall not exceed 1/1000th of their span under static conditions with the rated load uniformly distributed over the platform. It shall be able to withstand the operation of the safety gear or any condition loading without permanent deformation and shall not transfer the load to the enclosure. The safely factor of the frame shall not be less than five (5).

8.3 Car Enclosure

(a) The car enclosure shall be fabricated from galvanised steel of not less than 2 mm in thickness or any other material where specified and securely fastened to the car platform and so supported that cannot be loosened or become displaced in ordinary service or on the application of safety gear or on buffer engagement. The design of the final finishes of the walls, ceiling and floor is subject to the acceptance of the Engineer.

(b) No wood or other combustible materials shall be used for any part of the Elevator car including car door and emergency trap door.

(c) The enclosure shall be designed and supported such that when subjected to a pressure of 335N applied horizontally at any point over an area of 5 sqcm on the walls from the inside of the cars toward the outside, there shall be no permanent deformation and deflection shall not be more than 10 mm.

(d) The enclosure shall be insulated to prevent the transmission of noise and vibration from the car frame.

8.4 Car Platform

(a) The car platform shall be constructed from spray galvanized cold rolled steel with steel flooring. The platform shall be designed on the basis of the rated load being evenly distributed with a minimum safety factor of five (5). The design of the final floor finish is subject to acceptance by the Engineer.

(b) The car platform shall be Insulated to prevent the transmission of noise and vibration from the car frame to the platform.

8.5 The car roof shall be suitably constructed with galvanized sheet steel and reinforced to permit the maintenance and inspection of the Elevator shaft equipment to be carried out by maintenance personnel standing on the car roof. Perforated with mesh construction of the roof or wooden platform(s) on the car root shall not be acceptable. The car roof shall be fitted with guard rails set as suitable height and dimensions and strength to protect maintenance personnel in line with EN-81-20 and EN-81-50.

8.6 A toe guard shall be provided for the car doors conforming to Paragraph 8.4 of EN81 Part 1. The toe guard for elevator shall be made of galvanized sheet steel of not less than 2 mm thick and painted and shall be adequately braced at the back. The depth of the toe guard shall be sufficient to prevent any object from being trapped between the underline of the car platform and the landing during re levelling operation (with a minimum of 700 mm).

1.7 Ventilation

(1) Each Elevator car shall be adequately ventilated using Cross Flow Fans to achieve minimum standard of 20 air changes per hour The fans shall be located above the suspended ceiling or recessed in the car ceiling as appropriate. The location of the fans shall be submitted during design stage for Engineer's review and approval.

(2) A low-speed fan of low noise shall be used. The noise from the fan measured at a distance of 1 meter away within the Elevator car shall not exceed 50 DBA (+5%).

(3) The effective area of ventilation apertures shall be at least 1% of the car platform area as per EN-81.

(4) Fan shall automatically Start on registering the command/ Auto Call for the elevator. However, fan, switch shall be provided to disable auto starting of the Fan when not desired.

8.8 The car door shall be provided with an electric contact arranged to prevent the normal operation of the Elevator unless the gate is in the closed position. The car gate shall be arranged to give the minimum clear opening width as specified.

8.9 The car junction box with IP Class 55 protection, for the traveling cables and car enclosure wiring shall be installed at the car top.

8.10 **Car Interior and Elevator Finishes:** Unless specified elsewhere in this Specification, the following finishes for the Elevator shall be complied with: -

(1) Landing Finishes

i	Landing Transom Panels	Scratch Resistant Stainless steel.
ii	Architrave (Fascia/ Jamb)	Scratch Resistant Stainless steel/ Stone work. The fascia of minimum 300 mm width on every landing or as per site condition for fixing the Landing Plate, Indicators, and MAP etc shall be of Scratch Resistant Stainless steel and shall be in scope of elevator Contractor.
iii	Landing Doors	Scratch Resistant Stainless steel door with 2 hours Fire rating. Fire door testing shall be conducted at independent lab and inspection call for witnessing the same by Engineer's/Employer's representative shall be given by the Contractor. The Contractor may submit the Fire Door Testing certificate of the door already tested and supplied to Railway/Metro/ NCRTC/NHSRCL (in India) for consideration of the Engineer in last 3 years from the date of issue of LOA. For the glass Door elevator: Thickness of glass door shall not be less than 10 mm and with Scratch Resistant stainless-steel frame. The fire rating of the door shall be as per latest applicable NBC at the time of design submission stage. Fire door testing shall be conducted at independent lab and inspection call for witnessing the same by Engineer's/ Employer's representative shall be given by the Contractor. The Contractor may submit the Fire Door Testing certificate of the glass door already tested and supplied to Railway/Metro/ NCRTC/NHSRCL (in India) for consideration of the Engineer in last 3 years from the date of issue of LOA.

(2) Car Finishes

i	Car Transom Panels	Scratch Resistant Stainless steel frame
ii	Car Doorframe	Scratch Resistant Stainless steel
iii	Car Wall	
	1. Front Panels	Scratch Resistant Stainless steel
	2. Side Panels including the COP (Car Operating Panel)	Scratch Resistant Stainless steel.
	3. Back Panels	Scratch Resistant Stainless steel. Joints in all surfaces shall be coordinated. All fixings to be of the hidden secret type (Cover strips at joints are not acceptable).
iv	Car Doors	Scratch Resistant Stainless Steel for steel door elevator. For the glass door, Thickness of glass shall not be less than 10 mm and with scratch resistant stainless-steel frame. The Fire rating of Car door shall be complying with the requirement as per the National building Code.
v	Car Floor	Minimum 15 mm thick Granite/ synthetic artificial stone having anti-slippery design distinguishable through grating of any suitable material which can take the desired load. However, the approval for the colour of granite/ artificial synthetic stone and its specification shall be obtained from the Employer during design stage. The Contractor shall coordinate with Civil Contractor and match lift car floor granite with station/building floor in front of lift.
vi	Car Ceiling	Scratch Resistant Stainless-steel panels with sufficient LED down lights or other energy efficient lights. Ceiling design to be coordinated with the overall station design to the "Engineer" acceptance.
vii	Car Kick-Plates and skirting	Scratch Resistant Stainless steel on all three sides of car except the portion of COP.
viii	Hand/grip rail	Polished Stainless steel, of straight through type & supported from minimum 3 places. Design of rail shall be submitted for review and approval of the Engineer.

(3) All stainless-steel materials specified for car and landing finishes shall be of grade of 304 and shall be subject to the acceptance of the "Engineer".

(4) The degree of ingress protection provided by both Car-door and Landing-door to the car and the internal machinery shall be IP-54.

(5) All car interiors/architrave, doors and interfaces with civil structure and finishes shall be subject to the acceptance of the "Engineer".

8.11 Illumination of Cars and Lighting Fixtures

The minimum illumination level at the floor of the Elevator car shall be 150 lux using energy efficient LED fittings. The light inside the car cabin shall be either of light yellow or white colour and shall be decided during the design evaluation.

8.12 Emergency Lighting

In addition to the normal car lighting, a maintenance free emergency light fitting shall be provided in each elevator Car, which may be the same type of fitting as the normal car light and shall illuminate immediately and automatically in the event of failure of the normal car lighting electrical supply. The fitting shall incorporate a permanently illuminated signal to indicate mains healthy and shall be connected to the emergency battery. The luminous intensity of the emergency lighting shall not be less than 100 lux measured at floor level and on the car operating panel(s). The design of maintenance free emergency light system shall be got approved from the Engineer by the Contractor.

9 Heavy Duty Elevator Doors

9.1 Car and Landing Doors

(1) Heavy duty doors shall be of Robust Design to cater to 10,00,000 (ten lakh) operations of Elevator per year. Each elevator shall be provided with horizontal sliding doors complete with door frames and architraves, arranged in centre opening with two panels.

(2) Unless otherwise specified, the car and landing door panels shall be imperforate and fabricated from stainless steel hairline (grade 304) finish of at least 1.5 mm thick. The back of the door panels shall be treated with an anti-drumming compound which shall be non-combustible and shall not emit toxic fumes when affected by fire. The compound shall be reviewed without objection by the Engineer.

(3) The requirements of Glass Door are specified in sub clause 28 below.

(4) The door shall be able to withstand horizontal or lateral load according to latest version/ amendments of IS: 14665 (Part 4/sec 6): 2001.

(5) The doors shall be provided with keyways for interlocks. Door sills shall be made of machined SS block to provide anti-skidding surface, its bottom plate thickness shall be 5.0 mm with non-slip wearing surface.

9.2 Door Hangers and Rollers

The proneness and design of heavy-duty doors shall be specifically evaluated during the detailed design stage.

9.3 Door Operators

(1) Operation of Door shall commensurate with elevator motor starts/stop. The door operator for each Elevator shall consist of a motor, operating mechanism, linkages, and switches to give adjustable or variable speed door operation and shall be adjusted to ensure smooth, fast opening and closing. The average door speed shall be between 150 - 250 mm/sec. The car and landing doors shall operate simultaneously and quietly while the Elevator car is levelling.

(2) For the car and landing door made of glass panels with stainless steel hairline frame stainless steel cover of not less then 1.5 mm thick or other suitable arrangement for headers shall be provided with "Engineer's" approval to prevent the door locking devices, door tracks and mechanism from accumulation of dust. For stainless steel elevator steel door covers shall be made of galvanized steel.

(3) On “Without Attendant" mode, if no command is 'registered or due to some abnormality in Lift Safety circuit, after the expiry of a preset time interval of 10-30 seconds (adjustable) the door shall re-open once for 30 seconds (adjustable so as the commuter can come out) and close.

(4) For Elevator on "With Attendant" operation, the car and landing doors shall open automatically but the closing of doors will be subject to the pressure on “Door Close' button. During the closing motion, it shall be possible to reverse quickly and open the doors by pressing the “Door Open" button.

(5) The door lock shall prevent the car doors from being opened by the door operator or by force when the car is moving or is not stopped within the unlocking zone of a landing. Electric interlocks shall be provided to ensure that elevator will not operate, if the car door is not closed and locked. If the car door is forced open, the Elevator shall stop, and the alarm activated (even when the Elevator is out of order) until the door is fully closed. The audiovisual alarm signal shall be sent to the relevant landing as well as to Station Control Room (SCR) and Control Centre rooms. Call cancellation features shall be provided. The details shall be submitted for review and approval of the Engineer.

9.4 Door Safety Devices

9.4.1 Electrically Operated Proximity Detection Device

(1) Electrically operated proximity detector devices(s) shall be installed on the leading edge of the car doors. The device(s) shall create a three-dimensional zone of protection for the entire height of the door opening. This zone of detection shall extend a short distance in front of the landing doors. The zone of detection shall move forward as the doors close and the presence of a person, if within this zone, shall activate the detector to stop the closing movement of the doors and re-open them before hitting the person. After a preset time, interval (which is programmable) the doors shall start to close again in the absence of further interruption. A passenger entering or leaving the car shall not cause the doors to stop and re-open unless the doors’ edge reaches a certain predetermined proximity to the passenger. The Contractor shall consider the ambient condition inclusive of sunlight before deciding the sensitivity of the device, so as to avoid mal-functioning.

(2) If the doors are prevented from closing by the pressing of hall and/or car buttons or a person in their path for an adjustable pre-set time, the safety devices, except the mechanical door safety edge, shall be rendered inoperative to cause door reversals. The doors shall proceed to close at a reduced speed and a buzzer located on the car shall sound before and during the closing.

9.4.2 Photo Cells

Two Photocells shall be provided for each car door for preventing door closing when a passenger is entering or leaving the car. This should act as a backup protection to 3D-infrared curtains.

10 Car Operating Panel (COP)

10.1 Car operating panels and car call buttons shall be ergonomically designed and of robust construction to the Engineer’s acceptance. The car operating panel shall be integrated and flush mounted, on one of the side panels. All buttons shall be of Jumbo Size with minimum dimension of 50 mm X 50 mm on the panel and shall be of robust design and construction and flush with the panel. The car COP shall be fit in type instead of screw fitted. The design shall be submitted for review and approved by the Engineer.

10.2 The faceplate shall be made of scratch resistant stainless-steel grade 304 hairline-finishes. Specifications/features of various items to be provided in COP are following:

(a) A red "Car Overload" indicating lamp with buzzer in both Hindi and English Language. Car overload message in Red flickering fonts with yellow background shall also be provided along with voice announcement unit.

(b) Two vertical rows (where appropriate) of car minimum dimension of 50 mm X 50 mm on the call buttons for floor designations, bearing, numerals/ alphabets and Braille code next to each button for visually handicapped.

(c) A "Door-Open" button which, when pressed, shall cause the closing door to reopen or when continuously pressed shall keep the door open.

(d) A “Door-Close” button which, when pressed, shall cause the door to close to shorten the time.

(e) A capacity plate engraved onto the car operating panel shall indicate the rated load in kilograms and the maximum number of passengers to be carried. The size and design of the letters shall be subject to the acceptance of the "Engineer”.

(f) An "ON/OFF" switch whereby the ventilation fan can be switched ‘ON’ and 'OFF'. Each button shall be of Jumbo type (50 X 50 mm) micro-push suitable for heavy duty and vandal proof type. The response light shall be either orange or red when illuminated.

(g) An intercom button connected with EPABX (self illuminated feedback type), when pressed, shall allow direct communication with the personnel in the SCR/CC room, and main control cubicle. EPABX shall be designed to take simultaneous calls from all lifts of a particular station. The Contractor shall submit their features and proven vendor of intercom to Engineer for review and approval.

10.3 A key operated switch shall be provided on the car operating panel at a suitable location to facilitate elevator operation as under:

(a) One or more switches whereby the following modes of operation can be affected as desired:

(i) Fully Automatic with Attendant operation.
(ii) Automatic with Attendant operation.

(b) "UP or DOWN" buttons which shall cause a car to travel in the desired direction. These buttons shall be operative only during the "Attendant" operation and Auto mode in case of 2 floors lift.

(c) An "ON/OFF" switch whereby the ventilation fan can be switched ON and OFF.

(d) The fireman switch shall be provided as per IS-14665 (part-5) and statutory requirement. Location of fireman switch shall be at the level from where the exit is easily possible.

11 Big Size Car Position Indicator

11.1 The faceplate of the big size car position indicator shall be made of stainless-steel grade 304 hairline finished. The stainless-steel plate shall be at least 2.5 mm thick, and its mounting arrangement shall have minimum two sunken screws. This plate shall be pilfer proof. Floor numbers shall be digitally displayed using TFT (thin film transistor) display and it shall be easily and clearly visible even if direct sunlight falls on it. There shall also be an arrow in motion vividly and dynamically indicating car movement and direction. It shall also be capable of displaying simple messages such as, floor names like “Concourse, Platform”, “Out of

service", "under maintenance", "this landing is not in Use", "Fireman Operation", "Seismic", "Automatic Rescue Device", etc. The surface of the display unit shall be non-glare type. Real Clock time shall be displayed inside the car display.

A voice announcer, in English and Hindi shall be provided to indicate operation of the doors and the floors where the elevator stops and the direction of the elevator. It shall also announce overload, seismic, fire mode, auto rescue, donot panic you are safe in lift, function when applicable. The announcement shall be 100% synchronised with the actual operation of the elevator during voice announcer operation, other speakers including TFT audio system should stop automatically.

12 Elevator Inter-Communication System

12.1 The Contractor shall provide an Elevator inter-communication between the Elevator Car, main control cubicle and SCR/CC room.

12.2 Station shall be equipped with handsets installed inside the Elevator cars, which shall be of the hands-free type.

12.3 The power supply arrangements for handsets/ intercoms shall be connected with UPS power Supply of the station such that intercoms working shall not be affected by the failure of main supply.

12.4 A station shall be supplied and installed in the Station Control Room (SCR)/CC room as applicable. A single intercom system to handle the calls from all lifts shall be installed and it shall be handset type with call identification facility. Call waiting identification shall also be available.

12.5 The loudspeaker and microphone unit of the station shall be concealed in the car operating panel. The necessary cabling including conduiting from SCR/CC room to main control cubicle etc. shall be provided by the Contractor with proper interfacing with Civil Contractor. Routing shall be finalized with the Civil Contractors before fixing the false ceiling in the station/building. It should be possible to decipher the identity of calling Elevator at the SCR/ CC room. The Lifts (inside and outside) shall also be numbered at station/building for the purpose of easy identification.

13 No-Smoking Notice

13.1 A "SMOKING IS STRICTLY PROHIBITED" sign shall be supplied and surface mounted on the front return panel in each Elevator. The graphics, lettering and material shall be subject to the acceptance of the "Engineer".

14 Certificate Holder

14.1 A framed and glazed panel made of stainless steel, suitable to display the Elevator certificate shall be provided above the car operating panel. This shall be subject to the acceptance of the "Engineer".

15 Hallway Equipment

15.1 Landing Doors

(a) Fire Rating

Stainless steel Landing doors shall have a minimum of 2 hours fire rating. Landing doors with glass panels shall have a minimum of 1 hour fire rating. These doors shall be suitably tested and provided with approved stickers.

(b) Door Frames

(i) Door frames shall be of at least 1.5 mm thick scratch resistant stainless steel in hairline finishes and shall comprise head and jamb sections of the same material. The door frames shall be suitably braced and reinforced.

(ii) The frames shall be provided with adjustable wall anchors or comparable devices to permit bonding of these anchors or devices into the walls after the frames are in place. All frames shall be securely fastened to sills and hanger supports and shall be returned to the hoist way side to present a neat appearance.

(c) Door Sills

Toe guards similar to those provided to the car door sill shall be provided beneath each landing door sill. The design shall be submitted for review and approval by the Engineer.

(d) Supports and Covers

(i) Structural steel angles shall be furnished and of sufficient size to accommodate the door closing equipment. The angles shall be continuous and securely bolted to the sills and the building structure.

(ii) Hanger cover plates shall be made of galvanized steel, for elevator with landing as well as car door made of stainless steel. For other elevators having car doors as well as landing door made of glass with scratch resistant stainless-steel frame, hanger cover plates shall be made of stainless steel. These covers shall be removable, and so arranged to ensure hanger accessibility from within the Elevator car for maintenance purposes.

(iii) Cover bolts and threaded screws shall be adequately strong, with long life and capable of frequent opening and closing.

(e) Self-Closing

Gravity or spring actuated self-closing device shall be fitted to the landing doors so as to automatically re-close the doors when manually opened by means of the emergency unlocking device in form of gravity weight or spring tension. The gravity weight shall move freely and quietly within its enclosure fixed at each end of the door sill and be protected from falling into the elevator shaft due to whatever reason. This device shall not be accessible to the public.

(f) Locking Device

(i) Each landing door shall be provided with an accepted locking and interlocking device to prevent the operation of the elevator unless all landing doors are closed and locked.

(ii) It shall not be possible to open the landing door from the landing side without a landing door key. The feature shall be submitted during design stage for review and approval by the Engineer.

(iii) The locking device (electrical door contact switch) shall have at least IP 54 protection.

(iv) The electric contacts of the door locking device shall open positively independent of gravity.

(v) Each landing door shall be provided with its own locking device.

(vi) Provision shall be made for opening all landing door locks by means of a landing door key by an authorized person irrespective of the position of the Elevator car.

(g) Fascia

Where the gap between the car door sill and surface of the Elevator shaft wall exceeds 125 mm, galvanized sheet steel fascia plates of not less than 1.5 mm thick shall be provided. These shall be fixed between the undersides of landing entrance sills and the top of the door hanger case to form a flush surface in the path of travel at the car entrance. The plates shall cover the whole width of the landing door and extend by 150 mm on each side of the door. It shall be rigid and properly reinforced. The fascia plate shall be painted in an accepted colour. For Stainless Steel lift, fascia plate shall be of 750 mm in height and for glass it shall be of full height.

(h) Door Profile

To avoid the stucking of fingers in between Car frame and Car door, profile shall be provided and & the gap after provision of profile, if any, shall not be more than 5 mm.

15.2 Jumbo type Hall Call Buttons

(a) One (1) set of Jumbo type of minimum size 50 X 50 mm hall call buttons shall be provided for each Elevator at every floor served. The set of buttons shall be installed on the wall adjacent to each Elevator landing on architrave.

(b) The faceplate shall be made of stainless-Steel grade 304 hairline finishes. The Stainless-steel plate shall be at least 2.5 mm thick and its mounting arrangement should have two minimum Sunken Screws. This plate shall be flushed with architrave pane. This plate should be pilfering proof. The Jumbo type of hall call buttons shall be micro-push type, suitable for heavy duty and vandal proof. The response light of the call buttons shall be orange or red, when illuminated. When an Elevator arrives at the hall, the illumination shall cease.

15.3 Hall Position Indicator

(a) One (1) set of hall lanterns shall be provided for each Elevator at every floor served. The set of lanterns shall be installed on the wall adjacent to or on top of each Elevator landing. The display shall be the same as the car position indicator. The speaker of alarm shall be provided in this Hall position indicator box.

(b) Prior to the car's arrival, the hall lantern shall begin flashing/ illuminate and the Chime shall sound twice.

(c) The response light of the “UP" and “Down” indication lanterns shall be of red colour and plate shall be flushed with architrave panel.

15.4 Elevator Designation Number Plate

(a) At each landing, Lift Designation Number Plates shall be supplied and installed next to each Elevator by the Contractor. The Elevator No. with Station/building Name of elevator (as recorded on the elevator license) shall also be indicated on the plate.

(b) The Number Signs shall be made of stainless steel grade 304 mirror finishes. They shall fit into the designated space to be coordinated with the civil Contractor and shall be subject to the acceptance of the "Engineer".

15.5 The elevator’s equipment (i.e. big size Indicators, landing call Plate, fireman glass plate, etc.), if any, at Ground level shall be pilfer proof.

The Stainless-steel plate of SS 304 grade for mounting 'the indicators and landing call buttons shall be at least 2.5 mm thick and its mounting arrangement shall have minimum two Sunken Screws suiting the design criterion. The plate shall be flushed with architrave panel.

16 Elevator Functions

The Elevator shall incorporate the following functions.

16.1 Car Door Bypass (CDB)

In case of fault in elevator due to car door system not functioning properly, a suitable arrangement of Car Door Bypass shall be provided in elevator to rescue passenger safely from elevator car in conformance to EN-81, latest version. During travel in this mode, a beep sound shall alert the trapped passenger in the car.

16.2 Door Nudging Feature

If the Elevator doors are kept open longer than the pre-determined time, an override alarm shall sound to alert the passenger that the doors must close so that system performance is not adversely affected.

16.3 Next Landing

The car shall automatically proceed to the nearest floor, if the car doors fail to open at the designated floor.

16.4 Door Load Detector

When an object is caught in or interferes with the opening or closing of the doors, the doors shall reverse direction when an excess load is detected.

16.5 Load Weighing Device

Detailed design of load weighing device shall be submitted for review and approval by the Engineer. Frequency of calibration shall be submitted during design stage and same shall be monitored and records shall be submitted to the Employer's representative during the DNP.

16.6 Overload Holding Slop

When the car load exceeds the pre-determined weight, in addition to the overload buzzer with the announcement of overloading, the Elevator shall not operate and the doors shall remain open. The load measuring device shall be a proven product. The load measuring device shall be of the latest technology and of the latest version. The complete technical features of devices that can be used for sensing the overload in the car should be most reliable and defined. The approval for the same shall be obtained from the Engineer.

16.7 Electronic Door Safety

When passengers are boarding or exiting the car as the doors are closing, the doors shall re-open before touching the passengers.

16.8 Homing Service

This function shall automatically home the Elevator to the pre-assigned floors. After transporting passengers to the assigned floor, the Elevator shall automatically home to its preassigned floor. This feature shall be provided in the elevator with the approval of the Engineer.

16.9 Up or Down Selective Collective Automatic Operation & Auto Call Registration

(a) The elevator shall automatically respond to the call, when for "2 floor type elevators" the hall-calls are registered. The elevator shall respond to the call when for more than 2-floor elevators, hall-calls and car-calls are registered.

(b) It shall respond to all registered hall calls and car calls in the direction of service. When no call is registered then after a pre-set adjustable period, elevator car shall come to designated floor and open the door for 30 seconds (adjustable time) and then park the car there with doors closed.

17 Operating and Safety Devices

17.1 Each Elevator shall be provided with an overload device of accepted design, which shall operate when the load in the car exceeds the rated load. When activated, this device shall prevent any movement of the Elevator car and shall cause a warning buzzer on the car to be set off and illuminate an "Overload" signal. This device shall be incorporated in the car-operating panel.

17.2 The water sensors in the elevator pits shall be provided wherever pits are on the ground level or below the ground level. The requirement of water sump in the elevator pits for such elevator shall be coordinated with the Civil Contractor.

17.3 An inspection control panel shall be fitted on the top of the Elevator car for maintenance purpose. The design of the inspection control panel shall comply with the following requirements and prevent the Elevator car from being operated accidentally: -

(a) It shall not be possible to control the Elevator car from any other position after the NORMAL/TEST change-over switch has been set to the TEST position. When in the TEST position, the UP and DOWN continuous pressure push buttons within this panel shall become operative.

(b) An ON/OFF switch shall be provided. It shall render the Elevator inoperative in any mode, when the switch is in the OFF position.

(c) The Elevator car shall only move when all safety devices are in the safe position.

(d) The Elevator car shall move in either direction only on continuous pressure of the appropriate direction button at a car speed not exceeding 0.25 m/s.

(e) The control panel shall incorporate an adequately protected permanently located light fixture with a separate switch and a 15A switch socket outlet.

(f) A door operator ON/OFF switch shall be. provided. The door operator shall only be operative when the switch is at the "ON" position.

(g) Associated With this control, a terminal stop limit switch shall be provided to stop the car from traveling in an upward direction not less than 1.8 m from the soffit of the Elevator shaft. When this switch is activated, it shall not stop the car from operating in the down direction.

(h) There shall be provision of LED lights (with box type fitting) inside the shaft & in undercroft of car base which can be controlled from the top landing & from pit. It shall have an intensity of 200 Lux at floor level.

(i) All switches and buttons on the Inspection control station shall be clearly engraved with their functions. All buttons and switches shall be shrouded against accidental operation, with the exception of the emergency stop button.

17.4 The Elevator shall be provided with a floor levelling device, which shall automatically bring the Elevator car to stop within ±5 mm of the level of the floor for which a stop has been initiated

regardless of the load or direction of travel. In case ARD mode, the car shall stop within ±10 mm of the level of floor, this is subject to the Engineer's Acceptance at the design stage.

An automatic re-levelling device shall be provided which returns the Elevator to the floor automatically (within ±5mm) should the Elevator creep down or move up from floor level for any distance more than ±15mm. This device shall be operative at all floors served whether the landing and car doors are opened or closed.

Unintended Car Movement Protection (UCMP) device shall be provided in Elevator controller to avoid the movement of car in open door condition beyond door zone.

Single Arm Broke Torque Test: Single arm broke torque testing function shall be inbuilt in the controller and this function shall be provided in Quality check list.

17.5 Each Elevator car shall be provided with progressive type safety gear mounted on the lower member of the car frame structure. This safety gear shall be capable of operating only in the downward direction and capable of stopping the car with full load at the tripping speed of the over speed governor, by gripping the guides and holding the car stationary. The motor circuit shall be opened by a switch on the safely gear before, or at the same time the safely gear is applied. It shall be possible to release the safety gear by raising the Elevator car without the use of any special tools.

A mechanical device and electrical device shall be provided to prevent the car movement resulting from maintenance/inspection that can be dangerous to persons carrying out maintenance/ inspection works from inside the car or car roof.

17.6 An over speed governor shall be provided, which is capable of activating the safety gear in the event of the Elevator exceeding the rated speed by 40% (or as per relevant IS or EN standard) subject to approval of Engineer. The tripping of the over-speed governor for the safety gear shall occur when the car speed exceeds 140 % of the rated speed downwards. A mechanically operated safety switch shall be provided to disconnect the power supply to the motor when the governor is activated. The governor shall be adjusted to operate the safety gear in accordance with the recommended limits in IS: 14665. The governor rope shall be of steel and shall comply IS: 14665.

An over speed governor shall be provided to the Counter weight in case of Hanging pit. The Contractor shall interface with the designated Contractor for the requirement of hanging pits, if any.

17.7 A phase protection device and 3-phase as well as single phase earth leakage protection device shall be provided in the main control cubicle of each Elevator to prevent the Elevator car from moving in the event that there is a phase failure, or the phase of the power supply being reversed due to any reason whatsoever. These devices, when activated, shall cause a visual indicator to illuminate on the main control cubicle, until the fault has been rectified.

As in the case of Power failure (including single phasing/ unbalanced phase), elevator shall operate in the Automatic Rescue Device (ARD). The software for providing this feature is subject to the Engineer’s acceptance.

17.8 Two switches shall be provided in the Elevator shaft, one at bottom landing and other in the pit which, when in the "STOP" position, shall prevent any movement of the Elevator car, including inspection/ test operation, until both the switches are set to the "RUN" position. The switching positions shall be prominently labelled. The knob of these switches shall have luminous paint.

18. Electrical Requirements

18.1 Each Elevator shall be provided with a main control cubicle to accommodate all electrical switchgear. A caution notice with the wording “Danger- 440V/240V A.C. Do Not Remove Cover Unless Incoming Supply is Switched Off" shall be affixed to the cover/ door. The size

and shape of the main control cubicle shall be same as that of Maintenance Access Panel (MAP).

18.2 (a) The Elevator shall be designed to operate on a 440V ±10% AC, 3-phase, 4 wire, 50±3% Hz power supply.

(b) Power supply cables up to elevator's main control cubicle shall be arranged through respective BOQ item and shall not be in the scope of elevator work.

(c) All power and control cables including ELCB's, MCBs & Switches etc shall be provided by Contractor and these items shall be provided as per material reference list given in the tender document and approved by the Engineer.

(d) The shaft LED lighting (200 Lux as per IS: 15785), Ventilation arrangement and pit socket outlets shall be provided by the Contractor. The fixtures and cables etc shall be got approved from the Engineer.

18.3 There shall be provision of light on the top ledge of elevator door on all landings to ensure proper illumination and their identification. The light shall be LED type.

18.4 All switchgear and other auxiliary apparatus shall be of accepted design and labelled for identification. All the PCBs provided for elevator shall be provided with conformal coating of military grade and type test reports as per relevant IEC to be submitted during proto type testing.

18.5 (1) The control wiring shall be laid out neatly and clearly in cable sleeves and all terminals and cables shall be properly sealed, labelled or marked or tagged for identification.

(2) All casing, covers, trunking and armouring shall be thoroughly, and efficiently earthed and adequate protection shall be provided to prevent fuses and circuit breakers from arcing to earth or between phases.

18.6 Maintenance Access Panel (MAP) shall preferably be located at ground level of station/building. Maintenance Access Panel (MAP) & Shaft Electrification Panel (SEP) shall be IP55, pilfer proof. MAP shall have data downloading facilities for fault diagnostic through RS - 485 port and USB port (latest version). Fault data logging in MAP should have date & Time stamping facilities of 500 events. There shall be provision of resettable type counter for the recording number of operation of the Elevator.

18.7 The design of the contactors and relay contacts shall be such that the break and make contacts shall not be closed at the same time at any position of the armature. The operating conditions shall be as follows: -

(a) If, one of the break contacts (i.e., normally closed) is closed, all the make contacts are open.
(b) If, one of the make contacts (i.e., normally open) is closed, all the break contacts are open.
(c) The layout of cards in SEP should be maintenance friendly so that they are easily accessible to the maintainer. This would be evaluated during detailed design.

18.8 In the control and safety circuits, the operating voltage of the mean value in the case of direct current or the rms value in case of alternating current, between conductors or between conductor and earth shall not exceed 250 V.

18.9 There shall be provision of surge protection, power filters and other necessary equipment to avoid failure of elevator equipment on account of quality of power.

18.10 (a) In the event of failure of the normal electrical supply, the supply to the alarm cum intercom system, emergency car lighting and the ventilation fan shall be automatically switched to an emergency battery operated power supply (UPS).

(b) The UPS power supply from UPS to elevator control cubicle and/or Electrical box for UPS supply inside the elevator's shaft, shall be arranged from BOQ items and shall not be in the scope of elevator work.

18.11 All wiring and apparatus shall be subject to acceptance and suitable for the specified electrical supply. The insulation of all wiring including those within the controller shall be of flame retardant, low smoke (FRLS) complying with the cable requirement of this specification. All hoist way and car top safety switches shall be rated to IP Class 55.

18.12 All field wiring shall be multi-strand copper conductor type. No joints shall be permitted in any cables or wires in any location.

18.13 All lift wiring within lift shafts shall be run in galvanized conduit or GI trunking along with all accessories. All conduit outlets shall be bushed with insulating bushes of accepted pattern and shall be part of elevator. All wiring connections to switches and conduits shall be water tight. No wire and cable shall be visible from outside in case of glass lift.

18.14 The arrangements of terminals at either end of flexible trailing cables shall be identical and the terminal blocks marked to identify the cables connected to them. The cable boxes and wiring for the car light and the alarm bell shall be entirely independent of the elevator control wiring. Flexible trailing cables shall be securely clamped at each end so that the weight is not supported by any fixing of the various cores. The outer sheath of these cables shall be of waterproof and flame retardant material. A total of 10 or 10% of the total number of wires used whichever is more and 2 spare shield cables shall be provided per Elevator. The outer sheath of these cables shall be waterproof and flame resistance material which shall not emit toxic fume when affected by fire.

18.15 The compatibility of MCB and ELCB used for elevator shall be verified with the requirement of the elevator. The MCB and ELCB, wherever required shall be provided by the Contractor and shall be in the scope of elevator work. Termination of main incoming armoured cable on the MCB/ ELCB shall also be the responsibility of the elevator contractor.

18.16 Harmonics generation in VVVF system :
OEM shall design the VVVF system in such a manner that generation of harmonics is minimal. OEM shall also provide suitable harmonics filters to eliminate harmonics. Ceiling limits for "total harmonics distortion" (THD) shall be as per IEEE 519-1992 and details are as follows:

Rated Load Current (I)	THD(%)
I < 20 A	< 20.0
20 A ≤ I < 200 A	< 15.0
200 A ≤ I < 400 A	< 12.0

18.17 Provision for Remote Monitoring System (RMS)

(a) The PC (Computer system) for RMS shall provide/ receive the following status with monitoring points and control points to the RMS with all necessary software and hardware: -

(i) Provision of elevator fault/ trip signal.
(ii) Provision of elevator car alarm signal
(iii) Provision of power available and failure status.
(iv) Provision of elevator under maintenance signal
(v) Provision of elevator under working signal (Dynamic Arrow/graphic shall be provided).
(vi) Receiving remote control signal for parking on / off operation.
(vii) Provision of Fire Mode and its command from SCR/CC.
(viii) Fault history display and its Download facilities from Computer at SCR/CC
(ix) Down Time

(x) Maintenance History and support (Pop signals for preventive maintenance)
(xi) Suitable rack/ Trolley for placing the CPU under the counter in SCR/CC.
(xii) Provision of additional buzzer with 70db.
(xiii) Provision of Alarm accept button.
(xiv) Provision of buzzer test button.
(xv) Display of Lift's all Batteries including ARD charging status to monitor the status.
(xvi) Display of CCTV (Camera) provided inside the lift Car.
(xvii) Provision of Seismic Signal.

(b) The elevator fault/trip signal shall be activated whenever there is a fault in the elevator system, which causes a breakdown. The signal shall be latched on till it is manually reset. It shall only be reset after the fault is cleared. The Audio Visual signal shall be available in SCR/CC.

(c) The alarm signal shall be activated with an audio repeated buzzing till it is reset whenever the alarm inside the elevator car is pressed. (Time of Alarm should be adjustable and will be reviewed during installation stage).

(d) A by-pass switch with illuminated indication, which shall de-activate the fault/ trip signal to RMS when switched "ON" and give an "Under Maintenance" signal to RMS in SCR/CC which shall be provided in the controller for maintenance purpose. The switch shall be labeled in Hindi and English and shall be subjected to the acceptance by Engineer.

(e) Following Scheme shall be submitted for review and approval by Engineer before implementation:

Upon actuation by remote switch from the RMS for parking on, the elevator shall complete the last landing or car call, if any, and return to the designated landing and stop there with both the car and landing doors open for 15-20 seconds and then close. The "Not in service" indicator shall be illuminated on the landing indicator automatically for a pre-determined time and then extinguished. The car light and ventilation fan shall be switched off automatically at the same time. The essential buttons e.g. door open, intercom and alarm bell etc. on the car operating panels shall remain functional and illuminated when the elevator has been parked and locked out.

Upon actuation by remote switch from the RMS for non-parking, the elevator shall be switched back to normal operation and both the car light and ventilation fan shall be switched on automatically.

(f) The Contractor shall connect the contacts with screen wires and terminate at the terminals in the Insulated Terminal Block (ITB) to be located in SCR/CC. The connection from ITB to the RMS will be provided in the Elevator work. The GI conduits from the Elevator shaft to the SCR/CC will be provided from items in the BOQ and shall not be in the scope of elevator work.

(g) Audible Buzzer with 70db(A) noise shall operate whenever parameter "Under Fault" and "Alarm Button Pressed" become "ON". The audible buzzer will become off with the press of "Alarm Accept Button", however visual indication shall persist till the fault is cleared.

(h) An actual prototype of Lift RMS should be demonstrated during prototype and its detail design and features shall be submitted for Engineer's review and approval.

(i) The Contractor shall provide all wiring & apparatus and shall be subject to acceptance of "Engineer" and suitable for the specified electrical supply. The insulation of all wiring including those within the lift shaft shall be of flame retardant, low smoke halogen free (FRLSZH) type complying with the special cable requirement of this Specification.

19 Special Emergency Operations for Elevator

The Elevator operation system shall be designed to provide the following emergency operation.

19.1 **Emergency Operation of Elevator in the Event of Power Failure**

In the event of power failure or power interruption or single phasing or unbalanced phases (or any problem in the power supply which affect the normal operation of the lifts), the supply to Elevator shall be automatically switched over to the emergency power supply i.e. to Automatic Rescue Device (ARD) and the Elevator shall be brought to the designated floor and shall park there with the doors remaining open. In case Power supply to the lift is restored through Genset/Alternate source before the lift reaches designated floor even then ARD will complete its function and lift doors open at designation floor to evacuate the passenger. Thereafter, Elevator designated by the authorized person may resume operation depending on the capacity of emergency power. As a backup to ARD, manual rescue arrangement shall be provided. Manual rescue operation shall be possible even when Total load of Lift car with passengers becomes equal to the load of counter weights (i.e balanced load conditions). Further, a separate arrangement / device should be provided to rescue the passenger in any condition (Load balancing of lift , electrical failure in lift etc.).

19.2 **Emergency Operation of Elevator in the Event of Fire**

In the event of fire when any fire detection device is activated, the Elevator shall automatically be brought to the Ground Floor or as per requirement of Employer and shall park there with the doors open for 15-20 seconds and then close. Elevator shall automatically be rendered inoperative after it has been brought to the designated floor. The essential buttons such as "Door Open", intercom and alarm bell etc on the car operating panels shall remain functional and illuminated. Normal operation of the elevator shall be manually reset by the operation of a reset switch.

19.3 **Emergency Operation of Elevator In the Event of Power Failure and Fire**

In the event of power failure and fire, the operation of the Elevator shall be in accordance with the "Emergency Operation of Elevator in the Event of Fire" and the power supply shall be from the emergency supply panel at the stations.

19.4 A battery back-up device to home the Elevator to the landing in the event of power failure shall be provided. This shall be battery operated and shall be able to move the elevator with any load from no load to full load at reduced speed to the landing and open the doors, which shall be achieved by provision of ARD (Auto Rescue Device) and BDT (Battery Drive Tool) or ERT Electrical Rescue Tool). The elevator door shall remain close until resumption of power supply and the Elevator shall automatically reset to normal. The direction of travel shall depend upon the load in the Elevator which shall be provided by defining different loading conditions such as more than 50% / less than 50% / at 50%. During this operation all safety features of the Elevator shall remain operational. The rescue time of the device from the time of power failure to the time the doors fully open shall not exceed two minutes. However, the ARD start time can be adjusted from 10 to 30 seconds depending upon resumption of emergency supply from alternative source/ Gensets. The requirement of ARD will be finalized during the design stage depending upon availability of power from Genset. The landing accuracy shall be less than +/- 10 mm. The capacity of the battery when fully charged shall be capable of operating the Elevator at rated load from one landing to another for a minimum of 6 trips without further charging. To ensure the same new battery shall be capable to perform the test for 6 trips without intermediate charging at the time of commissioning. The battery shall be housed in a cabinet/ rack with a corrosion proof finish. The health of battery and inverter shall be monitored continuously and in case of any problem, elevator shall go to home landing and park there keeping doors open and “out of service” shall be displayed. The device shall immediately stop the Elevator and prevent its further immediate movement, if there is a short circuit or open circuit in the inverter output. The rating of the battery and inverter shall be approved by the Engineer during the design stage. The power supply indication in MCB for ARD shall be of red colour to property distinguish it from other power supplies in MCB’s. Over and above the ARD system, a manual lever and push button shall be provided for manual rescuing.

This device shall not modify the Elevator design and all its original safety features. The device shall be an additional accessory to the Elevator and shall not in any way affect the performance of the Elevator.

The performance of the charger and charging rate shall be equivalent to that of the UPS unit. Maintenance free batteries conforming to the relevant Indian or international standard shall be provided.

20 Elevator Monitoring and Fault diagnostic system

An Elevator monitoring and fault diagnostic system shall be provided for each Elevator by the Contractor. This system shall provide an auxiliary output port on the controller for plugging the laptop and USB for downloading historical data, the exact requirement of which shall be reviewed at design stage.

21 Pit Facilities

21.1 Spring buffers shall be provided in the Elevator pit.

21.2 A safety switch to prevent the car from moving when the governor rope tension weight is out of position shall be provided.

21.3 Fixed cat ladders shall be provided between the bottom landing and the pit floor by the Contractor.

21.4 Two stop switches, one at bottom landing level in the shaft and the other in the pit shall be provided, which, when in the "STOP" position, shall prevent any movement of the elevator car including movement during inspection operation, until both the switches are set in the "RUN" position. The switch shall have a mushroom head (red). It shall be locked off when pushed and reset manually.

21.5 First stop switch shall be accessible from the lower landing on opening of the landing door and the second switch from the pit floor. A stainless steel faceplate of not less than 2 mm in thickness, indelibly marked “Pit Stop Switch" in both English and Hindi characters and with legends to show the "STOP" and "RUN" positions shall be provided and fixed immediately adjacent to the switch. The knob of these switches or plate shall have Luminous Paint.

21.6 The Contractor shall do all necessary interfacing for ensuring proper drainage system. Designated Civil Contractor shall provide drainage. Ensuring of the proper drainage of Lift Pit, Lift Shaft/Roof shall be the Contractor’s responsibility before starting the installation.

22 Corrosion Protection

The Contractor shall take into Consideration, the corrosive effect of the atmosphere in the Elevator design.

22.1 All steel components shall be hot dipped galvanized in accordance with IS-4736, IS-4826, BS 729, with minimum thickness of 85 micron.

22.2 All mechanical and cast iron assemblies shall be cleaned and painted. The running surfaces of car guides shall be treated with an accepted rust preventive compound.

22.3 All parts constructed in sheet steel shall be either galvanized by the hot dipped process or fabricated from hot dipped galvanized sheet steel.

22.4 All hardwire, fastenings, screws and shims shall be hot-dipped galvanized. However, all visible screws and fastenings shall be of stainless steel. Epoxy painting will be permitted only on-site damage repairs only with the approval of the Engineer.

22.5 Wherever galvanization on ferrous components has been damaged in handling the same shall be given two coats of zinc chromate primer and two coats of aluminium paints conforming to IS 2339.

22.6 The contractor shall provide all parts, hardware fastenings, screws, components, assemblies, and shims confirm to latest Indian Standards.

22.7 Galvanization shall comply with the standards mentioned below: -

Specification	Description
ISO 1459	Metallic Coatings - Protection against corrosion by hot dip galvanizing - Guiding Principles.
ISO 1460	Metallic Coatings - Hot dip galvanized coatings of ferrous materials - Gravimetric determination of the mass per unit area.
ISO 1461	Hot dip Galvanized coating fabricated ferrous products Specification.
ISO 2064	Metallic and other non-organic coatings - definitions and conventions concerning the measurement of thickness.
ISO 2177	Metallic Coatings measurements of coating thickness - coulometric method by anodic dissolution
ISO 2178	Non-magnetic on magnetic substrates - measurements of coating thickness - magnetic method.
ISO 2859	Sampling procedures and tables for inspection by attributes

23 Provision for the Differently able persons

The Elevator shall be provided with following features**:**

(a) Elevator control buttons at locations and height specified in IS 15330.

(b) Hall call buttons at locations and height specified in IS 15330.

(c) Handrails, straight through type, having minimum 3 supports, shall be provided on the side wails of the Elevator at height and locations specified in IS: 15330. An international symbol of access of the differently able shall be permanently and conspicuously displayed at each and every Elevator landing next to the Elevator entrance. The Signage is to be made part of the Architrave work. Braille notations indicating the floor levels shall be incorporated next to each button at the handicap COP and handicap hall call buttons.

(d) A digital voice system for announcing the car position, opening/closing of doors, direction of travel and messages shall be provided as per IS: 15330.

(e) A laminated framed safety mirror of at least half of the size, shall be installed on rear panel of both glass and stainless-steel car door type elevators at appropriate position. To facilitate easy reversal/ exit of person on wheelchair from the elevator without the need rotating the wheel chair in the elevator.

(f) Kick Plate at Skirt Level on all three sides of Car Panels shall be provided to protect the Car Panels from Wheelchair contact.

24 Miscellaneous

24.1 Circuit, wiring diagrams shall be provided for all electrical circuits. They shall be in A1 size paper suitably treated to prevent deterioration from dirt or age.

24.2 A data plate shall be attached to the cross-head members of the car frame giving the following information: -

a) Contract load of the Elevator.
b) Speed of the Elevator.
c) Year of manufacture.
d) Name of Manufacturer

A Do's and Don'ts instruction plate shall be provided only after approval of Employer. There shall be two different plates, one outside and one inside the car. These plates shall be very friendly and simple.

The instruction plate inside the car shall be provided for guiding the passenger how to act at the time of lift stopping.

24.3 Special tools required for the operation, servicing, maintenance and repair of the Elevator shall be provided along with each elevator and the cost of such tools is included in the elevator cost.

24.4 Fault diagnosis procedures and circuit diagrams of the printed circuit board, detail information, software and technical data shall be provided to assist in trouble shooting for breakdown during normal operation and maintenance.

24.5 A maintenance barrier shall be provided for elevator landing entrance which shall prevent people from entering the elevator car. The barrier shall be painted yellow, made from stainless steel and be of minimum height 900 mm. The barrier shall be on wheels with lock and easy to handle and shift over a distance of 100 m with one person. The design of maintenance barriers shall be approved by the Engineer before it is delivered at site.

The contractor shall ensure that there is no water seepage inside MAP and elevator car even due to heaviest of rain.

24.6 Provision of supplying and installing signage at each landing shall be provided by the Contractor. The signage at each landing shall be flushed into the landing architrave panel. Architrave Signage's shall be LED based, and their cable shall be FRLSOH. Design and its fitment will be approved during design approval stage.

24.7 The Contractor shall ensure that the architrave supplied by him matches with the stone cladding (provided by civil Contractor) at each landing of the elevator.

24.8 The Contactor shall supply and install the Indication board and board for differently able commuters on the architrave.

24.9 **Accessories**

Each Elevator shall be provided with the following accessories:
a) Two sets each of all necessary keys for the landing door, operating panel, attendant key etc.
b) Two sets of maintenance barrier.

25 Earthing of elevator

The Elevator shall be provided with earthing arrangements by the Contractor as per the following specifications :-

IS – 3043; latest version.
Indian Electricity Rules; latest version.
IS – 14665 Part-2; latest Version.

Necessary earthing arrangement shall be got approved from the Engineer by the Contractor.

26 Special Requirement for Elevator with car and landing doors made of glass panels with stainless steel hairline frame.

26.1 Detail design of the elevator of Glass door with stainless steel hairline frame shall be carried out by the Contractor and reviewed without objection by the “Engineer" before fabrication.

26.2 Prototype landing and car doors made of glass panels with stainless steel hairline frame shall be pre-assembled in factory for inspection before delivery.

26.3 Car roof shall be stainless steel cover panels exposed to public view with a collapsible maintenance platform or any other suitable arrangement with "Engineer’s" approval above. It shall be able to sustain two persons and be able to resist a vertical force of 2000N at any position without permanent deformation. Permanent, hinged, and foldable safety balustrades or any other suitable arrangement with "Engineer’s approval forming an integral part of car top maintenance platform shall be provided. The design shall be subject to the review of the Engineer.

Glass shall comply with the following requirements:

(a) General

(i) All glass shall be clear float glass.
(ii) Glass thickness shall not be less than 10 mm with manufacturing tolerance as per IS-2553 Part-1. The selection of glass thickness and type shall be in accordance with the information contained in BS : 6262, BS 952: Part 1, BS: 6206 and European Standard EN-81, Annex J or equivalent international standard.
(iii) Particular regard shall be given to adequacy of glass thickness to withstand the calculated design loads and types of location to satisfy safety recommendations. Any reduction in strength characteristics due to acid etching, etc. shall be taken into account.
(iv) Where the edge of laminated glass is to be exposed, the interlayer material must be shown to be resistant to the effects, including clouding and delaminating of moisture absorption and contact with normal industrial strength cleaning solutions.
(v) The Contractor shall conduct a thermal stress analysis of the glazing system, undertake thermal calculations and make due allowance for toughened glass.
(vi) All glass shall be manufactured end processed in a factory where the quality control procedures comply with ISO 9000 (BS 5750, or equivalent international standard) and are independently maintained.
(vii) No glass shall be used which contains scratches, chips, bubbles or other blemishes which are likely to lead to failure at loadings less than which the unit is designed to withstand.
(viii) The glass shall be free of all discernible body and surface faults, and no glass which exhibits discernible optical or reflective distortions shall be used.
(ix) Unless reviewed without objection by the "Engineer”, all glazing shall be marked with permanent identification in accordance with BS 6206, and in a position visible but not prominent at the bottom left-hand corner of the glazing unit.
(x) Glazing shall be provided with edges that are ground, have a frosted appearance and arises chamfered and polished.
(xi) Toughened glass shall be tempered on a roller hearth furnace and shall conform to Class 'A’ Classification of BS 6206 or equivalent international

standard. Vertical toughening shall not be permitted Glass panel of landing door shall have minimum one hour fire rating.

(xii) All toughened glass shall be heat soak tested to prevent the risk of spontaneous glass breakage due to nickel sulphide inclusions and other impurities. The method of heat soak testing shall be determined by the glazing manufacturer, such that after testing the probability of failure in service shall be less than one in 130 tonnes of glazing. The Contractor and glazing manufacturer shall after testing, demonstrate by statistical analysis of test data that the probability of failure is not greater than the specified value.

(xiii) All edgework, holes and notches in the toughened glass shall be completed before the toughening process.

(xiv) Permissible roll distortion inherent in toughened glass shall be restricted to the horizontal plane when glazed/ installed and local defects such as tong marks shall not be permitted.

(xv) Dimensional tolerance on panel size shall be ±1 mm of the theoretical dimension required.

(b) Glass to door elevator cars is to meet the following performance criteria:

(i) Laminated glass with one pane of toughened glass and one pane of heat strengthened glass.

(ii) Glass panels to be capable of resisting applied loads when supported at each corner by a bolt fitted within a hole drilled in the glass. The details shall be reviewed by the "Engineer":

Applied loads:

Dead	Self-weight of glass. Dead loads imposed by adjacent glass panels (if any).
Live	Normal to panel 0.75 KN/m². Live loads 0.75 KN/m^2 @ mid pane.
Impact	Equivalent to 50 Kg baggage trolley @ 1.8 m/sec.

(iii) Laminated toughened glass shall be capable of resisting point impacts, to the toughened face, equivalent to an 85 mm hardened steel ball freely dropped from a height of 3 m, carried out in accordance with BS 5544.

(iv) The glass shall remain in place if either one or both panes break.

(v) The glass shall be free of bow sufficient to cause visual distortion when viewed normal to glass.

(vi) Maximum deflection under applied loads 15 mm.

(vii) Statistical/failure rate of glass under normal operating load <0.4%.

(c) All glass shall be marked to identify that it has been tested and inspected to manufacturer's standard which is reviewed without objection by the Engineer.

(d) The tolerance of glass shall be within:

i. Panel size + 3 mm.
ii. Step in laminated edge + 3 mm.
iii. Bolt holes position + 2 mm.

(e) A typical 5 mm gap shall be allowed between adjacent glass panels and between edges of glass panel and stainless-steel comer. The gaps shall be sealed with a suitable sealant material. Extent of seal shall be from the base of the floor to the top of the glass walls. All areas of glass edges subject to contact with the sealant shall be treated with a separator chemical to mitigate the chemical reaction between the Polyvinyl Butyral (PVB) interlayer and sealant. The Contractor shall conduct standard test from the glass manufacturer to demonstrate compatibility between sealant and PVB interlayer, the width of edge de-lamination is not to exceed 1 mm under simulated exterior exposure for a period of 2½ years.

27 Special Cable Requirements

27.1 All cables used except those within the enclosed controller shall comply with the following requirement: -

(a) All Control cables shall rated for minimum grade of 650V and all power cables for minimum grade of 1100 V.

(b) In case of 24V DC, insulation rating of Cable shall be minimum of 250V.

(c) The conductor shall be of stranded conductor composed of plain annealed copper wire complying with IEC 228, Class 2.

(d) The insulation shall consist of an extruded layer of cross-inked polyethylene (XLPE) complying with IEC 502.

(e) All cables shall be manufactured from fire retardant, low smoke, halogen free materials (FRLSZH) for lifts.

27.2 Fire retardant, low smoke, halogen free materials shall meet the following requirements: -

(a) London Transport Executive Three Metre Cube Smoke Emission Test, using optical measuring instruments. The maximum value of absorbance AO (ON), AO (OFF) shall be 0.8 & 1.2 respectively.

(b) The US National Bureau of Standard Smoke Chamber Test, used to evaluate plaque samples or materials of constant thickness (NFPA-258 Smoke Generation of Solid Materials 1982). the maximum specific optical density shall 170 under the non- Polluted Condition.

(c) The flame propagating criteria of US IEEE Standard 383 with a minimum test short circuit time of five minutes in the IEEE standard 383 test.

(d) IEC 332 Parts 1 and 3, Category ‘B', tests on single and bunched cables under fire conditions.

(e) Limiting Oxygen Index of at least 30, to ASTM D-2863.

(f) A temperature index (TI) of 260°C to ASTM D-2863.

(g) All insulation is to be moisture and heat resistant, with temperature ratings appropriate to the application conditions, and in no case lower then 90°C.

(h) When a sample of the cable is subjected to a combustion test for the determination of the amount of halogen acid gases (other than hydrofluoric acid) as set out in IEC 754 – Part-1, the halogen acid evolved shall not exceed a maximum of 0.5%.

The above tests shall be certified from Independent Test Lab and submitted within one and half year from the date of issue of the LOA. These tests shall be witnessed by Engineer and/or Employer's representative.

27.3 The above requirements shall be met without compromising the anti-termite, pest-resistant mechanical and electrical properties of the cables both during and after installation to meet the other requirements of this Specification.

28 Noise Generation

28.1 The whole of the elevator assembly, including the opening and closing or the car and landing doors shall be quiet in operation and shall be free of rattling or squeaking noises. Elevator door operation shall be smooth to avoid the transmission of impact noise to the surrounding structure.

28.2 Noise levels resulting from the operation of the elevator, including direct sound transmission, breakout noise and re-radiation of structure borne noise shall not exceed 55 dB(A) (fast response) at 1.5 m from the elevator shaft and 1.5 m above the floor.

28.3 Machinery noise level under normal operating conditions shall not exceed 70 dB(A) at 1 m from the equipment in free field.

28.4 The total noise level in a moving elevator car shall not exceed 55 dB(A) with ventilation fan operating.

29 Ride Comfort Parameters:-

a) Apart from noise (whose permissible value is mentioned above), lateral quaking, acceleration, jerk and vertical vibration are the other parameters based on which 'Ride Comfort' and its quality is measured. These parameters are defined below (definition as per ISO 18738): -

i. Lateral Quaking	A sideways acceleration/ deceleration measured in gal
ii. Acceleration/ deceleration	A rate of acceleration/ deceleration measured on the z-axis velocity and expressed in metres per second squared (m/s^2).
iii. Jerk	The rate of change of z-axis acceleration/ deceleration, attribute to lift motion control and expressed in metres per second cubed (m/sec^3).

b) The contractor by performing suitable tests as per ISO 18738 shall ensure that following permissible values above parameters shall be achieved for satisfactory ride comfort quality: -

S. N	Ride Comfort Parameter	Unit	Permissible value
1	Maximum Lateral Quaking (in any of X or Y direction)	Gal	12 Peak - Peak

2	Acceleration/ deceleration (adjustable)	m/s^2	0.5
3	Maximum Jerk	m/s^3	2.0
4	Maximum Vertical Vibration (in Z direction)	Gal	20Peak-Peakk (1-100Hz)

Note: - The permissible values given above for various 'Ride Comfort Parameters' are indicative only. The actual values shall be those prevailing in elevator industry at the time of commissioning of the elevator and the contractor has to ensure that those values are achieved.

c) The Contractor shall submit the "Ride Comfort Report" whose acceptance shall be subject to Engineer's approval.

30 (1) The Contractor shall provide Seismic Operation Control system with primary wave sensor for the Lifts measurable in Richter scale. These shall be integrated with Seismic operation control device through RMS/ISMS System. Upon detecting such wave, the equipment shall direct all the Lift cars in the station/building to the nearest floor and immediately open doors for safe exit. The lift shall only be reset manually after the signal is clear and the lift has been inspected by the maintenance personnel. Minimum One number of primary wave seismic sensors shall be provided in each station/building.

(2) Upon Detection of a Seismic wave, a signal to be sent to the Central Monitoring System. Display on car operating Panel/ RMS & voice announcement shall be commenced during this operation.

(3) Seismic risks should be considered, and special supports shall be provided, wherever required.

(4) Earthquake Design: Apart from earthquake rescue system, the elevator vendor shall provide rope and counterweight retaining brackets, Counterweight displacement detector with low voltage wire, anti-snag guards to prevent swinging ropes and traveling cables from hanging up. Once earthquake shock waves have ceased, the elevator hoist way should be inspected for any displaced equipment before placing the elevator in operation.

31 SPARES

The Contractor shall supply the following spares for elevator:

List of Spares for Lifts

S.No	Description	Unit	Quantity
1	Brake Release Cable	Nos.	1
2	Door Belt	Nos.	1
3	Door Contact Switch	Nos.	1
4	Door Contact Bullet	Nos.	1
5	Track Roller for car & landing (Open End) and (close End)	Nos.	1
6	Synchronization Roller Landing (LH and RH)	Nos.	1
7	Synchronization Roller Car (LH and RH)	Nos.	1

S.No	Description	Unit	Quantity
8	Door Glide Roller	Nos.	1
9	Photocell	Nos.	1
10	Rope for Closing Weight Assembly	Nos.	2
11	Rope for Synchronization - Car	Nos.	1
12	Rope for Synchronization - Landing Door	Nos.	1
13	Anti-Lift Roller	Nos.	1
14	Main Steel Rope	m	50
15	Emergency key	Nos.	2

The spares mentioned above shall be used for the lift and shall be supplied by the Contractor and the price of these spares is included in 13 Passenger (G+5) elevator price in the BOQ and no extra payment shall be made to the Contractor.

32 TESTING AND INSPECTION

32.1 General

(1) As part of the preliminary design submission, the Contractor shall submit to the “Engineer” for acceptance a schedule of tests giving full details of all tests to be carried out.
(2) Tests at places of manufacture shall be witnessed by the “Engineer" shall be grouped together, so far as can be arranged, so that as many tests as possible can be witnessed on each visit.
(3) The Contractor shall prepare and forward to the "Engineer" one original and four copies of all Test Reports as soon as practicable after completion of each test whether witnessed by the “Engineer" or not. All test data shall be certified by the Contractor's Engineer approved by the Engineer.
(4) The Contractor shall perform all applicable test specified in these specifications as per relevant standards. Any test required as per the applicable safety standards but not specified in this specification shall be performed without any extra cost.

32.2 General Requirements for Type Tests and Acceptance Tests

(1) The Contractor shall provide details of any type and acceptance tests, which have been carried out on equipment offered, or any additional tests he recommends.
(2) In general, certificates of previous type tests may be accepted at the discretion of the “Engineer”, provided that they are for identical equipment and conditions. Where appropriate, new and/or modified components to meet the requirements of this specification shall be made available for type testing.
(3) All applicable Type tests as per the relevant standards on equipment shall be carried out strictly as specified in the Specification and procedure of testing shall be submitted to "Engineer" for No Objection.
(4) The "Engineer" shall have right to witness tests and inspections on individual materials, components, or sub-assemblies.
(5) At the conclusion of all type tests, the Contractor shall compile all the test data together with any observations made during the tests, file them into a type test binder and submit it to the "Engineer" tor acceptance and record.

32.3 General Requirements for Tests during Manufacture

(1) The Contractor shall carry out all applicable tests during manufacture as specified and propose any additional tests to be carried out as per relevant safety Standards. These tests shall be subject to the acceptance of the

"Engineer". Routine tests shall be integrated with the manufacturing programme. The "Engineer" shall, at his discretion, witness the routine tests during the period of manufacture, or accept the records of the Contractor's in-house quality control scheme where appropriate, as sufficient evidence for the execution of the routine tests.

(2) Routine tests shall be carried out strictly as specification.

(3) On completion of the manufacture of items or sub-assemblies, and following completion of the manufacturer's own tests and inspection, the "Engineer" shall be invited to witness such tests as he deems appropriate. The Contractor shall schedule the routine tests to meet the manufacturing programme, whether or not the 'Engineer" will be present at the tests, provided advance notice has been served to the "Engineer" at least 30 days in advance.

(4) The "Engineer" will determine and advise the Contractor of those tests where certification by the manufacturer may be acceptable in lieu of witnessed tests.

(5) Before equipment is dispatched, the "Engineer" shall issue No Objection for acceptance of the test certificates releasing such equipment from the place of manufacture or test.

(6) Methods of packing and shipping shall be as specified in the Employer's Requirements, the "Engineer" reserves the right to visit the manufacturers' or packers' premises to ensure that accepted methods are employed.

32.4 Test Specification

(1) The Contractor shall submit for acceptance by the "Engineer", test specifications for type tests, routine tests, tests on site, final acceptance tests and commissioning. The specifications shall detail the methods of conducting the tests, the tools and instruments used. Reference to the accepted documents and drawings shall be included in these specifications. The records/results shall be tabulated in a prescribed format applicable to this Contract.

(2) Nothing in this Specification shall: prevent the "Engineer* from calling for extra tests.

(3) These test specification shall include the design values of all quantities to be verified, with allowable tolerance or limits. Summary drawings or diagrams shall be included with the test specification to show the dimension and tolerances of all structural assemblies and sub-assemblies. In the case of welded fabrications, key diagrams giving all weld data shall be provided to enable systematic inspection to take place.

(4) Verification of accuracy shall be required for all tools apparatus, testing jigs, measuring instruments and 'go' or 'no go' gauges used for the purpose of routine tests. Calibration certificate of testing equipments and tools shall be submitted along with test reports.

(5) All test instrument shall be calibrated not more than one year prior to their use. The Contractor shall submit calibration certificate or other documents for proof of compliance.

32.5 Testing of Materials and Details

(1) Where materials or components used in this Contract are not covered by separate test specifications, samples of such material or up to two per cent of such components shall, if desired by the "Engineer" be tested at the Contractor's expense at an approved laboratory.

(2) The Contractor shall supply the material required for testing free of charge and shall supply and prepare the necessary test pieces, labour, and appliances for making all tests, and for carrying out all gauging and weighing on his premises in accordance with the terms of this Specification. If the Contractor Is unable to provide approved facilities at his own factory for making the prescribed tests, the Contractor shall bear the cost of carrying out the tests elsewhere, at a place subject to the "Engineer" acceptance. Such radiographic examination of welds or castings as the "Engineer" deems necessary shall be carried out.

32.6 Elevator Prototype Tests

(1) One complete Elevator shall be available for the commencement of witness testing after Contract Award. The selected Elevator shall be representative of their various types.

(2) A complete Elevator system including traction drive system, in addition to the controller, Elevator car enclosure, landing and car doors, protection devices and call fixtures shall be assembled on a test rig or inside a test tower to undergo a comprehensive running and functional testing in accordance With the accepted test specification to verify compliance with the Specification.

(3) The tests shall include the following minimum requirements.

a) Verification of the suitability of the traction drive system, its efficiency, etc.
b) Verification of the car operation and response to call fixtures, door operation including the safety edges all indications and signalling features, and car top control features.
c) Weight tests on safety gear and measurement of electrical readings and verification of the operating speed under various loading conditions.
d) Verification of riding comfort and levelling accuracy under various load conditions.
e) Verification of the fault indication and fault diagnosis features.
f) Verification of the construction of the various Control panels to the specification shall be done. Insulation resistance and high voltage tests shall be conducted in accordance with the test specification.
g) Any additional testing as required by BS 5655 Part 10.
h) A 12-hour duty cycle test, during which the Elevator shall run continuously with the contract load for 12 hours and shall travel up and down with intermediate stops with the number of starts per hour as specified.
i) Complete functional tests on the isolating transformer and ripple filter.
j) Operation of the battery back-up device and the battery-operated power supply.

k) Simulation of the emergency homing sequence during fire and power failure.

32.7 Elevator Type Tests

(1) Driving Mechanism

One unit selected by the “Engineer” for each range of duty of the driving machines provided for in this Contract.

Scope of Tests

a) Dimensional Checking

Dimensionally check gear assembly backlash and shaft end float as follows:

i) Backlash with four consecutive 90 turns, in the same direction of the input shaft.

ii) Backlash with four consecutive 90 turns, in the same direction, of the output shaft.

iii) Input shaft end float where applicable.

iv) Eccentricity of shafts on ground section adjacent to glands or oil seals.

v) Output shaft end float.

b) Dynamic Tests

The input shaft shall be turned a sufficient number of revolutions to establish the position of the contact area prior to the dynamic tests.

The test machine shall be run at simulated full toad conditions at contract speed continuously for 8 hours, 4 hours in each direction.

The following temperatures are to be recorded prior to the run, during the run, at 30-minute intervals and on completion of the run: -

i) Oil

ii) Input shaft bearing (drive end)

iii) Input shaft bearing (non-drive end)

iv) Output shaft bearing (output side)

v) Output shaft bearing (non-output side)

vi) Gear casing

vii) Motor casing

viii) Ambient

The temperature of the rim on the gear of the output shaft shall be recorded prior to the run and immediately on completion in each direction.

The contact area of the gears shall be checked on completion of the run in each direction. This shall demonstrate that the wear pattern is forming in a correct manner.

The machine shall also be run under no load and at test load conditions at full speed in each direction for a sufficient period to record the maximum vibration amplitudes at: -

i) Mounting points

ii) Bearings

c) Verification of Efficiency

The overall efficiency of the machine shall be verified by calculation from the results of the tests.

(2) Motor

Frequency of Tests

One unit selected by the “Engineer” for-each range of motors supplied for this Contract.

If the quantity of the same range of motor exceeds forty, an additional motor shall be selected from the second batch by the "Engineer" to repeat the same tests described below.

If a separate motor is used for achieving maintenance speed, the same requirements shall also apply to the maintenance motors.

in general, all tests shall be conducted in accordance with the relevant parts of BS 4999.

Scope of Tests

a) Insulation Test

i) Insulation resistance of windings, using 1000V megger, shall not to be less than 200 M Ohm.

ii) Insulation resistance of thermistors, subject to 1000V for 5 seconds, shall not be less than 200 M Ohm. Windings shall be earthed.

iii) Main and slow speed winding shall each be pressure tested to 2000V rms for 60 seconds. During this test, thermistor wires shall be grounded to earth.

iv) Cold resistance of both high and low Speed Windings shall be recorded.

b) Dynamic Tests

i) No load current and speed shall be recorded at rated voltage and frequency for both high and low speed windings.

ii) Full load, 75%. 50% and 25% load, tests shall be carried out on both high and low speeds at rated voltage and frequency. Current and speed shall be recorded for each test. Input power, efficiency, slip and power factor shall be established and recorded for each test.

iii) Temperature rise test on full load shall be carried out on high speed windings only. Voltage Shall be 440V. Frequency shall be as rated.

iv) Ambient air outlet, casing, output power and temperature shall be recorded at 15-minute intervals for the first two hours and 30-minute intervals subsequently until temperature levels off.

v) Voltage, current, frequency, output power and temperature shall be recorded at 15-minute intervals for the first two hours and 30-minute intervals subsequently until temperature levels off.

vi) When the temperature has levelled off, the motor shall be switched off and the winding temperature rise shall be established using the resistance method as specified in BS 4999 Part 101.

vii) A momentary overload of 200% full load shall be applied for 15 seconds. The motor shall not stall or abruptly change speed.

viii) A locked rotor test shall be carried out at rated voltage and frequency for both high and low speed windings. Current and torque shall be recorded in both cases.

ix) The speed/torque characteristic and the starting current characteristic shall be produced from the results obtained.

(3) Controller

Frequency of Test

One of each type of controller shall be type tested.

Scope of Tests

a) Physical Construction Checking
The construction of the control cubicle shall be checked as per the approved drawings. Facilities to padlock incoming fused isolator shall be checked. Verification of the protection classification shall be conducted and/or provided.

b) Pressure Test

i) Earth leakage circuit breakers shall be tested on both poles. The current and time required to trip shall be recorded. Similarly, the dc earth leakage unit shall be tested and values to be recorded.

ii) Pressure testing at 2000V ac rms for 60 seconds between: phase to phase and phase to earth.

iii) Control wiring itself shall be Pressure tested at 1500V ac rms for 60 seconds between control/auxiliary wiring and frame. Insulation tests shall be carried out before and after the above tests by a, 1000V insulation tester. The insulation resistance thus measured shall not be less than 200M ohm.

iv) All protection on electronic circuits shall be tested by a 500 V installation tester.

(v) Wiring to all electronic components shall be meggered. Megger setting shall be at the discretion of the "Engineer".

(vi) Verification of the protection circuit shall be carried out in accordance with the approved procedures.

Temperature rise during the tests shall be recorded and verified.

(4) Braking System

Frequency Of Test

One of each type of brake provided shall be required to undergo type testing.

Scope of Test

A full dimensional check shall be carried out to verify compliance with the manufacturing drawings and a full functional test shall be carried out. A demonstration of brake adjustment and setting shall be carried out.

(5) Elevator Inter-communication System

Two of each type of Elevator-Inter-Communication Systems shall be type tested. A full functional test shall be carried out to verify compliance with the specification. The tst results shall be recorded.

32.8 Elevator Routine Tests

The following are the minimum requirements of the routine tests.

(1) Driving Machines

Random Check

Verification of the insulation resistance of the windings using a 1000 Volts megger test. A high voltage test to 2000 Volts rms for one minute of the stator winding shall be conducted.

A dynamic test for every driving machine shall be conducted for a period of 4 hours continuously without stopping, except for changing of direction, 2 hours in each direction, at contract speed and 25% load conditions. The test is to ensure no undue vibration or abnormal temperature rise occurs in any component.

(2) Power unit

100% check:

The assembled power unit shall be checked in accordance with the accepted test specification along with surge protectors, power filters, etc.

(3) Main Control Cubicle

100% Check:

The complete control cubicle shall be checked with a simulator to verify correct wiring connection and function of the electrical/ electronic devices.

Verification of the insulation resistance of the control wiring and electronic components shall be conducted in accordance with the accepted tests specifications.

(4) Call Button and Fixtures

Random Check:

The call button shall be checked at random to confirm the manufacturing quality.

The assembled fixtures shall be inspected and functionally tested accordance with the accepted test specifications.

(5) Hoist Rope/belt

A manufacturers' certificate or sample test shall be acceptable to the "Engineer".

(6) Safety Gear

Manufacturer's certificate or test report on the assembly shall be accepted by the "Engineer".

(7) Car Enclosure and Door Assembly

Random Check:

(a) The assemblies shall be checked at random to ensure the correct dimensions and layout. Quality of the finishing shall be inspected to ensure the correct type of materials have been used for fabrication.
(b) Protection of the finished assembly shall be inspected in accordance with the accepted test specifications.
(c) For Glass Elevator, the Contractor shall fabricate and erect a prototype Glass Elevator and carry out strength, deformation, and stability testing compliance with European Standard EN 81. In addition, the assembly shall be subject to pendulum impact test according to DIN 52337 with the following fall heights.
(d) Fall height 0.7m, pendulum impact test with a soft impact body (PW), (sack filled with 45 kg of shot):

(e) Fall height 0.5m, pendulum impact test with solid impact body (PH), (pear-shaped steel ball 10kg).

(f) The Contractor shall provide certification of the test results. Only the complete absence of breakage, permanent deformation, delimitations, dislodging of panels or fixings, and loss of stability will result in a successful test finding.

32.9 Elevator Site Checking and Inspection

A test and inspection specification shall be prepared for each of the following critical phases of works. Forty-eight hours' notice is required prior to completing these phases to enable the "Engineer" to carry out any checks he deems necessary. The following are the minimum requirements:

a) Setting out the plumb lines.

b) Erection and alignment of guide rails, rail brackets.

c) Erection and alignment of landing doors, jamb, sills, header etc.

d) Erection of Elevator shaft and Elevator pit equipment.

e) Erection of car enclosures.

f) Positioning of machine equipment and control cubicles.

g) Installation of the hoist ropes and governor rope.

h) Erection of landing fixtures and car fixtures.

i) Installation of hoist way and machine room trunking prior to installation of wiring.

j) Installation of wiring and cabling

k) Installation of car fixture and car top equipment.

l) Earthing and bonding checks

32.10 Elevator Commissioning and Acceptance Tests

(1) Tests shall be carried out on each Elevator in accordance with the relevant portions of BS 5655, which shall include but not be limited to the following: -

(a) Readings on starting current, running current and supply voltage shall be taken at the rated speed of each Elevator in both directions of operation under no load, 20%, 40%, 60%, 80% and full load conditions.

(b) Both power and control wiring of the controller shall be tested between lines connected together and earth at 1000V 50Hz. This voltage shall be applied and maintained for one minute. The control wiring shall be separately tested between poles and earth immediately following each test a 1000 Vdc. Insulation tester shall show an insulation resistance of not less than 3 M ohms. All field wiring withstands a 1000V megger test on site and each conductor shall show an insulation resistance to earth of not less than 3 M ohms.

(c) The overspeed governor shall be tested to ensure that it will activate when the speed exceeds 40% of the nominal speed.

Functional tests on the safety gear with no load at rated speed by manually tripping the governor.

The Elevator car shall be operated up and down several times Including tests to demonstrate the levelling operation.

(d) Test on the car and landing doors system

i) Checking of the condition of the landing and car door roar smooth operation.

ii) Functional tests on the door closing time, door speed, re-opening, safety edge, proximity detection landing and car door contacts of the door lock.

(e) Functional tests on all the landing call buttons, indicators and all function provided in key-switch operated cabinet mounted below the car operating panels.

(f) Functional tests on the emergency call buttons.

(g) Functional tests on the final limit switches, terminal slow down and terminal over travel limit switches.

(h) Functional tests on the following safety switches and devices: -

i) Overload device.
ii) Phase protection device.
iii) Anti-creep system.
iv) Emergency lowering and raising devices.
v) Pipe rupture device.
vi) Over current protection device.
vii) Counterweight safety (if applicable)
viii) Remote Monitoring System (RMS)

(i) Functional test on the car top maintenance panel.

(j) Testing of the Intercom system.

(k) Compress buffer test.

(l) Running clearance tests.

(m) Functioning test of Elevator management, monitoring and fault diagnostic system.

(n) Noise/ sound level test of equipment and installation.

(o) Functional tests of battery backup device.

(p) Complete function tests-on track machine, motor brake and control equipment.

(q) Floor levelling accuracy and re-levelling at different loads.

(r) Tests on Emergency Power and Fire operation.

Temperature readings of elevator controller and equipment shall be taken every fifteen minutes for at least 2 hours or the duration of test whichever is longer.

(s) Functional tests of all features and functions not included in the above but required in the Contract.

(2) Twelve Hour Run

Each Elevator shall be subject to a 12-hour duty cycle test, during which the Elevator shall run continuously with the contract load for 12 hours and shall travel up and down with intermediate stops such that the number of starts complied with the specification.

32.11 Interface and Integrated Tests

The Contractor shall co-ordinate and carry out interfacing and integrated testing together with other concerned Contractors to ensure that the all integrated systems function as desired.

32.12 Certificate of Taking Over

The final acceptance tests of each item of equipment shall be undertaken in the presence of the "Engineer" in accordance with the test specification. Any defects and/or deviations discovered without prior written approval during the tests shall be rectified at the Contractor's own expense. These shall be entered into a defect list agreed between the Contractor and the "Engineer". The Certificate to Taking Over will not be issued until these tests have been completed and the defect list substantially reduced to such an extent that the "Engineer" considers that the equipment is safe for operation.

32.13 Certification

Upon completion of each Elevator testing, the Contractor shall submit to the Employer, a Certificate of Supervision issued by the Contractor's Professional Engineer, in a format acceptable to the "Engineer".

33 Training Resources: -

Complete system documentation along with training manual, having following features:

(i) E-Learning Software
(ii) 3D Remedial / Replacement of major Components in virtual 3D environment.
(iii) Wall Charts.
(iv) Documentation (interactive Training Manual)

34 Contractor shall submit the technical details in the tender as per table below complying the above defined specifications: -

(1) For 13- Passengers Lift

Travel rise	G+5
1. Main Driving Motor	
Make and Type	
Type of Enclosure	
Voltage between Terminals	
Current in Amps at Rated Outputs	
Rated output in HP	
Class of Rating	
Speed in RPM at Rated Output	
Type, Size and Make of Bearings	

Class of Insulation	
Temperature Rise in Full Load	
2. Brake	
Make	
Type	
Width & Diameter of Brake Wheel	
Method of Adjustment	
Provision for Manual Release	
3. Car	

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CHAPTER – 7 TECHNICAL SPECIFICATIONS AND DRAWINGS

APPENDIX-8: LIST OF DRAWINGS

LIST OF DRAWINGS

Electrical Drawings

SN	Description	Drawing No.
1	Indicative LT Supply System with Local, DG and Auxiliary Transformer Supply for Manesar Station	GC-HRIDC-DRW-ELE-01_A0
2	Indicative LT Supply Distribution Diagram at Manesar Station	GC-HRIDC-DRW-ELE-02_A0
3	Indicative cable route plan for track crossing of power cable and route marker	GC-HRIDC-DRW-ELE-03_A0
4	Indicative earthing arrangement of Electrical system by copper cladded electrode	GC-HRIDC-DRW-ELE-04_A0
5	Indicative schematic drawing of 11kV power supply arrangement at Manesar	GC-HRIDC-DRW-ELE-05_A0
6	Indicative Compact Substation (CSS) single line diagram	GC-HRIDC-DRW-ELE-06_A0
7	Main LT (440V, 3-Phase) Panel (incomer) at IMD Manesar Building	GC-HRIDC-DRW-ELE-07_A0
8	LT (440V, 3-Phase) Panel for IMD Manesar Building	GC-HRIDC-DRW-ELE-08_A0
9	LT (440V, 3-Phase) Panel for Air Conditioning (VRV) in IMD Manesar building	GC-HRIDC-DRW-ELE-09_A0
10	First Floor Lighting Conduit Layout	DS_KCC_MEP_01 (Rev. R0) (Sheet No. ED0202)
11	First Floor Power Conduit Layout	DS_KCC_MEP_01 (Rev. R0) (Sheet No. ED0304)
12	Second Floor Lighting Conduit & FDA Layout	DS_KCC_MEP_03 (Rev. R0) (Sheet No. ED0205)
13	Second Floor Power Conduit Layout	DS_KCC_MEP_05 (Rev. R0) (Sheet No. ED0307)
14	Third Floor Lighting Conduit Layout	DS_KCC_MEP_13 (Rev. R0) (Sheet No. ED0207)
15	Third Floor Power Conduit Layout	DS_KCC_MEP_31 (Rev. R0) (Sheet No. ED0311)

16	Third Floor Fire Detection Layout	DS_KCC_MEP_70 (Rev. R0) (Sheet No. FD0104)
17	Fourth Floor Lighting Conduit Layout	DS_KCC_MEP_15 (Rev. R0) (Sheet No. ED0209)
18	Fourth Floor Power Conduit Layout	DS_KCC_MEP_33 (Rev. R0) (Sheet No. ED0313)
19	Fourth Floor Fire Detection Layout	DS_KCC_MEP_71 (Rev. R0) (Sheet No. FD0105)
20	Fifth Floor Lighting Conduit Layout	DS_KCC_MEP_17 (Rev. R0) (Sheet No. ED0211)
21	Fifth Floor Power Conduit Layout	DS_KCC_MEP_35 (Rev. R0) (Sheet No. ED0315)
22	Fifth Floor Fire Detection Layout	DS_KCC_MEP_72 (Rev. R0) (Sheet No. FD0106)

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Section 5VI: Bid Drawings and Documents

A- Bid Drawings
B- Documents

Section VII-8A
Bid Drawings

Section 5-VI: Bid Drawings are available for downloading under Active Tender Section on HRIDC website (https://hridc.co.in/active-tender.php). Section 5-VI: Bid Drawings uploaded on HRIDC website for Package MNS-01 shall be deemed to form part of Bid Documents. List of Bid Drawings are enclosed hereunder.

List of Bid Drawings

I. Civil Drawings

S. No	TITLE	DRAWING NO.
1. Architectural Drawings of Office Building		
1.	IMD BUILDING ARCH. FLOOR PLAN-SITE PLAN	DS-KCC-HORC-C1-IMD-ARCH-01-R0
2.	IMD BUILDING ARCH. FLOOR PLAN-GROUND FLOOR PLAN	DS-KCC-HORC-C1-IMD-ARCH-02-R4
3.	IMD BUILDING ARCH. FLOOR PLAN-FIRST FLOOR PLAN	DS-KCC-HORC-C1-IMD-ARCH-02-R4
4.	IMD BUILDING ARCH. FLOOR PLAN-SECOND FLOOR	DS-KCC-HORC-C1-IMD-ARCH-02-R3
5.	IMD BUILDING ARCH. FLOOR PLAN-THIRD FLOOR	DS-KCC-HORC-C1-IMD-ARCH-02-R3
6.	IMD BUILDING ARCH. FLOOR PLAN-FOURTH FLOOR	DS-KCC-HORC-C1-IMD-ARCH-02-R3
7.	IMD BUILDING ARCH. FLOOR PLAN-FIFTH FLOOR	DS-KCC-HORC-C1-IMD-ARCH-02-R3
8.	IMD BUILDING ARCH. FLOOR PLAN-TERRACE FLOOR	DS-KCC-HORC-C1-IMD-ARCH-02-R3
9.	IMD BUILDING ARCH. ELEVATION-A (FRONT ELEVATION)	DS-KCC-HORC-C1-IMD-ARCH-03-R2
10.	IMD BUILDING ARCH. ELEVATION- C (BACK ELEVATION)	DS-KCC-HORC-C1-IMD-ARCH-03-R2
11.	IMD BUILDING ARCH. ELEVATION- D (KMP SIDE ELEVATION)	DS-KCC-HORC-C1-IMD-ARCH-03-R2
12.	IMD BUILDING ARCH. ELEVATION- B (MARUTI SIDE ELEVATION)	DS-KCC-HORC-C1-IMD-ARCH-03-R2
13.	IMD BUILDING ARCH.SECTION Y-Y	DS-KCC-HORC-C1-IMD-ARCH-04-R2
14.	IMD BUILDING ARCH.SECTION Z-Z	DS-KCC-HORC-C1-IMD-ARCH-04-R2
2. Manesar Station Building		
15.	CONCEPTUAL ARCHITECTURAL DRAWING OF MANESAR STATION BUILDING	GC-HRIDC-MNS-01-GAD-007-A0 SH 1of 1

S. No	TITLE	DRAWING NO.
16.	CONCEPTUAL PLAN & SECTIONS OF MAINTENANCE BUILDING MANESAR STATION	GC-HRIDC-MNS-01-MNB-GAD-002_A0 Sheet No 1of 1
3. S & T Hut Building		
17.	S&T HUT PLAN	ICPL-HORC-C23-GAD-AR-TYP-1400-R0 Sheet No 1 of 3
18.	S&T HUT ELEVATION	ICPL-HORC-C23-GAD-AR-TYP-1500- R0 Sheet No 2 of 3
19.	S&T HUT SECTION	ICPL-HORC-C23-GAD-AR-TYP-1600- R0 Sheet No 3 of 3
20.	CONCEPTUAL SKETCH FOR SINGLE & DOUBLE LANE ROAD	GC-HRIDC-SK-GEN-025 Sheet 1 of 1

4. General Electrical services Drawing		
21.	FIRST FLOOR LIGHTING CONDUIT LAYOUT	DSS_KCC_MEP-01
22.	FIRST FLOOR POWER CONDUIT LAYOUT	DSS_KCC_MEP-01
23.	SECOND FLOOR LIGHTING CONDUIT LAYOUT	DSS_KCC_MEP-03
24.	SECOND FLOOR POWER CONDUIT LAYOUT	DSS_KCC_MEP-05
25.	THIRD FLOOR LIGHTING CONDUIT LAYOUT	DSS_KCC_MEP-13
26.	THIRD FLOOR POWER CONDUIT LAYOUT	DSS_KCC_MEP-31
27.	THIRD FLOOR FIRE DETECTION LAYOUT	DSS_KCC_MEP-70
28.	FOURTH FLOOR LIGHTING CONDUIT LAYOUT	DSS_KCC_MEP-15
29.	FOURTH FLOOR POWER CONDUIT LAYOUT	DSS_KCC_MEP-33
30.	FOURTH FLOOR FIRE DETECTION LAYOUT	DSS_KCC_MEP-71
31.	FIFTH FLOOR LIGHTING CONDUIT LAYOUT	DSS_KCC_MEP-17
32.	FIFTH FLOOR POWER CONDUIT LAYOUT	DSS_KCC_MEP-35
33.	FIFTH FLOOR FIRE DETECTION LAYOUT	DSS_KCC_MEP-72

Section 5VIB
Documents

S.NO	LIST OF DOCUMENTS	Pg. No.
1.	Approved Manufactures/Suppliers List	06-09
2.	Geotechnical Investigation Reports of Subway	-

1. Approved Manufactures/Suppliers List

1. Approved Manufactures/Suppliers List

All materials and products shall conform to the Outline Construction Specification (OCS), BIS codes and other relevant codes etc. and shall be of make as approved by the Engineer.

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S. No.	Details of Materials/ Products	Manufacturer's Name
1.	Cement	ACC, Ultratech, Ambuja Cements, JK Lakshmi, JSW, JK Cement, Lafarge, Shree Cement, Birla Cement, Grasim, Wonder Cement
2.	Reinforcement Bars	SAIL, JSW STEEL, TATASTEEL, RINL, JSPL
3.	Epoxy	FOSROC, SIKA QUALCRETE, BASF, CICO, MC–BAUCHEMIE, MAPEI, CHRYSO, Huntsman Advanced Materials
4.	Expansion Joints for Viaduct	Prequalified Manufacturers as per RDSO's latest approved list
5.	Admixtures	FOSROC, SIKA, MC-BAUCHEMIE, CHRYSO, MAPEI, CICO, Asian Paints, Kunal Conchem.
6.	Pile Integrity Testing	CIMEC, Geodynamics, AIMIL, CBRI, Pile Dynamic, CEGTH, FUGRO
7.	*Anchor Fastener	HILTI, FISHER, BOSCH, (Please note that ETA Certification is mandatory for using/supplying fasteners for load bearing structural members)
8.	Structural Steel	TATA, SAIL, ESSAR, JSPL, JSW
9.	Pre- stressing Strand (LRPC)	TATA SSL Ltd, USHA MARTIN
10.	*Pot/Elastomeric /Spherical Bearings	Prequalified Manufactures as per RDSO's latest approved list.
11.	HDPE Sheathing	Rex Polyextrusion, Gwalior Poly Pipes Ltd, Dynamic Prestress, JK Prestressing
12.	Formwork Release Agent	FOSROC, MC BAUCHEMIE, CICO, MAPEI, SIKA, CHRYSO

S. No.	Details of Materials/ Products	Manufacturer's Name
13.	*Prestressing System	Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), JK Prestressing, Usha Martin, VSIL
14.	*Reinforcement Couplers	DEXTRA, SANFIELD, SPLICETECH COUPLERS
15.	Hollow Sections, Pipes	Surya Pipes, Hi-Tech Pipes, JSW, JSPL, TATA.
16.	Drainage Pipes	Tirupati Plastomatics, Duraline, REX, STIPL
17.	Acrylic Textured Coatings	Spectrum, Surfa Nova, Jotun, Asian Paints, Berger, Hempel, DULUX
18.	Non Shrink Grout	FOSROC, Fairmate, SIKA, CICO, MC-Bauchemie, CHRYSO
19.	Bonding Coat	CICO, FOSROC, BASF, SIKA, MAPEI, MC-BAUCHEMIE, CHRYSO
20.	Polysuphide Sealant	CICO, PIDILITE, FOSROC, SIKA, CHRYSO, Kunal Conchem
21.	*Steel Structural Fasteners	Sundram Fasteners, Nelson, Dextra India, Panchsheel, Pooja Forge (Please note that ETA Certification is mandatory for using/supplying fasteners for load bearing structural members)
22.	*Corrosion Protection Paints	Berger, Jenson and Nicholson, Nerolac, Asian Paints, Akzo Nobel, Jotun
23.	Fire Resistant Paint	Akzo Nobel, PPG, Jotun
24.	Water stopper/ Bar	Greenstreak, Duron, Maruti, Kanta Rubber
25.	*Liquid Polymer membrane waterproofing	SIKA, MAPEI, NINA, CICO, MYK Schomburg, Geo-Constech, Kunal Conchem
26.	Curing Compound	FOSROC, CHRYSO, CICO, MC- BAUCHEMIE, MAPEI, SIKA.
27.	*Polycarbonate Sheets	Gallina Acroplus, Coxwell, Poly U, Fabic, Lexan, (SABIC Innovative Plastics), DANPALON, GE Plastics, VMI Plastics, Power Chem Plast
28.	Fly Ash	Thermal Plants, Ashcrete, Ultra Pozz, Star Pozz, Ashtech
29.	*Pre-Coated Profiled Metal Sheetings	TATA Blue Scope, Multicolor, Essar Steel, Bhushan Steel, Ispat Profile India
30.	Fly Ash Block/ AAC Block	Siporex, Ascolite, J.K. Laxmi, Ashtech

S. No.	Details of Materials/ Products	Manufacturer's Name
31.	Rock Bolts/Swellex Bolts	Geo Constech, DSI, Atlas Copco, FIREP International, Minova
32.	Soft eye GFRP	Dextra, FIREP International, Minova, Hughes Brothers, Geo Constech
33.	Polymer	WALLGRIP, TRISHUL, Shubham Minerals, Goldy Minerals, GeoPolymer
34.	Welding electrodes	Ador welding Ltd. (Advani-Oerlikon), ESAB, D&H Welding Electrodes, Modi Arc
35.	Aluminium Sheets	Hindustan Aluminium, Jindal, Balco
36.	Vitrified Tiles	Asian Tiles, Somany, Johnson, Bell Ceramics, Kajaria, Simpolo
37.	Ceramic Tiles	NITCO, Orient, Regency Ceramics
38.	Wall Putty	JK White, Birla
39.	Flush Doors	Samrat, Kanchan, Prima Swastik, Kutty, Diamond
40.	Adhesives	Pidilite, Araldite, Toyo Ferrous Crete
41.	Plywood	Duroply, Century Plywood, Green Plywood, Kitply
42.	Veneers	Green Plywood, Century Plywood, Kitply
43.	FloatGlass/Toughened Glass/Insulated Glass/Laminated Glass	Saint Gobain, Modiguard, Tata Float, Asahi Glass Ltd.
44.	Heavy Duty Chequered Tiles	NITCO. Hindustan Tiles, Super Tiles & Marbles Pvt.Ltd.
45.	Heavy Duty Vitrified Tiles	Kajaria World
46.	Emulsion Paint	Asian Paints, Berger, Nerolac, Jenson & Nicholson, Dulux, ICI
47.	Synthetic Enamel	Asian Paints, Berger, Nerolac, Jenson & Nicholson, Dulux, ICI
48.	Paver Blocks	As approved by the Engineer
49.	Sanitary & Bath Fittings	Hindware, Parryware, Jaquar, HR & Johnson, Cera, Somany, Asian Granito
50.	Aluminium doors & windows	Sehgal & Sehgal Industries
51.	Yellow Tactile Tiles	Pelican

S. No.	Details of Materials/ Products	Manufacturer's Name
52.	SS Railing	The Cavalier, D Line India, DOORMAT, Panchal Enterprises, SS Enterprises
53.	Glass Mosaic Tiles	Mridul Enterprises, Italia, Bissazza, Kenzai, Opio
54.	Granite Slabs & Tiles	As approved by the Engineer.

NOTE: For the categories marked as *, the enclosed undertaking performa should be duly filled and signed by authorized representatives of concerned agencies.

UNDERTAKING

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This is to certify that work of …… (Category to be mentioned) at …… (Location) of the contract ..... (Name of contract) has been executed/completed in accordance with the manufacturer's/supplier's specifications and as per the approved method statement.

The work has been jointly inspected by authorised representative of ……(Manufacturer/supplier), …… (Executing agency) &…….. (Contractor) during its execution and all non-conformities observed during inspection have been complied to achieve the best industry standards.

The undersigned take full responsibility of the overall adequacy, accuracy, effectiveness & warranty (upto design life) of the completed work as per the provision of the contract……. (Contract number) and Outline Construction Specifications of the Part 2- Employer's Requirements.

(Stamp and Signature)	**(Stamp and Signature)**	**(Stamp and Signature)**
Manufacturer Representative	**Executing agency Representative**	**Contractor Representative**

2. Geotechnical Investigation Reports

(To be inserted)

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S.NO	LIST OF DOCUMENTS	Pg. No
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1.1	**Priority Section - Bridge Nos. (Old) - 122,123,124,125,126,127,128,129,130 & Embankment at ROR Location/Priority Section - Bridge Nos. (New) - 127,128,129,130,131,132,133,134,135 & Embankment at ROR Location**	
1.2	**Bridge No. 132 (Chainage 51+773.032)**	
1.3	**Bridge No. 132A (Chainage 51+973.032)**	

Geotechnical Investigation Reports

For

1.1 Priority Section - Bridge Nos. (Old) - 122,123,124,125,126,127,128,129,130 & Embankment at ROR Location/Priority Section - Bridge Nos. (New) - 127,128,129,130,131,132,133,134,135 & Embankment at ROR Location

Geotechnical Investigation Reports
For

1.2 Bridge No. 132 (Chainage 51+773.032)

Geotechnical Investigation Reports
For

1.3 Bridge No. 132A (Chainage 51+973.032)

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3.	Epoxy	FOSROC, SIKA QUALCRETE, BASF, CICO, MC–BAUCHEMIE, MAPEI, CHRYSO, Huntsman Advanced Materials
4.	Expansion Joints for Viaduct	Prequalified Manufacturers as per RDSO's latest approved list
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1.2	**Bridge No. 132 (Chainage 51+773.032)**	1-6
1.3	**Bridge No. 132A (Chainage 51+973.032)**	1-6

Geotechnical Investigation Reports

For

1.1 Priority Section - Bridge Nos. (Old) - 122,123,124,125,126,127,128,129,130 & Embankment at ROR Location/Priority Section - Bridge Nos. (New) - 127,128,129,130,131,132,133,134,135 & Embankment at ROR Location

Doc. No. -HRIDC/Geo/03	Date - 25-04-2022 Rev-04

Soil Investigation Report

of

Construction of Major RUB at Gurugram - Pataudi Road HORC Old Chainage 46500 to 52500 and New Chainage (49+700 to 55+700).and Manesar Station to Patil Station Yard

Priority Section - Bridge Nos. (Old) - 122,123,124,125,126,127,128,129,130 & Embankment at ROR Location
Priority Section - Bridge Nos. (New) - 127,128,129,130,131,132,133,134,135 & Embankment at ROR Location

Submitted To :

Haryana Rail Infrastructure Development Corporation Ltd.

Submitted By :

Meridian Constructions

(Space for planning and creativity)

'**Meridian House**', D-4, Kusum Vihar, Ramnagaria Road, Jagatpura , Jaipur
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SOIL INVESTIGATION REPORT

CONTENTS

S.No.	TITLE
1	Introduction
1.1	Location and characteristics of site.
1.2	Scope of work
2	Field investigation
2.1	Drilling Boreholes
2.2	Sampling
2.3	Standard Penetration Test
3	Laboratory Tests
4	Results and analysis
5	'N' values from SPT
6	Laboratory test results
7	Bearing Capacity as per IS:6403-1981
8	Annexure
A	Settlement criterion
B	Shear failure criterion
A-1	Annexure - Lab Test Results

Standard Penetration Test Result of Construction of Major RUB at Gurugram - Pataudi Road HORC Old Chainage 46500 to 52500 and New Chainage (49+700 to 55+700).and Manesar Station to Patil Station Yard

1. INTRODUCTION

The main function of a foundation is to distribute or transmit all the loads coming over it to the soil or ground upon which it rests. The knowledge of the characteristics of underlying soil is therefore very essential for safe & economical design of foundations. The performance of supporting stratum depends upon the physical of soil, type& shape of footing & structure, water table depth etc.

It is therefore necessary to have sufficient information about the arrangement & behaviour of the underlying materials and their physical properties, for adopting and designing the structural foundation. Soil exploration through field investigation and relevant laboratory testing of the soil are essential to arrive at required parameters for designing of foundation.

1.1 LOCATION AND CHARACTERISCS OF THE SITE

The Construction of Major RUB at Gurugram - Pataudi Road HORC Old Chainage 46500 to 52500 and New Chainage (49+700 to 55+700).and Manesar Station to Patil Station Yard for Haryana Rail Infrastructure Development Corporation Ltd. The Priority Section - Bridge Nos. (Old) - 122,123,124,125,126,127,128,129,130 & Embankment at ROR Location

1.2 SCOPE OF WORK

Field investigations at the site were planned to determine the required characteristics of the underlying soil, to design the foundation of the above mentioned structures.The data obtained from these investigations have been analyzed to arrive at the required parameters for design.

In order to achieve the stated objective, the stipulated scope of work allotted to the consultant involved carrying out of the following operations:-

1. Transportation of the personnel, plant and equipment to the site of work and with drawing the same on completion of work.
2. Drilling 1 bore hole of 100 - 150 mm diameter up to 10m depth below the ground level or upto refusal with standard penetration test.
3. Conducting standard penetration test in bore hole as per Indian standard Specification (IS-2131-1963, IS-2132)
4. Extracting undistributed soil sample and sealing, numbering and transporting them as per (IS-2131-1963, IS-2132)
5. Carrying out following tests on the soil specimen necessary to establish its characteristics:-

§ Sieve analysis

§ Hydrometer analysis

§ Natural moisture content

§ Bulk density

§ Specific gravity

§ Atterberg limits

§ Shear strength parameters

6. Preparation and submission of detailed report on soil Investigation.

2. FIELD INVESTIGATIONS

The subsurface investigations in the field involve three basic operations:-

- Drilling
- Sampling
- Conducting the required field test. This is followed by operations in the laboratory for conducting prescribed laboratory tests.

2.1 Drilling Boreholes

In soils, bore holes was drilled with the help of a Post Hole auger. The auger was pressed in to the soil and twisted. Extension rods were connected to augur to increase the reach of augur inside the bore hole, up to the required depth. After a certain depth, beyond which drilling is not possible, mechanized machines were used for drilling purpose. It was ensured, that Penetration Test is performed on natural ground and to permit driving of the split spoon sampler to obtain the penetration record..

2.2 Sampling

The soil that was removed during drilling of bore holes was continuously examined for changes in the soil stratification at regular intervals and at levels, where there is change is soil type, samples were collected for further testing in the laboratory. Undistributed soil samples were collected at required depth in thin wall tubes according to IS:2131. The sampling tube was pushed into soil by continuous and rapid motion. The tube was then turned at least for two revolutions to shear the sample off at the bottom. Sampling tubes were and sealed at both ends and carefully labeled and transported to laboratory for testing.

2.3 Standard penetration Test

The standard penetration test was conducted in bore hole in soils following the standard procedure as per Indian standard IS: 2131, which specifies the procedure for conducting SPT for soil. This test is carried out using the standard split spoon sampler to measure the number of blows called 'N' Value. Standard split spoon sampler was attached to a 'A' rod. It was driven into the soil to a distance of 45 cm using a standard hammer falling freely from a height of 75 cm while driving, the number of blows required to penetrate the last 30 cm is taken as N' value at that particular depth of the bore hole. This value is then used for calculating the bearing capacity of the soil.

3.0 LABORATORY TESTS

In the laboratory, the sample were extracted out carefully from the undisturbed sample tubes. Undisturbed samples were used for following test:-

- Shear strength test
- Determination of Bulk density
- Natural moisture content
- Determination of dry density
- Sieve Analysis
- Hydrometer Analysis
- Atterberg Limit
- Specific Gravity

All these tests were conducted in accordance with the procedures prescribed in Indian standards.

The test results are included in the enclosed tables.

4. RESULTS AND ANALYSIS

Bridge No. 122 - (Old) / 127 - (New)

* The soil stratum at the site is consists of Silty Sand and later after 7.0m Silty Sand with kankars.
* The SPT 'N' value indicates that soil stratum is medium to dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Raft foundation is recommended.
* **SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	33.90	57.84
2	1.50	33.90	66.77
3	2.00	28.17	56.34

Bridge No. 123 - (Old) / 128 - (New)

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars at later depths.
* The SPT 'N' value indicates that soil stratum is dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Raft foundation is recommended.
* **SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	26.22	26.22
2	1.50	29.84	29.84
3	2.00	30.84	30.84

Bridge No. 124 (Old) / 129 - (New)

* The soil stratum at the site is consists of Sand with Kankars and Rock starts at 3.0m Lvl.
* The SPT 'N' value indicates that soil stratum is dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Raft foundation is recommended.
* **SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	32.39	61.38
2	1.50	33.90	67.80
3	2.00	35.09	70.18

Bridge No. 125 (Old) / 130 - (New)

* The soil stratum at the site is consists of Sndy Soil and Rock starts at 4.0m depth.
* The SPT 'N' value indicates that soil stratum is dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated foundation is recommended.

*** SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	28.57	37.29
2	1.50	28.99	43.91
3	2.00	30.21	48.34

Bridge No. 126 (Old) / 131 - (New)

* The soil stratum at the site is consists of Silty Sand and later after 7.0m Silty Sand with kankars.
* The SPT 'N' value indicates that soil stratum is dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated foundation is recommended.

*** SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	28.57	45.71
2	1.50	28.99	46.38
3	2.00	29.63	47.41

Bridge No. 127 (Old) / 132 - (New)

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars.
* The SPT 'N' value indicates that soil stratum is loose to dense.
* Water was found at 16.0m levl at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Pile foundation is recommended.

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	10.47	20.94
2	1.50	12.31	24.62
3	2.00	13.96	27.91

II. Pile Capacity

1	**1.2m dia pile and length of 20m is 637.37t.**
2	**Lateral Load capacity of 1.2m dia pile is 42T and depth of fixidity is 7.57m.**

Bridge No. 128 (Old) / 133 - (New)

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars.
* The SPT 'N' value indicates that soil stratum is loose to dense.
* Water was found at 19.5m levl at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Pile foundation is recommended.

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	11.33	21.17
2	1.50	10.05	20.10
3	2.00	9.20	18.39

II. Pile Capacity

1	**1.2m dia pile and length of 20m is 662.86t.**
2	**Lateral Load capacity of 1.2m dia pile is 36T and depth of fixidity is 7.99m.**

Bridge No. 129 (Old) / 134 - (New) - BH-01

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars.
* The SPT 'N' value indicates that soil stratum is medium to dense.
* Water was found at 18.5m levl at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Pile foundation is recommended.
* **SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	2.00	21.05	33.68
2	3.00	28.17	45.07
3	4.00	33.90	54.24

II. Pile Capacity

1	**1.2m dia pile and length of 20m is 744.68t.**
2	**1.2m dia pile and length of 24m is 915.56t.**
3	**1.2m dia pile and length of 28m is 1037.48t.**
4	**Lateral Load capacity of 1.2m dia pile is 69.62T and depth of fixidity is 6.42m.**

Bridge No. 129 (Old) / 134 - (New) - BH-02

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars.
* The SPT 'N' value indicates that soil stratum is medium to dense.
* Water was found at 18.5m levl at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Pile foundation is recommended.
* **SBC values are higher but it is strictly recommended to have 30t/m2 as max SBC for design of Bridge open foundation.**

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	2.00	19.80	31.68
2	3.00	22.22	35.56
3	4.00	26.67	42.67

II. Pile Capacity

1	**1.2m dia pile and length of 20m is 739.77t.**
2	**1.2m dia pile and length of 24m is 917.89t.**
3	**1.2m dia pile and length of 28m is 1046.24t.**
4	**Lateral Load capacity of 1.2m dia pile is 46T and depth of fixidity is 7.36m.**

Bridge No. 130 (Old) / 135 - (New)

* The soil stratum at the site is consists of Silty Sand and later after 4.0m Silty Sand with kankars.
* The SPT 'N' value indicates that soil stratum is Loose to dense.
* Water table was not found at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Raft foundation is recommended.

I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	1.00	9.09	
2	1.50	9.20	18.39
3	2.00	10.05	20.10

Embankment at ROR

* The soil stratum at the site is consists of Silty Sand and Silty Sand with Kankars.
* The SPT 'N' value indicates that soil stratum is medium to dense.
* Water was found at 18.0m levl at the time of investigation.
* Soil is Non Plastic and having No Cohesion.
* An Isolated / Pile foundation is recommended.

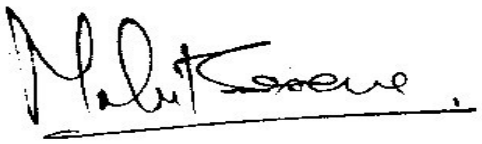
I. Bearing Capacity for Open Foundation

S. No.	Depth (m)	Allowable Bearing Capacity (t/m^2)	
		25mm Settlement	50mm Settlement
1	2.00	10.67	20.09
2	3.00	11.27	22.54
3	4.00	11.27	22.54

II. Pile Capacity

1	**1.2m dia pile and length of 20m is 550.26t.**
2	**1.2m dia pile and length of 24m is 682t.**
3	**1.2m dia pile and length of 28m is 784.94t.**
4	**Lateral Load capacity of 1.2m dia pile is 34T and depth of fixidity is 8.16m.**

The above recommendations are based on the field and laboratory tests conduct on the soil met in bore hole locations and our experience in this regard. If the actual sub soil conditions during excavation for foundations differ from the observations reported here, the design experts must be referred for suggestions.



(for Meridian Constructions)

BRIDGE NO. 122

Standard Penetration Test Result

Bore Hole atBridge No. 122

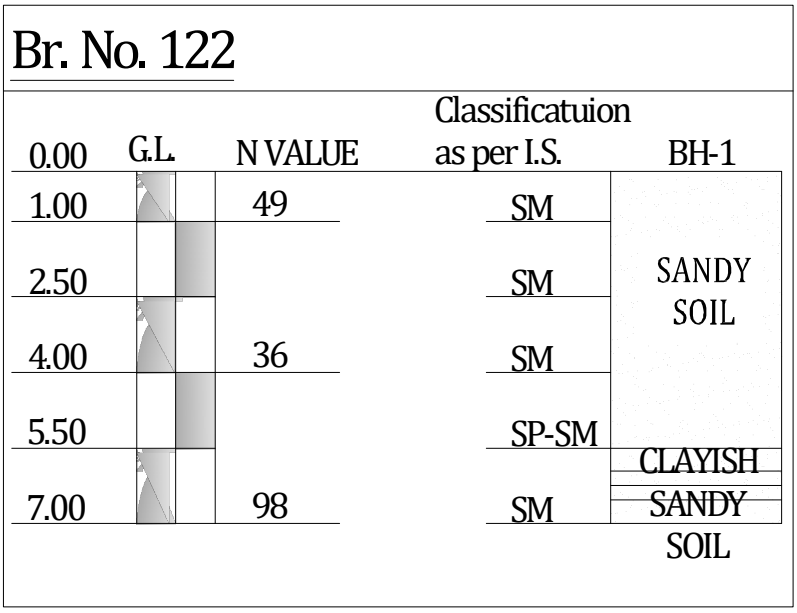
Date of Field Test - 27-12-2020 **Bore Hole NGL - 253.182**

BH - Coordinates - E 3138253.596, N 684192.244

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	49	76	Silty Sand	252.18	SM
2.50	UDS	-	Silty Sand	250.68	SM
4.00	36	39	Silty Sand	249.18	SM
5.50	UDS	-	Silty Sand	247.68	SP-SM
7.00	98	89	Clayish Sand with Kankars	246.18	SM

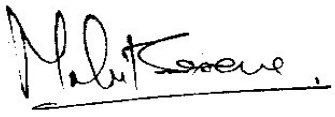
BH Terminates at 7.50m



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**					
	Depth					
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	
Cobble (%)	0.00	0.00	0.00	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	
Fine Gravel (%)	0.00	1.41	0.00	0.11	12.02	
Coarse Sand (%)	0.00	1.28	0.00	1.13	6.04	
Medium Sand (%)	0.03	3.03	0.05	11.67	8.57	
Fine Sand (%)	82.13	78.22	81.88	81.25	50.90	
Clay And Silt Size (%)	17.84	16.06	18.06	5.84	22.47	
Atterberg Limit						
Liquid Limit (%)	23.46	24.36	24.55	23.10	24.86	
Plastic Limit (%)	-	-	-	-	-	
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	
Sp. Gravity	2.68	2.68	2.69	2.68	2.69	
Void Ratio		0.55		0.61		
Density						
Moisture Content(%)	3.96	5.74	4.31	10.22	4.31	
Bulk Density(kN/m^3)		18.34		17.95		
Dry Density (kN/m^3)		17.34		16.28		
Shear Strength Parameters						
Unit Cohesion (kg/cm^2)		0.05		0.00		
Angle of Internal Friction (degree)		33		31		



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle **B = 4.80** **L = 8.00**

Ɣ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.83	48.00	0.50	32.00	35.49	23.18	30.22	1.12	1.12	0.76
1.83	48.00	0.50	32.00	35.49	23.18	30.22	1.12	1.12	0.76
1.83	39.00	0.50	32.00	35.49	23.18	30.22	1.12	1.12	0.76

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.08	1.04	1.04	1.00	4.80	1.83	57.84	**1.80**	**57.84**	0.55
1.08	1.06	1.06	1.50	4.80	2.75	66.77	**1.80**	**66.77**	0.55
1.08	1.08	1.08	2.00	4.80	3.67	76.00	**1.80**	**76.00**	0.55

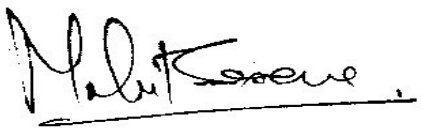
Ɣ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.83	48.00	0.50	22.78	18.05	8.66	8.20	1.12	1.12	0.76
1.83	48.00	0.50	22.78	18.05	8.66	8.20	1.12	1.12	0.76
1.83	39.00	0.50	22.78	18.05	8.66	8.20	1.12	1.12	0.76

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.06	1.03	1.03	1.00	4.80	1.83	18.42	**1.50**	33.90
1.09	1.05	1.05	1.50	4.80	2.75	21.49	**1.50**	33.90
1.13	1.06	1.06	2.00	4.80	3.67	24.65	**1.50**	28.17

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	4.80	57.84	18.42	57.84	**67.80**	**57.84**
2		1.50	4.80	66.77	21.49	66.77	**67.80**	**66.77**
3		2.00	4.80	76.00	24.65	76.00	**56.34**	**56.34**

Factor of Safety Taken 3

Water Correction factor taken 0.8



BRIDGE NO. 123

Standard Penetration Test Result

Bore Hole at Bridge No. 123

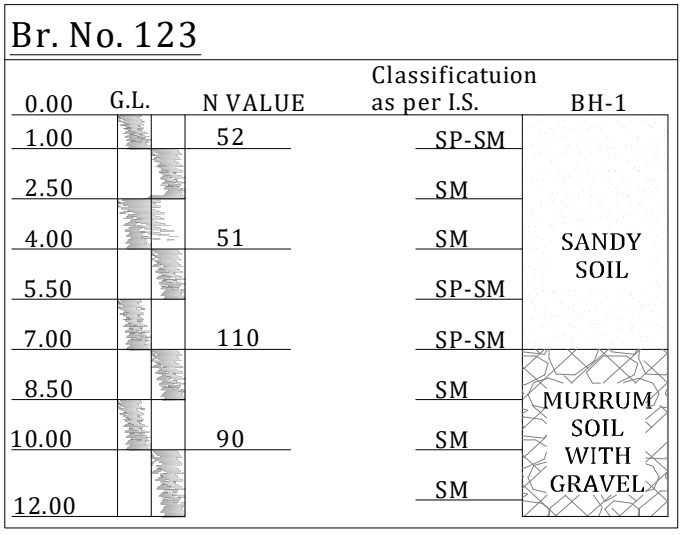
Date of Field Test - 27-12-2020 **Bore Hole NGL -249.659**

BH - Coordinates - E3138655.38, N 684055.199

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	52	82	Silty Sand	248.66	SP-SM
2.50	UDS	-	Silty Sand	247.16	SM
4.00	41	45	Silty Sand	245.66	SM
5.50	UDS	-	Silty Sand	244.16	SP-SM
7.00	>100	-	Silty Sand	242.66	SP-SM
8.50	UDS	-	Silty Sand	241.16	SM
10.00	>100	-	Silty Sand	239.66	SM
12.00	UDS	-	Silty Sand	237.66	SM

BH Terminates at 12.50m

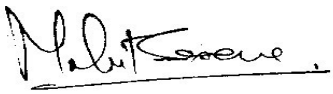


Meridian Constructions

Laboratory Test Results

LABORATORY TEST RESULTS :

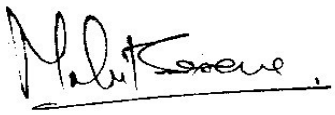
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.00	0.25	0.00	0.94	8.79	0.39	4.83
Coarse Sand (%)	0.00	1.16	0.07	2.72	1.26	3.15	2.95
Medium Sand (%)	0.13	2.31	0.27	6.89	11.77	6.06	13.29
Fine Sand (%)	89.82	82.89	86.00	77.89	67.98	74.89	63.11
Clay And Silt Size (%)	10.05	13.39	13.66	11.56	10.20	15.51	15.82
Atterberg Limit							
Liquid Limit (%)	22.52	22.71	24.33	23.73	21.25	23.11	25.72
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.69	2.69	2.68	2.69	2.66	2.68	2.65
Void Ratio		0.73		0.74		0.61	
Density							
Moisture Content(%)	4.06	13.77	5.41	12.97	6.95	10.80	7.75
Bulk Density(kN/m^3)		17.46		17.17		18.14	
Dry Density (kN/m^3)		15.30		15.21		16.37	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.05		0.02		0.07	
Angle of Internal Friction (degree)		33		32		33	



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**	
	Depth	
Gradation Analysis	**12.0m**	
Cobble (%)	0.00	
Coarse Gravel (%)	0.00	
Fine Gravel (%)	0.06	
Coarse Sand (%)	0.77	
Medium Sand (%)	1.89	
Fine Sand (%)	72.53	
Clay And Silt Size (%)	24.75	
Atterberg Limit		
Liquid Limit (%)	23.59	
Plastic Limit (%)	-	
Plasticity Index (%)	NPI	
Sp. Gravity	2.68	
Void Ratio		
Density		
Moisture Content(%)	13.16	
Bulk Density(kN/m^3)	17.85	
Dry Density (kN/m^3)	15.79	
Shear Strength Parameters		
Unit Cohesion (kg/cm^2)	0.07	
Angle of Internal Friction (degree)	33	



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 8.30 L = 8.00

ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.75	48.00	0.50	32.00	35.49	23.18	30.22	1.21	1.21	0.59
1.75	48.00	0.50	32.00	35.49	23.18	30.22	1.21	1.21	0.59
1.75	45.00	0.50	32.00	35.49	23.18	30.22	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.04	1.02	1.02	1.00	8.30	1.75	67.01	**1.80**	**26.22**	0.73
1.04	1.03	1.03	1.50	8.30	2.62	75.69	**1.80**	**29.84**	0.73
1.04	1.04	1.04	2.00	8.30	3.49	84.54	**1.80**	**30.84**	0.74

ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.75	48.00	0.50	22.78	18.05	8.66	8.20	1.21	1.21	0.59
1.75	48.00	0.50	22.78	18.05	8.66	8.20	1.21	1.21	0.59
1.75	45.00	0.50	22.78	18.05	8.66	8.20	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.04	1.02	1.02	1.00	8.30	1.75	21.04	**1.50**	26.22
1.05	1.03	1.03	1.50	8.30	2.62	24.03	**1.50**	29.84
1.07	1.04	1.04	2.00	8.30	3.49	27.06	**1.50**	30.84

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	8.30	67.01	21.04	26.22	**52.43**	**26.22**
2		1.50	8.30	75.69	24.03	29.84	**59.68**	**29.84**
3		2.00	8.30	84.54	27.06	30.84	**61.69**	**30.84**

Factor of Safety Taken 3

Water Correction factor taken 0.5 0.8

BRIDGE NO. 124

Standard Penetration Test Result

Bore Hole at Bridge No. 124

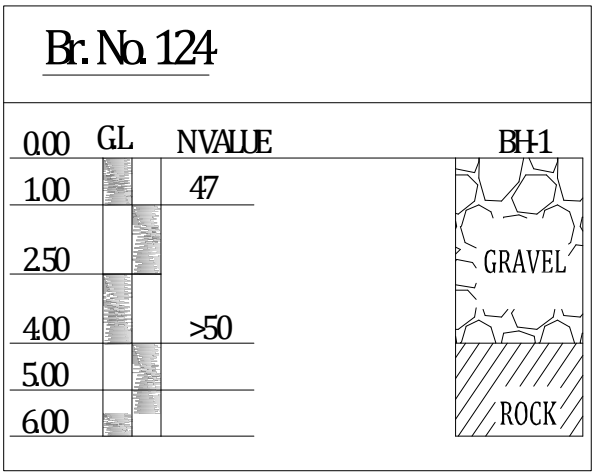
Date of Field Test - 27-12-2020 **Bore Hole NGL - 246.527**

BH - Coordinates - E 3138964.352, N 683954.664

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	47	73	Sandy Soil	245.53	SW
2.50	UDS	-	Boulder	244.03	
4.00	>100	-	Rock	242.53	
6.00	>100	-	Rock	240.53	

BH Terminates at 7.0m
Rock starts from 3.0m



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**	
	Depth	
Gradation Analysis	**1.0.0m**	
Cobble (%)	0.00	
Coarse Gravel (%)	0.00	
Fine Gravel (%)	6.17	
Coarse Sand (%)	10.12	
Medium Sand (%)	22.68	
Fine Sand (%)	60.04	
Clay And Silt Size (%)	0.98	
Atterberg Limit		
Liquid Limit (%)	22.19	
Plastic Limit (%)	-	
Plasticity Index (%)	NPI	
Sp. Gravity	2.68	
Density		
Moisture Content(%)	9.25	
Bulk Density(kN/m^3)		
Dry Density (kN/m^3)		
Shear Strength Parameters		
Unit Cohesion (kg/cm^2)		
Angle of Internal Friction (degree)		

Tests on Rock

S. N.	**Depth of BH**	**Height (h) in mm**	**Dia(d) in mm**	**Load(KN)**	**UCS (MPa)**	**Point Load Index (MPa)**	**Density (kN/m^3)**	**Water Absorption**	
1	4.0 m				-	-	23.73	1.59%	
2	6.0 m				-	**57.11**	25.60	0.60%	

BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 2.70 L = 8.00

ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.90	45.00	0.00	35.00	46.12	33.30	48.03	1.07	1.07	0.87
1.90	48.00	0.00	35.00	46.12	33.30	48.03	1.07	1.07	0.87
1.90	50.00	0.00	35.00	46.12	33.30	48.03	1.07	1.07	0.87

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.14	1.07	1.07	1.00	2.70	1.90	61.38	**1.92**	**61.38**	0.55
1.14	1.11	1.11	1.50	2.70	2.85	75.49	**1.92**	**75.49**	0.55
1.14	1.14	1.14	2.00	2.70	3.80	90.37	**1.92**	**90.37**	0.55

ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.90	45.00	0.00	25.17	20.72	10.66	10.88	1.07	1.07	0.87
1.90	48.00	0.00	25.17	20.72	10.66	10.88	1.07	1.07	0.87
1.90	50.00	0.00	25.17	20.72	10.66	10.88	1.07	1.07	0.87

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.12	1.06	1.06	1.00	2.70	1.90	15.41	**1.57**	32.39
1.17	1.09	1.09	1.50	2.70	2.85	19.39	**1.57**	33.90
1.23	1.12	1.12	2.00	2.70	3.80	23.55	**1.57**	35.09

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	2.70	61.38	15.41	61.38	**64.78**	**61.38**
2		1.50	2.70	75.49	19.39	75.49	**67.80**	**67.80**
3		2.00	2.70	90.37	23.55	90.37	**70.18**	**70.18**

Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

BRIDGE NO. 125

Standard Penetration Test Result

Bore Hole at Bridge No. 125

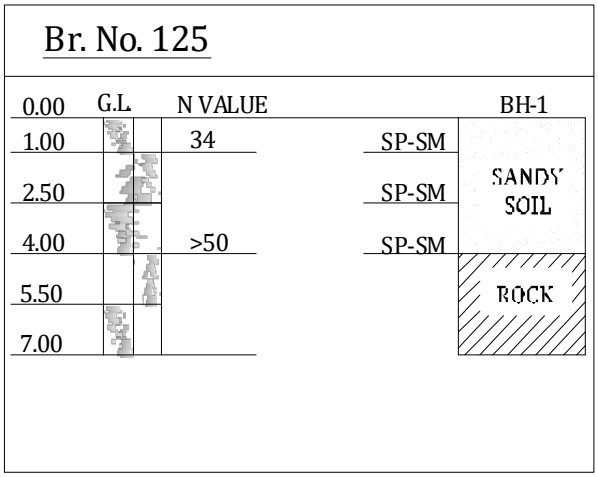
Date of Field Test - 04-01-2021 **Bore Hole NGL - 245.810**

BH - Coordinates - E 3139049.935, N 683926.816

Field Data

Depth below ground		N-values BH-1				BH Levels	Soil Classification
Level (m)	N	Corrected	Description	CR%	RQD%		
1.00	25	39	Sandy Soil	-	-	244.81	SP-SM
2.50	UDS	-	Sandy Soil with	-	-	243.31	SP-SM
4.00	>50	-	Rock	-	-	241.81	Residual Soil
5.50	>50	-	Rock	26.67	10	240.31	Highly Weathered
7.00	>50	-	Rock	38	17.33	238.81	

BH Terminates at 7.0m
Rock starts from 4.0m



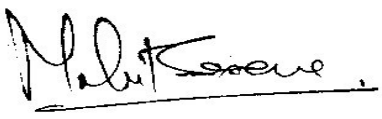
Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	BH-1			
	Depth			
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	
Cobble (%)	0.00	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	0.00	
Fine Gravel (%)	0.00	0.17	0.00	
Coarse Sand (%)	0.00	0.07	0.11	
Medium Sand (%)	0.65	2.15	2.10	
Fine Sand (%)	93.62	89.17	91.55	
Clay And Silt Size (%)	5.73	8.43	6.23	
Atterberg Limit				
Liquid Limit (%)	23.03	22.26	25.57	
Plastic Limit (%)	-	-	-	
Plasticity Index (%)	NPI	NPI	NPI	
Sp. Gravity	2.64	2.62	2.67	
Void Ratio		0.62		
Density				
Moisture Content(%)	11.40	10.78	3.77	
Bulk Density(kN/m^3)		17.56		
Dry Density (kN/m^3)		15.89		
Shear Strength Parameters				
Unit Cohesion (kg/cm^2)		0.00		
Angle of Internal Friction (degree)		33		

Test on Rocks

S. N.	Depth of BH	Height (h) in mm	Dia(d) in mm	Load(KN)	UCS (MPa)	Point Load Index (MPa)	Density (kN/m^3)	Water Absorption
1	4.0 m	96	54	48.40	**20.92**	-	24.23	0.64%
2	5.5 m				-	-	25.40	0.52%
3	7.0 m	140	54	96.80	**41.75**	-	23.65	0.45%



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 4.90 L = 8.00

ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.76	39.00	0.00	32.00	35.49	23.18	30.22	1.12	1.12	0.76
1.76	41.00	0.00	32.00	35.49	23.18	30.22	1.12	1.12	0.76
1.76	43.00	0.00	32.00	35.49	23.18	30.22	1.12	1.12	0.76

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.07	1.04	1.04	1.00	4.90	1.76	49.03	**1.80**	**37.29**	0.62
1.07	1.06	1.06	1.50	4.90	2.63	57.59	**1.80**	**43.91**	0.62
1.07	1.07	1.07	2.00	4.90	3.51	66.42	**1.80**	**50.74**	0.62

ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.76	39.00	0.00	22.78	18.05	8.66	8.20	1.12	1.12	0.76
1.76	41.00	0.00	22.78	18.05	8.66	8.20	1.12	1.12	0.76
1.76	43.00	0.00	22.78	18.05	8.66	8.20	1.12	1.12	0.76

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.06	1.03	1.03	1.00	4.90	1.76	14.34	**1.50**	28.57
1.09	1.05	1.05	1.50	4.90	2.63	17.18	**1.50**	28.99
1.12	1.06	1.06	2.00	4.90	3.51	20.11	**1.50**	30.21

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (40mm)	Adopted
1	**1**	1.00	4.90	49.03	14.34	37.29	**45.71**	**37.29**
2		1.50	4.90	57.59	17.18	43.91	**46.38**	**43.91**
3		2.00	4.90	66.42	20.11	50.74	**48.34**	**48.34**

Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

BRIDGE NO. 126

Standard Penetration Test Result

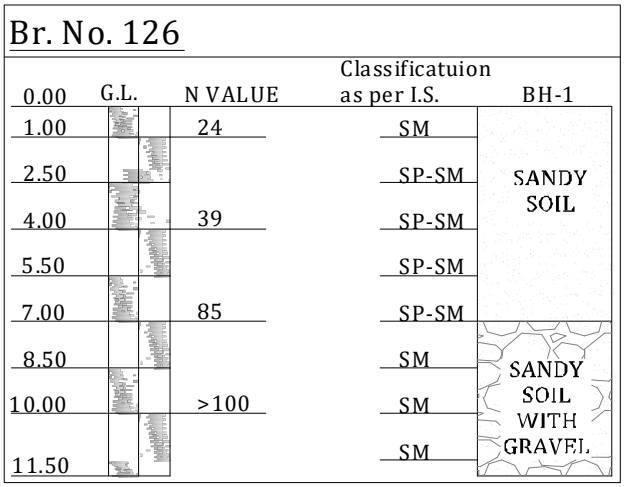
Bore Hole atBridge No. 126

Date of Field Test - 27-12-2020 **Bore Hole NGL -240.036**

BH - Coordinates - E 3139774.954, N 683697.842

Field Data

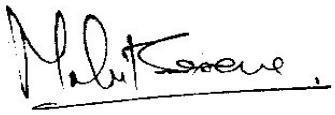
Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	24	37	Sandy Soil	239.04	SM
2.50	UDS	-	Sandy Soil	237.54	SP-SM
4.00	39	42	Sandy Soil	236.04	SP-SM
5.50	UDS	-	Sandy Soil	234.54	SM
7.00	85	77	Sandy Soil	233.04	SP-SM
8.50	UDS	-	Sandy Soil	231.54	SM
10.00	>100	-	Sandy soil with Gravel	230.04	SP-SM
12.00	UDS	-	Sandy soil with Gravel	228.04	SM



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.00	0.12	0.00	0.91	1.13	1.76	6.02
Coarse Sand (%)	0.00	0.95	0.00	1.55	0.97	1.36	14.30
Medium Sand (%)	0.00	11.65	0.11	8.87	2.92	3.28	12.61
Fine Sand (%)	85.04	81.13	90.10	73.58	88.12	78.80	57.55
Clay And Silt Size (%)	14.96	6.16	9.79	15.09	6.85	14.81	9.52
Atterberg Limit							
Liquid Limit (%)	22.97	23.51	21.39	20.43	20.67	20.25	22.12
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.65	2.60	2.65	2.64	2.61	2.61	2.62
Void Ratio		0.55		0.55			
Density							
Moisture Content(%)	3.66	12.47	5.19	11.88	3.83	10.86	10.11
Bulk Density(kN/m^3)		18.93		18.83		18.34	0.00
Dry Density (kN/m^3)		16.83		16.83		16.54	0.00
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.00		0.06		0.05	
Angle of Internal Friction (degree)		33		32		33	



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**	
	Depth	
Gradation Analysis	**12.0m**	
Cobble (%)	0.00	
Coarse Gravel (%)	0.00	
Fine Gravel (%)	4.46	
Coarse Sand (%)	4.65	
Medium Sand (%)	5.20	
Fine Sand (%)	64.94	
Clay And Silt Size (%)	20.74	
Atterberg Limit		
Liquid Limit (%)	21.03	
Plastic Limit (%)	-	
Plasticity Index (%)	NPI	
Sp. Gravity	2.60	
Void Ratio		
Density		
Moisture Content(%)	12.21	
Bulk Density(kN/m^3)	18.15	
Dry Density (kN/m^3)	16.19	
Shear Strength Parameters		
Unit Cohesion (kg/cm^2)	0.06	
Angle of Internal Friction (degree)	33	

BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 8.30 L = 8.00

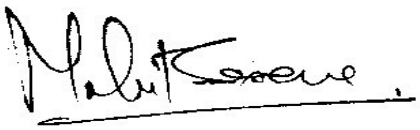
Ɣ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.89	40.00	0.00	32.00	35.49	23.18	30.22	1.21	1.21	0.59
1.89	41.00	0.00	32.00	35.49	23.18	30.22	1.21	1.21	0.59
1.89	42.00	0.00	32.00	35.49	23.18	30.22	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.04	1.02	1.02	1.00	8.30	1.89	64.56	**1.80**	**64.56**	0.55
1.04	1.03	1.03	1.50	8.30	2.84	73.96	**1.80**	**73.96**	0.55
1.04	1.04	1.04	2.00	8.30	3.79	83.56	**1.80**	**83.56**	0.55

Ɣ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.89	40.00	0.00	22.78	18.05	8.66	8.20	1.21	1.21	0.59
1.89	41.00	0.00	22.78	18.05	8.66	8.20	1.21	1.21	0.59
1.89	42.00	0.00	22.78	18.05	8.66	8.20	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.04	1.02	1.02	1.00	8.30	1.89	18.73	**1.50**	28.57
1.05	1.03	1.03	1.50	8.30	2.84	21.89	**1.50**	28.99
1.07	1.04	1.04	2.00	8.30	3.79	25.11	**1.50**	29.63

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	8.30	64.56	18.73	64.56	**45.71**	**45.71**
2		1.50	8.30	73.96	21.89	73.96	**46.38**	**46.38**
3		2.00	8.30	83.56	25.11	83.56	**47.41**	**47.41**



Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

BRIDGE NO. 127

Standard Penetration Test Result

Bore Hole atBridge No. 127

Date of Field Test - 02-01-2021 **Bore Hole NGL -237.326**

BH - Coordinates - E 3140167.367, N 683619.422

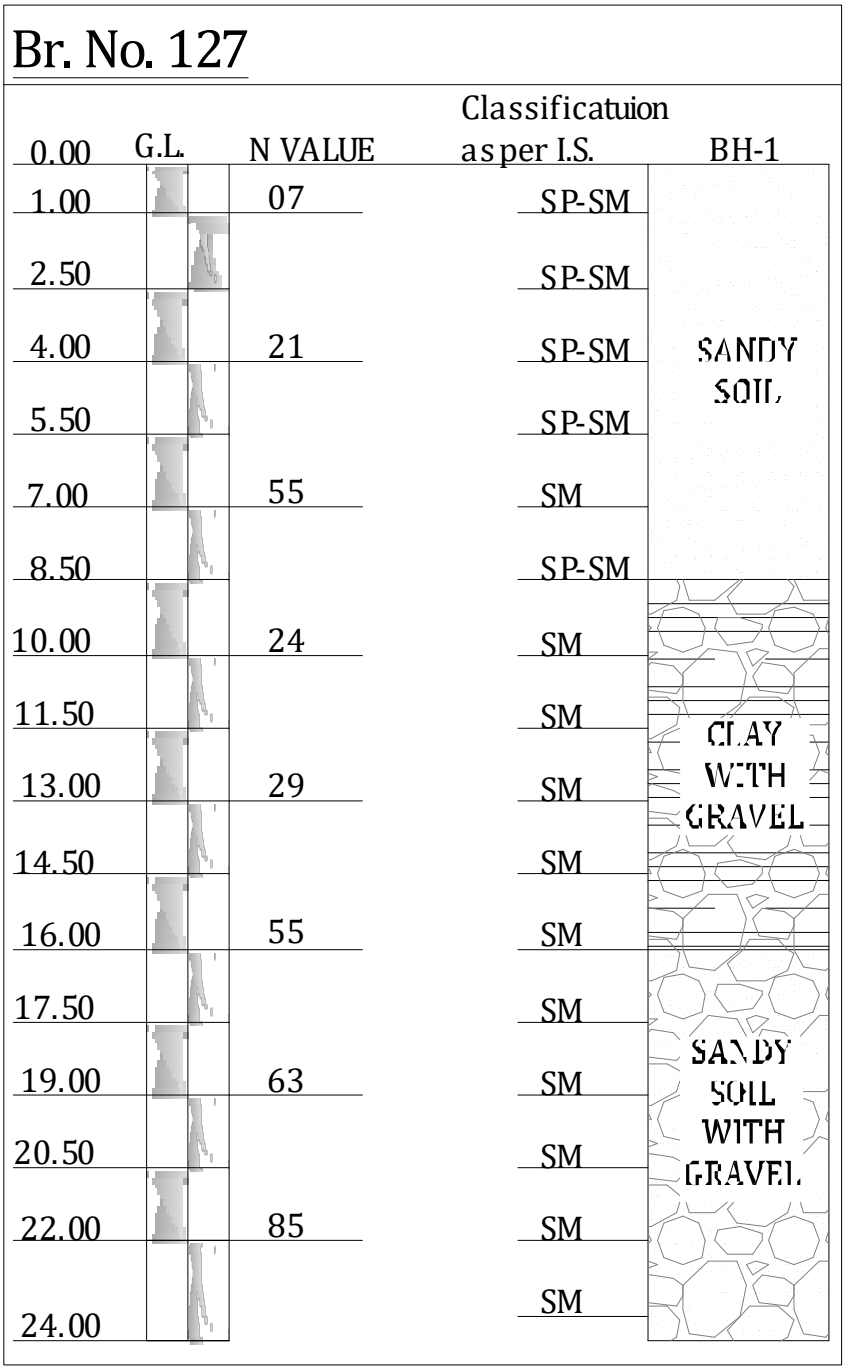
Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	7	11	Sandy Soil	236.33	SP-SM
2.50	UDS	-	Sandy Soil	234.83	SP-SM
4.00	21	23	Sandy Soil	233.33	SP-SM
5.50	UDS	-	Sandy Soil	231.83	SP-SM
7.00	55	52	Sandy Soil	230.33	SM
8.50	UDS	-	Sandy Soil	228.83	SP-SM
10.00	24	19	Sandy soil with Gravel	227.33	SM
11.50	UDS	-	Sandy soil with Gravel	225.83	SM
13.00	29	21	Sandy soil with Gravel	224.33	SM
14.50	UDS	-	Sandy soil with Gravel	222.83	SM
16.00	55	36	Sandy soil with Gravel	221.33	SM
17.50	UDS	-	Sandy soil with Gravel	219.83	SM
19.00	63	38	Sandy soil with Gravel	218.33	SM
20.50	UDS	-	Sandy soil with Gravel	216.83	SM
22.00	85	47	Sandy soil with Gravel	215.33	SM
24.00	UDS	-	Sandy soil with Gravel	213.33	SM

BH Terminates at 24.50m

Water Found at 17.0m

Br. No. 127


Classificatuion
0.00 G.L.
N VALUE
as per I.S.
BH-1
1.00
07
SP-SM
2.50
SP-SM
4.00
21
SP-SM
SANDY SOIL
5.50
SP-SM
7.00
55
SM
8.50
SP-SM
10.00
24
SM
11.50
SM
CLAY WITH GRAVEL
13.00
29
SM
14.50
SM
16.00
55
SM
17.50
SM
SANDY SOIL WITH GRAVEL
19.00
63
SM
20.50
SM
22.00
85
SM
SM
24.00

Laboratory Test Results

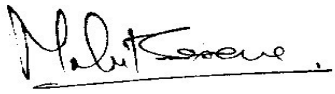
LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.04	12.70	0.00	16.06	20.44	12.23	34.73
Coarse Sand (%)	0.00	10.31	0.00	5.94	5.48	10.04	9.47
Medium Sand (%)	4.49	5.29	0.00	6.88	13.76	3.65	15.82
Fine Sand (%)	84.49	64.17	89.27	64.44	36.24	67.29	21.05
Clay And Silt Size (%)	10.98	7.53	10.73	6.69	24.08	6.79	18.93
Atterberg Limit							
Liquid Limit (%)	21.95	21.49	24.30	22.23	21.25	21.96	21.49
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.68	2.64	2.67	2.65	2.64	2.64	2.63
Void Ratio		0.71		0.55		0.63	
Density							
Moisture Content(%)	10.43	11.45	8.83	7.72	9.70	8.33	11.71
Bulk Density(kN/m^3)		16.87		18.05		17.17	
Dry Density (kN/m^3)		15.14		16.78		15.89	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.00		0.00		0.00	
Angle of Internal Friction (degree)		32		34		34	

Laboratory Test Results

LABORATORY TEST RESULTS :

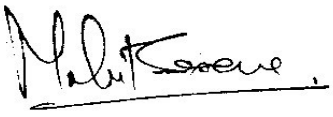
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**11.5m**	**13.0m**	**14.5m**	**16.0m**	**17.5m**	**19.5m**	**20.5m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	0.06	8.69	0.16	14.83	2.33	15.0	0.0
Coarse Sand (%)	0.13	9.11	0.48	6.37	3.61	1.2	0.1
Medium Sand (%)	1.03	19.33	1.53	22.81	9.38	9.2	1.5
Fine Sand (%)	81.16	34.35	82.69	40.60	67.30	62.2	82.9
Clay And Silt Size (%)	17.63	28.52	15.15	15.38	17.39	12.33	15.40
Atterberg Limit							
Liquid Limit (%)	24.60	23.19	23.74	21.22	21.58	24.04	22.00
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.66	2.66	2.69	2.66	2.66	2.67	2.67
Void Ratio	0.73		0.70		0.68		0.66
Density							
Moisture Content(%)	13.91	11.01	10.51	12.63	12.49	10.22	9.71
Bulk Density(kN/m^3)	16.87		17.16		17.46		17.27
Dry Density (kN/m^3)	15.11		15.53		15.50		15.73
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)	0.06		0.06		0.06		0.07
Angle of Internal Friction (degree)	33		33		33		33



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**		
	Depth		
Gradation Analysis	**22.0m**	**24.0m**	
Cobble (%)	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	
Fine Gravel (%)	8.84	0.06	
Coarse Sand (%)	4.03	0.53	
Medium Sand (%)	18.19	1.98	
Fine Sand (%)	48.84	77.11	
Clay And Silt Size (%)	20.10	20.33	
Atterberg Limit			
Liquid Limit (%)	22.00	20.63	
Plastic Limit (%)	-	-	
Plasticity Index (%)	NPI	NPI	
Sp. Gravity	2.65	2.68	
Density			
Moisture Content(%)	14.95	8.30	
Bulk Density(kN/m^3)		17.44	
Dry Density (kN/m^3)		0.50	
Shear Strength Parameters			
Unit Cohesion (kg/cm^2)		0.07	
Angle of Internal Friction (degree)		32	



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle **B = 8.30** **L = 8.00**

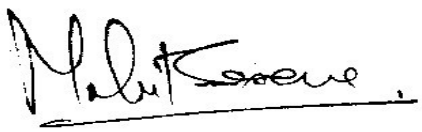
ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.69	17.00	0.00	31.00	32.67	20.63	25.99	1.21	1.21	0.59
1.69	20.00	0.00	31.00	32.67	20.63	25.99	1.21	1.21	0.59
1.69	23.00	0.00	31.00	32.67	20.63	25.99	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.04	1.02	1.02	1.00	8.30	1.69	49.84	**1.77**	**21.46**	0.71
1.04	1.03	1.03	1.50	8.30	2.53	57.24	**1.77**	**24.92**	0.71
1.04	1.04	1.04	2.00	8.30	3.37	64.77	**1.77**	**64.77**	0.55

ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.69	17.00	0.00	21.95	16.88	7.82	7.13	1.21	1.21	0.59
1.69	20.00	0.00	21.95	16.88	7.82	7.13	1.21	1.21	0.59
1.69	23.00	0.00	21.95	16.88	7.82	7.13	1.21	1.21	0.59

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.04	1.02	1.02	1.00	8.30	1.69	14.62	**1.48**	10.47
1.05	1.03	1.03	1.50	8.30	2.53	17.12	**1.48**	12.31
1.07	1.04	1.04	2.00	8.30	3.37	19.67	**1.48**	13.96

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	MIxed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	8.30	49.84	14.62	21.46	**20.94**	**20.94**
2		1.50	8.30	57.24	17.12	24.92	**24.62**	**24.62**
3		2.00	8.30	64.77	19.67	64.77	**27.91**	**27.91**



Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.00	32	0.002	
5.5	8.5	0.00	34	0.002	
8.5	11.5	0.06	33	0.002	
11.5	14.5	0.06	33	0.002	
14.5	17.5	0.06	33	0.001	Submerged Taken
17.5	20.5	0.07	33	0.001	
20.5	22.3	0.07	32	0.001	

1 For 1.2m Dia. and 20m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.29	120686	32.00	0.625	**21.79**
5.5-8.5	300.00	620.00	1	0.84	113143	34.00	0.675	**63.77**
8.5-11.5	300.00	920.00	1	1.35	113143	33.00	0.650	**98.93**
11.5-14.5	300.00	1220.00	1	1.86	113143	33.00	0.650	**136.46**
14.5-17.5	300.00	1520.00	1	2.23	113143	33.00	0.650	**163.61**
17.5-20.5	300.00	1820.00	1	2.45	113143	33.00	0.650	**179.85**
20.5-22.3	180.00	2000.00	1	2.62	67886	32.00	0.625	**111.23**
Total Ultimate Shaft Resistance (R_f)								**775.64**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.00	120685.7	0.00	**0.00**
5.5-8.5	300.00	1	0.3	0.00	113142.9	0.00	**0.00**
8.5-11.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
11.5-14.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.07	113142.9	2376.00	**2.38**
20.5-22.3	180.00	1	0.3	0.07	67885.7	1425.60	**1.43**
Total Ultimate Shaft Resistance (R_f)							**9.91**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **807.88 tons**

So,

q_{ult} = Ru + Rf,

= **1593.43 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	32	°
Nc	=	9.00	
Nγ	=	30.22	
Nq	=	25.90	
Length	=	2000.00	cm
Pd	=	2.69	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 20m and 1.2m

1593.43 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **637.37 tons**

11.2.1 Lateral Load Capacity

As per IS:2911(PartI/Sec2)

D=	Dia of pile		=	1.20	m
L_1=	Free length of pile		=	0	m
E=	Young's modulus of plie material=5000xsqrt(fck)		=	295804.0	kg/cm2
I=	$p*D^4/64$		=	1.0E+07	cm4
f =	Blows 10-35	Medium Sand	=	28.67	Blows (Av
K_1=	Constant		=	0.623	kg/cm3
T=	$(EI/K_1)^{1/5}$		=	344.19	
L_1/T=			=	0.00	
L_f/T=	(from fig.2 of Appendix B)		=	2.20	
Depth of Fixity(L_f)=			=	757.21	cm
(L_1+L_f)=			=	7.57	**m**
For Fixed head Pile	$Y = Q(L_1+L_f)^3/(12EI)$				
Y = lateral deflection			=	5	mm
Q = Lateral capacity of pile			=	41609.74	kg
			=	416.10	kN
		Say	**=**	**416**	**kN**

BRIDGE NO. 128

Standard Penetration Test Result

Bore Hole at Bridge No.-128

Date of Field Test - 01-01-2021 **Bore Hole NGL -235.096**

BH - Coordinates - E 3140824.69, N 683428.398

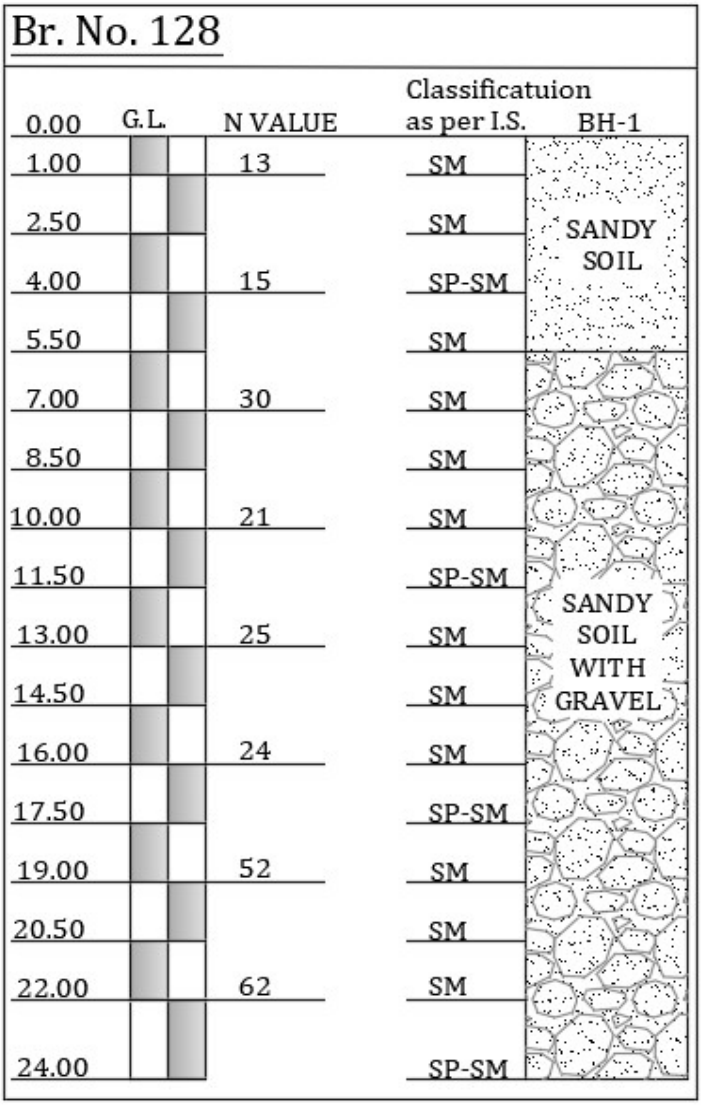
Field Data

Depth below ground	N-values BH-1			BH Levels	Soil Classification
Level (m)	N	Corrected	Description		
1.00	13	20	Sandy Soil	234.10	SM
2.50	UDS	-	Sandy Soil	232.60	SM
4.00	15	16	Sandy Soil	231.10	SP-SM
5.50	UDS	-	Sandy Soil	229.60	SM
7.00	30	28	Sandy soil with Gravel	228.10	SM
8.50	UDS	-	Sandy soil with Gravel	226.60	SM
10.00	21	17	Sandy soil with Gravel	225.10	SM
11.50	UDS	-	Sandy soil with Gravel	223.60	SP-SM
13.00	25	18	Sandy soil with Gravel	222.10	SM
14.50	UDS	-	Sandy soil with Gravel	220.60	SM
16.00	24	15	Sandy soil with Gravel	219.10	SM
17.50	UDS	-	Sandy soil with Gravel	217.60	SP-SM
19.00	52	31	Sandy soil with Gravel	216.10	SM
20.50	UDS	-	Sandy soil with Gravel	214.60	SP-SM
22.00	62	34	Sandy soil with Gravel	213.10	SP-SM
24.00	UDS	-	Sandy soil with Gravel	211.10	SM

BH Terminates at 24.50m

Water Found at 16.0m

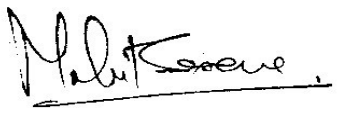
Br. No. 128


0.00
G.L.
N VALUE
Classificatuion as per I.S.
BH-1
1.00
13
SM
2.50
SM
SANDY SOIL
4.00
15
SP-SM
5.50
SM
7.00
30
SM
8.50
SM
10.00
21
SM
11.50
SP-SM
SANDY SOIL WITH GRAVEL
13.00
25
SM
14.50
SM
16.00
24
SM
17.50
SP-SM
19.00
52
SM
20.50
SM
22.00
62
SM
24.00
SP-SM

Laboratory Test Results

LABORATORY TEST RESULTS :

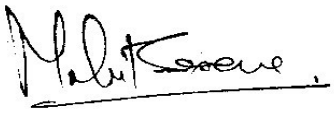
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.00	1.05	1.42	1.16	11.15	6.11	6.80
Coarse Sand (%)	0.00	1.14	0.34	2.45	8.54	7.13	2.15
Medium Sand (%)	0.00	7.73	0.68	4.77	15.88	4.66	25.18
Fine Sand (%)	83.96	77.14	87.10	69.89	31.91	68.21	45.59
Clay And Silt Size (%)	16.04	12.95	10.45	21.73	32.52	13.90	20.28
Atterberg Limit							
Liquid Limit (%)	23.65	22.57	22.26	24.12	22.64	23.77	22.56
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.69	2.68	2.67	2.66	2.65	2.67	2.67
Void Ratio		0.70		0.70		0.59	
Density							
Moisture Content(%)	5.91	11.38	16.50	13.96	9.40	11.17	15.04
Bulk Density(kN/m^3)		17.27		17.46		18.34	
Dry Density (kN/m^3)		15.50		15.32		16.50	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.06		0.05		0.00	
Angle of Internal Friction (degree)		30		30		32	



Laboratory Test Results

LABORATORY TEST RESULTS :

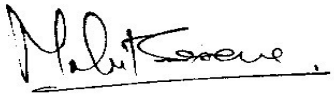
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**11.5m**	**13.0m**	**14.5m**	**16.0m**	**17.5m**	**19.0m**	**20.5m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	10.39	15.77	1.16	19.21	10.46	26.1	10.8
Coarse Sand (%)	8.33	3.55	1.42	8.76	14.49	9.7	6.9
Medium Sand (%)	5.36	3.41	3.28	11.27	11.61	14.3	4.3
Fine Sand (%)	64.62	61.66	76.90	48.56	57.45	35.4	66.9
Clay And Silt Size (%)	11.31	15.61	17.25	12.19	6.00	14.55	11.06
Atterberg Limit							
Liquid Limit (%)	23.55	21.70	23.56	21.67	21.72	20.51	23.08
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.67	2.66	2.68	2.63	2.68	2.62	2.61
Void Ratio	0.65		0.67		0.62		0.62
Density							
Moisture Content(%)	9.53	9.48	11.76	17.34	10.16	12.08	13.79
Bulk Density(kN/m^3)	17.36		17.56		17.85		17.95
Dry Density (kN/m^3)	15.85		15.71		16.21		15.78
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)	0.03		0.08		0.00		0.03
Angle of Internal Friction (degree)	33		32		35		34



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**		
	Depth		
Gradation Analysis	**22.0m**	**24.0m**	
Cobble (%)	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	
Fine Gravel (%)	27.90	10.45	
Coarse Sand (%)	20.40	8.31	
Medium Sand (%)	10.82	15.66	
Fine Sand (%)	32.29	53.39	
Clay And Silt Size (%)	8.58	12.19	
Atterberg Limit			
Liquid Limit (%)	21.71	23.15	
Plastic Limit (%)	-	-	
Plasticity Index (%)	NPI	NPI	
Sp. Gravity	-	2.66	
Density			
Moisture Content(%)	18.78	10.54	
Bulk Density(kN/m^3)		18.15	
Dry Density (kN/m^3)		16.42	
Shear Strength Parameters			
Unit Cohesion (kg/cm^2)		0.03	
Angle of Internal Friction (degree)		35	



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 6.10 L = 8.00

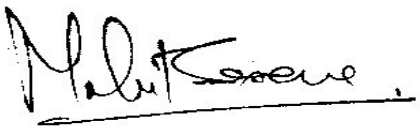
Ɣ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.73	18.00	0.59	29.00	27.86	16.44	19.34	1.15	1.15	0.70
1.73	17.00	0.59	29.00	27.86	16.44	19.34	1.15	1.15	0.70
1.73	16.00	0.59	29.00	27.86	16.44	19.34	1.15	1.15	0.70

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.06	1.03	1.03	1.00	6.10	1.73	41.45	**1.70**	**21.17**	0.70
1.06	1.04	1.04	1.50	6.10	2.59	47.26	**1.70**	**24.22**	0.70
1.06	1.06	1.06	2.00	6.10	3.45	53.20	**1.70**	**26.50**	0.70

Ɣ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.73	18.00	0.59	20.41	14.83	6.40	5.39	1.15	1.15	0.70
1.73	17.00	0.59	20.41	14.83	6.40	5.39	1.15	1.15	0.70
1.73	16.00	0.59	20.41	14.83	6.40	5.39	1.15	1.15	0.70

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.05	1.02	1.02	1.00	6.10	1.73	13.92	**1.44**	11.33
1.07	1.04	1.04	1.50	6.10	2.59	15.98	**1.44**	10.05
1.09	1.05	1.05	2.00	6.10	3.45	18.07	**1.44**	9.20

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m²				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	6.10	41.45	13.92	21.17	**22.66**	**21.17**
2		1.50	6.10	47.26	15.98	24.22	**20.10**	**20.10**
3		2.00	6.10	53.20	18.07	26.50	**18.39**	**18.39**



Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.05	30	0.002	
5.5	8.5	0.00	32	0.002	
8.5	12.0	0.03	33	0.002	
12.0	14.5	0.08	32	0.001	Submerged Taken
14.5	17.5	0.00	35	0.001	
17.5	20.5	0.03	34	0.001	
20.5	22.3	0.03	35	0.001	

1 For 1.2m Dia. and 20m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	30.00	0.578	**19.48**
5.5-8.5	300.00	620.00	1	0.83	113143	32.00	0.625	**58.99**
8.5-12	350.00	970.00	1	1.41	132000	33.00	0.650	**121.18**
12-14.5	250.00	1220.00	1	1.81	94286	32.00	0.625	**106.77**
14.5-17.5	300.00	1520.00	1	2.02	113143	35.00	0.701	**160.41**
17.5-20.5	300.00	1820.00	1	2.26	113143	34.00	0.675	**172.62**
20.5-22.3	180.00	2000.00	1	2.45	67886	35.00	0.701	**116.60**
Total Ultimate Shaft Resistance (R_f)								**756.04**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1962.57	**1.96**
5.5-8.5	300.00	1	0.3	0.00	113142.9	0.00	**0.00**
8.5-12	350.00	1	0.3	0.03	132000.0	1001.89	**1.00**
12-14.5	250.00	1	0.3	0.08	94285.7	2338.11	**2.34**
14.5-17.5	300.00	1	0.3	0.00	113142.9	152.22	**0.15**
17.5-20.5	300.00	1	0.3	0.03	113142.9	1153.49	**1.15**
20.5-22.3	180.00	1	0.3	0.03	67885.7	511.25	**0.51**
Total Ultimate Shaft Resistance (R_f)							**7.12**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **893.98 tons**

So,

q_{ult} = Ru + Rf,

= **1657.14 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2000.00	cm
Pd	=	2.52	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 20m and 1.2m

1657.14 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **662.86 tons**

11.2.1 Lateral Load Capacity

As per IS:2911(PartI/Sec2)

D=	Dia of pile		=	1.20	m
L_1=	Free length of pile		=	0	m
E=	Young's modulus of plie material=5000xsqrt(fck)		=	295804.0	kg/cm2
I=	$p*D^4/64$		=	1.0E+07	cm4
f =	Blows 10-35	Medium Sand	=	21.33	Blows (Av
K_1=	Constant		=	0.477	kg/cm3
T=	$(EI/K_1)^{1/5}$		=	363.16	
L_1/T=			=	0.00	
L_f/T=	(from fig.2 of Appendix B)		=	2.20	
Depth of Fixity(L_f)=			=	798.95	cm
(L_1+L_f)=			=	7.99	**m**
For Fixed head Pile	$Y = Q(L_1+L_f)^3/(12EI)$				
Y = lateral deflection			=	5	mm
Q = Lateral capacity of pile			=	35423.51	kg
			=	354.24	kN
		Say	**=**	**354**	**kN**

BRIDGE NO. 129

Standard Penetration Test Result

Bore Hole at Bridge No.-129(1)

Date of Field Test - 20-12-2020 **Bore Hole NGL -229.027**

BH - Coordinates - E 3142457.998, N 683043.446

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	15	23	Sandy Soil	228.03	SP
2.50	UDS	-	Silty Sand	226.53	SM
4.00	52	58	Sandy Soil	225.03	SP
5.50	UDS	-	Silty Sand	223.53	SM
7.00	58	54	Silty Sand	222.03	SM
8.50	UDS	-	Silty Sand	220.53	SP-SM
10.00	>100	-	Moorum with Gravel	219.03	SM
11.50	UDS	-	Moorum with Gravel	217.53	SP-SM
13.00	>100	-	Moorum with Gravel	216.03	SP-SM
14.50	>100	-	Moorum with Gravel	214.53	SM
16.00	78	51	Moorum with Gravel	213.03	SM
17.50	UDS	-	Sandy soil with Gravel	211.53	SM
19.00	83	49	Sandy soil with Gravel	210.03	SM
20.50	UDS	-	Sandy soil with Gravel	208.53	SM
22.00	85	46	Sandy Soil	207.03	SP-SM
23.50	UDS	-	Sandy Soil	205.53	SP-SM
25.00	97	49	Sandy Soil	204.03	SP-SM

Standard Penetration Test Result

Bore Hole at Bridge No.-129(1)

Date of Field Test - 20-12-2020 **Bore Hole NGL -229.027**

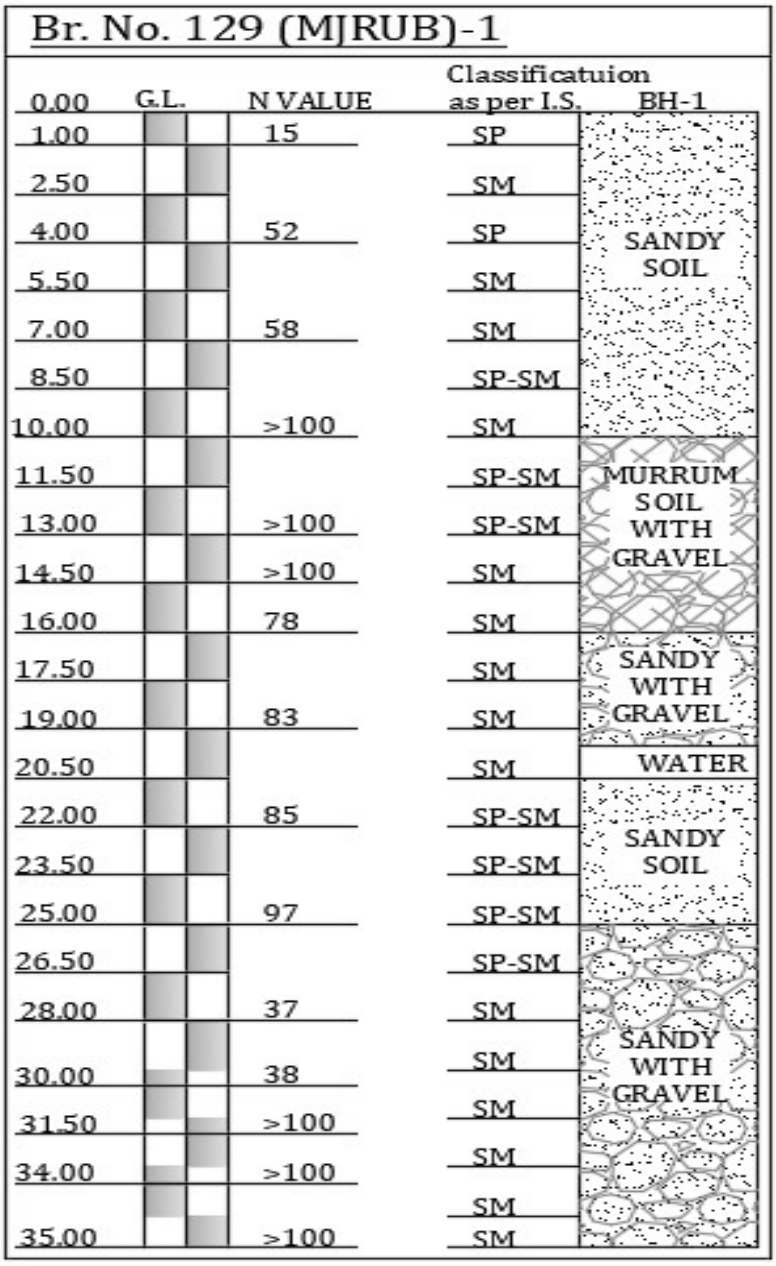
BH - Coordinates - E 3142457.998, N 683043.446

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
26.50	UDS	-	Sandy soil with Gravel	202.53	SM
28.00	37	17	Sandy soil with Gravel	201.03	SM
30.00	38	17	Sandy soil with Gravel	199.03	SM
31.00	>100	-	Sandy soil with Gravel	198.03	SM
34.00	>100	-	Sandy soil with Gravel	195.03	SM
35.00	>100	-	Sandy soil with Gravel	194.03	SM

Bore Hole Terminated at 35.50m

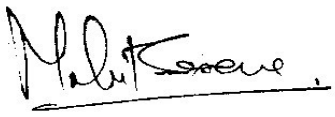
Water Found at 19.5m Level


Br. No. 129 (MJRUB)-1
0.00
G.L.
N VALUE
Classificatuion as per I.S.
BH-1
1.00
15
SP
2.50
SM
4.00
52
SP
5.50
SM
7.00
58
SM
8.50
SP-SM
10.00
>100
SM
11.50
SP-SM
13.00
>100
SP-SM
14.50
>100
SM
16.00
78
SM
17.50
SM
19.00
83
SM
20.50
SM
22.00
85
SP-SM
23.50
SP-SM
25.00
97
SP-SM
26.50
SP-SM
28.00
37
SM
30.00
38
SM
31.50
>100
SM
34.00
>100
SM
35.00
>100
SM
SANDY SOIL
MURRUM SOIL WITH GRAVEL
SANDY WITH GRAVEL
WATER
SANDY SOIL
SANDY WITH GRAVEL

Laboratory Test Results

LABORATORY TEST RESULTS :

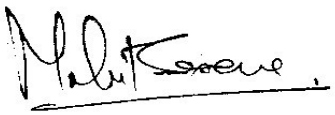
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.00	2.16	0.00	0.04	6.50	0.17	22.07
Coarse Sand (%)	0.00	3.79	0.00	0.09	0.78	0.61	5.90
Medium Sand (%)	0.00	9.69	0.04	0.82	3.18	1.97	8.85
Fine Sand (%)	95.32	70.64	97.40	85.68	77.50	85.31	49.03
Clay And Silt Size (%)	4.68	13.71	2.56	13.37	12.05	11.94	14.16
Atterberg Limit							
Liquid Limit (%)	22.59	22.41	24.30	24.81	23.13	23.09	20.22
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.67	2.66	2.66	2.66	2.67	2.65	2.67
Void Ratio		0.63		0.55		0.55	
Density							
Moisture Content(%)	5.72	9.10	2.07	6.50	9.78	6.90	11.24
Bulk Density(kN/m^3)		17.46		18.44		17.95	
Dry Density (kN/m^3)		16.00		17.32		16.79	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.05		0.05		0.05	
Angle of Internal Friction (degree)		33		33		33	



Laboratory Test Results

LABORATORY TEST RESULTS :

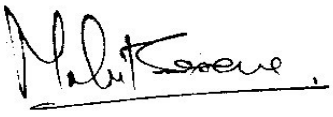
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**11.5m**	**13.0m**	**14.5m**	**16.0m**	**17.5m**	**19.0m**	**22.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	12.56	25.48	12.02	3.40	0.04	2.3	10.3
Coarse Sand (%)	10.35	2.80	11.75	2.99	0.13	1.5	2.1
Medium Sand (%)	4.43	6.11	17.63	13.18	1.94	10.3	1.7
Fine Sand (%)	65.35	55.23	36.87	60.07	79.96	59.8	74.8
Clay And Silt Size (%)	7.31	10.38	21.73	20.36	17.93	26.06	11.09
Atterberg Limit							
Liquid Limit (%)	22.78	21.55	22.41	22.05	24.48	24.07	22.80
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.66	2.64	2.67	2.65	2.63	2.63	2.64
Void Ratio	0.55		0.72		0.55		
Density							
Moisture Content(%)	4.48	9.93	21.56	14.60	5.42	15.58	14.69
Bulk Density(kN/m^3)	18.93		18.54		18.34		
Dry Density (kN/m^3)	18.12		15.25		17.40		
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)	0.03		0.06		0.06		
Angle of Internal Friction (degree)	34		34		34		



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**25.0m**	**28.0m**	**30.0m**	**31.5m**	**33.0m**	**35.0m**	
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	
Fine Gravel (%)	22.07	19.20	3.07	0.00	0.00	0.0	
Coarse Sand (%)	10.50	19.25	2.32	1.42	1.47	2.1	
Medium Sand (%)	11.22	19.46	3.82	0.97	2.83	1.9	
Fine Sand (%)	46.37	26.77	70.88	77.83	76.80	75.2	
Clay And Silt Size (%)	9.84	15.32	19.91	19.77	18.89	20.80	
Atterberg Limit							
Liquid Limit (%)	22.13	-	22.63	23.58	23.35	23.92	
Plastic Limit (%)	-	-	-	-	-	-	
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	
Sp. Gravity	2.67	2.64	2.65	2.68	2.67	2.67	
Density							
Moisture Content(%)	12.76	14.84	13.69	13.75	14.90	14.48	
Bulk Density(kN/m^3)							
Dry Density (kN/m^3)							
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)							
Angle of Internal Friction (degree)							



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - **Rectangle** **B** **=** **5.00** **L** **=** **8.00**

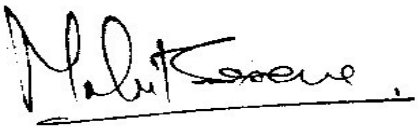
Ɣ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.75	30.00	0.50	32.00	35.49	23.18	30.22	1.13	1.13	0.75
1.75	39.00	0.50	32.00	35.49	23.18	30.22	1.13	1.13	0.75
1.75	48.00	0.50	33.00	38.64	26.09	35.19	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.14	1.07	1.07	2.00	5.00	3.49	74.11	**1.80**	**53.42**	0.63
1.14	1.11	1.11	3.00	5.00	5.24	92.44	**1.80**	**66.87**	0.63
1.14	1.15	1.15	4.00	5.00	6.98	127.73	**1.84**	**92.40**	0.63

Ɣ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.75	30.00	0.50	22.78	18.05	8.66	8.20	1.13	1.13	0.75
1.75	39.00	0.50	22.78	18.05	8.66	8.20	1.13	1.13	0.75
1.75	48.00	0.50	23.56	19.32	9.60	9.44	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.12	1.06	1.06	2.00	5.00	3.49	22.66	**1.50**	21.05
1.18	1.09	1.09	3.00	5.00	5.24	28.84	**1.50**	28.17
1.24	1.12	1.12	4.00	5.00	6.98	39.85	**1.53**	33.90

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m²				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	2.00	5.00	74.11	22.66	53.42	**33.68**	**33.68**
2		3.00	5.00	92.44	28.84	66.87	**45.07**	**45.07**
3		4.00	5.00	127.73	39.85	92.40	**54.24**	**54.24**



Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.30	5.5	0.05	33.00	0.002	
5.50	8.5	0.05	33.00	0.002	
8.50	11.5	0.05	33.00	0.002	
11.50	14.5	0.03	34.00	0.002	
14.50	17.5	0.06	34.00	0.001	Submerged Taken
17.50	20.5	0.06	34.00	0.001	
20.50	22.3	0.06	34.00	0.001	

1 For 1.2m Dia. and 20m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.84	113143	33.00	0.650	**61.41**
8.5-11.5	300.00	920.00	1	1.38	113143	33.00	0.650	**101.55**
11.5-14.5	300.00	1220.00	1	1.93	113143	34.00	0.675	**147.72**
14.5-17.5	300.00	1520.00	1	2.35	113143	34.00	0.675	**179.19**
17.5-20.5	300.00	1820.00	1	2.60	113143	34.00	0.675	**198.53**
20.5-22.3	180.00	2000.00	1	2.80	67886	34.00	0.675	**128.29**
Total Ultimate Shaft Resistance (R_f)								**838.59**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
8.5-11.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
11.5-14.5	300.00	1	0.3	0.03	113142.9	1018.29	**1.02**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
20.5-22.3	180.00	1	0.3	0.06	67885.7	1221.94	**1.22**
Total Ultimate Shaft Resistance (R_f)							**11.52**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **1011.59 tons**

So,

q_{ult} = Ru + Rf,

= **1861.70 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2000.00	cm
Pd	=	2.88	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 20m and 1.2m
1861.70 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **744.68 tons**

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	33.0	0.002	
5.5	8.5	0.1	33.0	0.002	
8.5	11.5	0.1	33.0	0.002	
11.5	14.5	0.0	34.0	0.002	
14.5	17.5	0.1	34.0	0.001	Submerged Taken
17.5	20.5	0.1	34.0	0.001	
20.5	26.3	0.1	34.0	0.001	

1 For 1.2m Dia. and 24m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.84	113143	33.00	0.650	**61.41**
8.5-11.5	300.00	920.00	1	1.38	113143	33.00	0.650	**101.55**
11.5-14.5	300.00	1220.00	1	1.93	113143	34.00	0.675	**147.72**
14.5-17.5	300.00	1520.00	1	2.35	113143	34.00	0.675	**179.19**
17.5-20.5	300.00	1820.00	1	2.60	113143	34.00	0.675	**198.53**
20.5-26.3	580.00	2400.00	1	2.97	218743	34.00	0.675	**438.02**
Total Ultimate Shaft Resistance (R_f)								**1148.32**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
8.5-11.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
11.5-14.5	300.00	1	0.3	0.03	113142.9	1018.29	**1.02**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
20.5-26.3	580.00	1	0.3	0.06	218742.9	3937.37	**3.94**
Total Ultimate Shaft Resistance (R_f)							**14.23**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **1126.4 tons**

So,

q_{ult} = Ru + Rf,

= **2288.9 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2400.00	cm
Pd	=	3.21	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 24m and 1.2m

2288.9 tons.

Factor of Safety = 2.5

Allowable bearing capacity = 915.56 tons

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	33.0	0.002	
5.5	8.5	0.1	33.0	0.002	
8.5	11.5	0.1	33.0	0.002	
11.5	14.5	0.0	34.0	0.002	
14.5	17.5	0.1	34.0	0.001	Submerged Taken
17.5	20.5	0.1	34.0	0.001	
20.5	30.3	0.1	34.0	0.001	

1 For 1.2m Dia. and 28m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.84	113143	33.00	0.650	**61.41**
8.5-11.5	300.00	920.00	1	1.38	113143	33.00	0.650	**101.55**
11.5-14.5	300.00	1220.00	1	1.93	113143	34.00	0.675	**147.72**
14.5-17.5	300.00	1520.00	1	2.35	113143	34.00	0.675	**179.19**
17.5-20.5	300.00	1820.00	1	2.60	113143	34.00	0.675	**198.53**
20.5-30.3	980.00	2800.00	1	2.97	369600	34.00	0.675	**740.10**
Total Ultimate Shaft Resistance (R_f)								**1450.40**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
8.5-11.5	300.00	1	0.3	0.05	113142.9	1697.14	**1.70**
11.5-14.5	300.00	1	0.3	0.03	113142.9	1018.29	**1.02**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
20.5-30.3	980.00	1	0.3	0.06	369600.0	6652.80	**6.65**
Total Ultimate Shaft Resistance (R_f)							**16.95**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **1126.4 tons**

So,

q_{ult} = Ru + Rf,

= **2593.7 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2800.00	cm
Pd	=	3.21	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 28m and 1.2m

2593.7 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **1037.48 tons**

11.2.1 Lateral Load Capacity

As per IS:2911(PartI/Sec2)

D=	Dia of pile		=	1.20	m
L_1=	Free length of pile		=	0	m
E=	Young's modulus of plie material=5000xsqrt(fck)		=	295804.0	kg/cm2
I=	$p*D^4/64$		=	1.0E+07	cm4
f =	Blows 35-100	Dense Sand	=	45.00	Blows (Av
K_1=	Constant		=	1.423	kg/cm3
T=	$(EI/K_1)^{1/5}$		=	291.81	
L_1/T=			=	0.00	
L_f/T=	(from fig.2 of Appendix B)		=	2.20	
Depth of Fixity(L_f)=			=	641.97	cm
(L_1+L_f)=			=	6.42	**m**
For Fixed head Pile		$Y = Q(L_1+L_f)^3/(12EI)$			
Y = lateral deflection			=	5	mm
Q = Lateral capacity of pile			=	68280.99	kg
			=	682.81	kN
		Say	=	**683**	**kN**

Standard Penetration Test Result

Bore Hole at Bridge No.-129(2)

Date of Field Test - 26-12-2020 **Bore Hole NGL - 228.1**

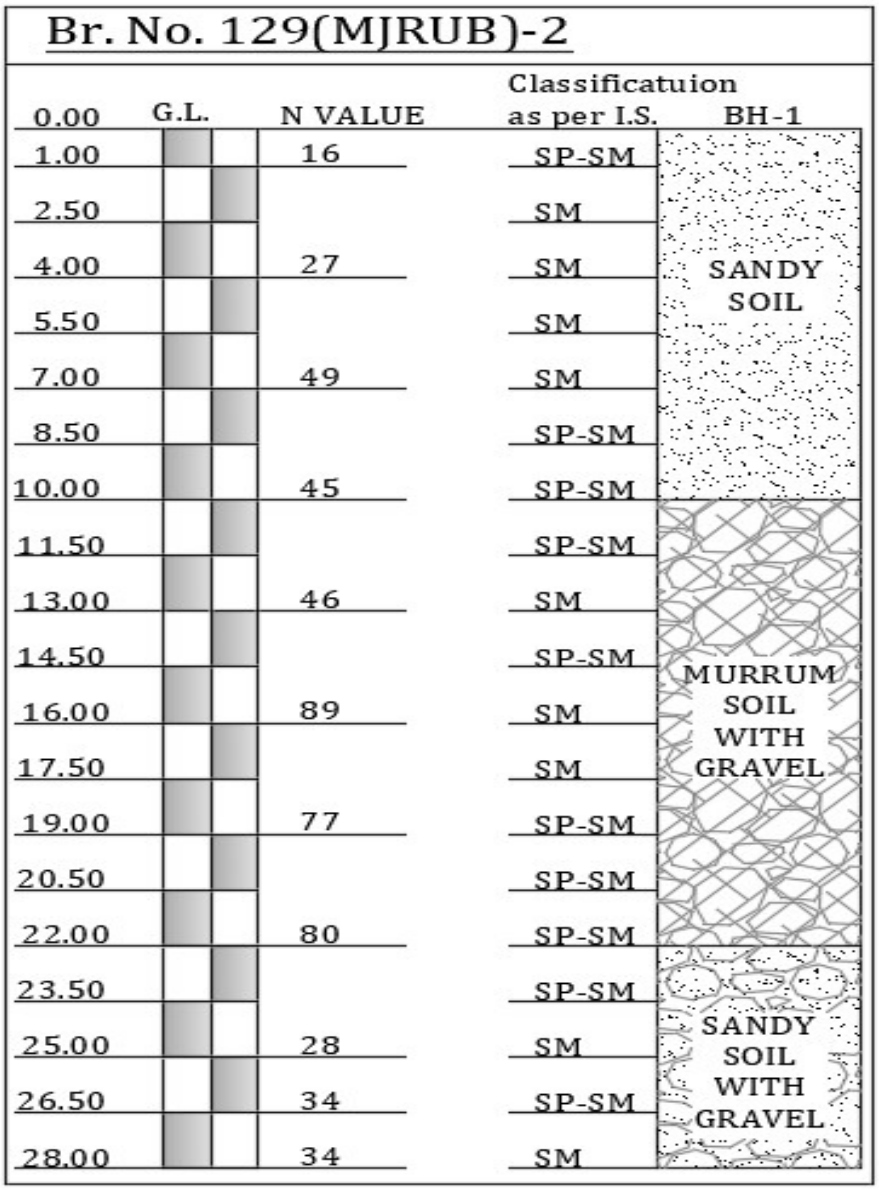
BH - Coordinates - E 3142537.143, N 683128.281

Field Data

Depth below ground Level (m)	N-values BH-1			BH Levels	Soil Classification
	N	Corrected	Description		
1.00	16	25	Silty sand with Kankars	227.10	SP-SM
2.50	UDS	-	Silty sand with Kankars	225.60	SM
4.00	27	30	Silty sand with Kankars	224.10	SM
5.50	UDS	-	Silty sand with Kankars	222.60	SM
7.00	49	45	Silty sand with Kankars	221.10	SM
8.50	UDS	-	Silty sand with Kankars	219.60	SP-SM
10.00	45	36	Moorum with Gravel	218.10	SP-SM
11.50	UDS	-	Moorum with Gravel	216.60	SP-SM
13.00	46	33	Moorum with Gravel	215.10	SM
14.50	UDS	-	Moorum with Gravel	213.60	SP-SM
16.00	89	58	Moorum with Gravel	212.10	SM
17.50	UDS	-	Moorum with Gravel	210.60	SM
19.00	77	45	Moorum with Gravel	209.10	SP-SM
20.50	UDS	-	Moorum with Gravel	207.60	SP-SM
22.00	80	43	Moorum with Gravel	206.10	SP-SM
23.50	UDS	-	Sandy soil with Gravel	204.60	SP-SM
25.00	28	14	Sandy soil with Gravel	203.10	SM

Depth below ground	N-values				
	BH-1				
26.50	34	16	Sandy soil with Gravel	201.60	SP-SM
28.00	34	15	Sandy soil with Gravel	200.10	SM

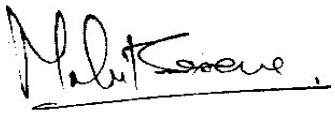
Bore Hole Terminated at 28.50m
Water Found at 18.5m Level



Laboratory Test Results

LABORATORY TEST RESULTS :

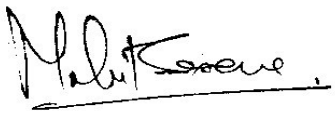
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	11.11	10.16	27.13	15.58	24.82	33.27	23.59
Coarse Sand (%)	6.53	10.99	7.41	4.09	11.10	6.22	6.00
Medium Sand (%)	17.62	5.53	12.53	16.45	21.96	10.54	22.13
Fine Sand (%)	53.99	58.93	31.23	49.72	27.45	43.46	38.56
Clay And Silt Size (%)	10.76	14.39	21.71	14.16	14.67	6.51	9.72
Atterberg Limit							
Liquid Limit (%)	24.33	21.90	19.42	19.67	19.63	19.65	23.38
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.63	2.65	2.61	2.69	2.62	2.69	2.60
Void Ratio		0.64		0.71		0.63	
Density							
Moisture Content(%)	11.84	11.65	8.93	13.92	9.65	13.01	14.09
Bulk Density(kN/m^3)		17.65		17.55		18.34	
Dry Density (kN/m^3)		15.81		15.41		16.19	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.05		0.02		0.02	
Angle of Internal Friction (degree)		34		35		36	



Laboratory Test Results

LABORATORY TEST RESULTS :

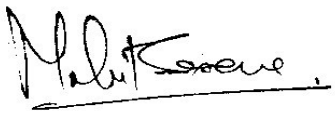
Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**11.5m**	**13.0m**	**14.5m**	**16.0m**	**19.0m**	**20.5m**	**22.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	28.21	27.22	31.18	16.34	29.14	26.8	27.4
Coarse Sand (%)	8.20	8.93	5.56	9.22	11.63	7.7	6.9
Medium Sand (%)	12.93	21.20	8.75	24.59	17.22	6.8	7.3
Fine Sand (%)	45.58	30.52	49.47	30.37	30.38	53.1	53.4
Clay And Silt Size (%)	5.09	12.12	5.04	19.49	11.63	5.51	5.06
Atterberg Limit							
Liquid Limit (%)	19.10	21.63	20.78	19.45	21.25	22.05	20.98
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.61	2.63	2.61	2.67	2.64	2.65	2.62
Void Ratio	0.55		0.55			0.55	
Density							
Moisture Content(%)	8.15	10.24	7.99	8.03	11.04	10.20	13.27
Bulk Density(kN/m^3)	18.63		18.04			18.44	
Dry Density (kN/m^3)	17.23		16.71			16.78	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)	0.02		0.02			0.01	
Angle of Internal Friction (degree)	36		37			36	



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**				
	Depth				
Gradation Analysis	**23.5m**	**25.0m**	**26.5m**	**28.0m**	
Cobble (%)	0.00	0.00	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	0.00	0.00	
Fine Gravel (%)	29.56	14.10	4.12	13.03	
Coarse Sand (%)	8.33	5.27	21.31	2.95	
Medium Sand (%)	15.48	13.23	13.61	10.37	
Fine Sand (%)	38.00	50.35	54.94	69.47	
Clay And Silt Size (%)	8.63	17.06	6.02	4.18	
Atterberg Limit					
Liquid Limit (%)	21.34	23.53	24.72	23.34	
Plastic Limit (%)	-	-	-	-	
Plasticity Index (%)	NPI	NPI	NPI	NPI	
Sp. Gravity	2.62	2.70	2.68	2.65	
Void Ratio	0.64				
Density					
Moisture Content(%)	12.30	14.11	14.83	16.79	
Bulk Density(kN/m^3)	17.55				
Dry Density (kN/m^3)	15.63				
Shear Strength Parameters					
Unit Cohesion (kg/cm^2)	0.02				
Angle of Internal Friction (degree)	36				



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 5.00 L = 8.00

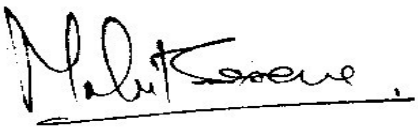
ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.77	28.00	0.52	33.00	38.64	26.09	35.19	1.13	1.13	0.75
1.77	33.00	0.52	33.00	38.64	26.09	35.19	1.13	1.13	0.75
1.77	38.00	0.52	33.00	38.64	26.09	35.19	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.15	1.07	1.07	2.00	5.00	3.53	86.02	**1.84**	**61.88**	0.63
1.15	1.11	1.11	3.00	5.00	5.30	107.11	**1.84**	**77.32**	0.63
1.15	1.15	1.15	4.00	5.00	7.06	129.43	**1.84**	**57.71**	0.71

ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.77	28.00	0.52	23.56	19.32	9.60	9.44	1.13	1.13	0.75
1.77	33.00	0.52	23.56	19.32	9.60	9.44	1.13	1.13	0.75
1.77	38.00	0.52	23.56	19.32	9.60	9.44	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.12	1.06	1.06	2.00	5.00	3.53	25.97	**1.53**	19.80
1.18	1.09	1.09	3.00	5.00	5.30	33.01	**1.53**	22.22
1.24	1.12	1.12	4.00	5.00	7.06	40.39	**1.53**	26.67

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	2.00	5.00	86.02	25.97	61.88	**31.68**	**31.68**
2		3.00	5.00	107.11	33.01	77.32	**35.56**	**35.56**
3		4.00	5.00	129.43	40.39	57.71	**42.67**	**42.67**



Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.30	5.5	0.05	33.00	0.002	
5.50	8.5	0.02	33.00	0.002	
8.50	11.5	0.02	33.00	0.002	
11.50	14.5	0.02	34.00	0.002	
14.50	17.5	0.06	34.00	0.001	Submerged Taken
17.50	20.5	0.01	36.00	0.001	
20.50	22.3	0.02	36.00	0.001	

1 For 1.2m Dia. and 20m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.82	113143	33.00	0.650	**60.43**
8.5-11.5	300.00	920.00	1	1.35	113143	33.00	0.650	**99.59**
11.5-14.5	300.00	1220.00	1	1.90	113143	34.00	0.675	**145.34**
14.5-17.5	300.00	1520.00	1	2.30	113143	34.00	0.675	**175.89**
17.5-20.5	300.00	1820.00	1	2.55	113143	36.00	0.727	**209.68**
20.5-22.3	180.00	2000.00	1	2.75	67886	36.00	0.727	**135.74**
Total Ultimate Shaft Resistance (R_f)								**848.58**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.02	113142.9	704.88	**0.70**
8.5-11.5	300.00	1	0.3	0.02	113142.9	553.77	**0.55**
11.5-14.5	300.00	1	0.3	0.02	113142.9	743.34	**0.74**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.01	113142.9	444.43	**0.44**
20.5-22.3	180.00	1	0.3	0.02	67885.7	321.19	**0.32**
Total Ultimate Shaft Resistance (R_f)							**6.61**

Ultimate Base Resistance:

$$\mathbf{R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p}$$

R_u = **994.22 tons**

So,

$\mathbf{q_{ult}}$ = Ru + Rf,

= **1849.41 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2000.00	cm
Pd	=	2.83	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 20m and 1.2m

1849.41 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **739.77 tons**

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	33.0	0.002	
5.5	8.5	0.0	33.0	0.002	
8.5	11.5	0.0	33.0	0.002	
11.5	14.5	0.0	34.0	0.002	
14.5	17.5	0.1	34.0	0.001	Submerged Taken
17.5	20.5	0.0	36.0	0.001	
20.5	26.3	0.0	36.0	0.001	

1 For 1.2m Dia. and 24m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.82	113143	33.00	0.650	**60.43**
8.5-11.5	300.00	920.00	1	1.35	113143	33.00	0.650	**99.59**
11.5-14.5	300.00	1220.00	1	1.90	113143	34.00	0.675	**145.34**
14.5-17.5	300.00	1520.00	1	2.30	113143	34.00	0.675	**175.89**
17.5-20.5	300.00	1820.00	1	2.55	113143	36.00	0.727	**209.68**
20.5-26.3	580.00	2400.00	1	2.92	218743	36.00	0.727	**464.22**
Total Ultimate Shaft Resistance (R_f)								**1177.07**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.02	113142.9	704.88	**0.70**
8.5-11.5	300.00	1	0.3	0.02	113142.9	553.77	**0.55**
11.5-14.5	300.00	1	0.3	0.02	113142.9	743.34	**0.74**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.01	113142.9	444.43	**0.44**
20.5-26.3	580.00	1	0.3	0.02	218742.9	1034.96	**1.03**
Total Ultimate Shaft Resistance (R_f)							**7.33**

Ultimate Base Resistance:

$$\mathbf{R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p}$$

R_u = **1110.3 tons**

So,

$\mathbf{q_{ult}}$ = Ru + Rf,

= **2294.7 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2400.00	cm
Pd	=	3.16	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 24m and 1.2m
2294.7 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **917.89 tons**

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	33.0	0.002	
5.5	8.5	0.0	33.0	0.002	
8.5	11.5	0.0	33.0	0.002	
11.5	14.5	0.0	34.0	0.002	
14.5	17.5	0.1	34.0	0.001	Submerged Taken
17.5	20.5	0.0	36.0	0.001	
20.5	30.3	0.0	36.0	0.001	

1 For 1.2m Dia. and 28m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.28	120686	33.00	0.650	**21.91**
5.5-8.5	300.00	620.00	1	0.82	113143	33.00	0.650	**60.43**
8.5-11.5	300.00	920.00	1	1.35	113143	33.00	0.650	**99.59**
11.5-14.5	300.00	1220.00	1	1.90	113143	34.00	0.675	**145.34**
14.5-17.5	300.00	1520.00	1	2.30	113143	34.00	0.675	**175.89**
17.5-20.5	300.00	1820.00	1	2.55	113143	36.00	0.727	**209.68**
20.5-30.3	980.00	2800.00	1	2.92	369600	36.00	0.727	**784.38**
Total Ultimate Shaft Resistance (R_f)								**1497.22**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.05	120685.7	1810.29	**1.81**
5.5-8.5	300.00	1	0.3	0.02	113142.9	704.88	**0.70**
8.5-11.5	300.00	1	0.3	0.02	113142.9	553.77	**0.55**
11.5-14.5	300.00	1	0.3	0.02	113142.9	743.34	**0.74**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2036.57	**2.04**
17.5-20.5	300.00	1	0.3	0.01	113142.9	444.43	**0.44**
20.5-30.3	980.00	1	0.3	0.02	369600.0	1748.72	**1.75**
Total Ultimate Shaft Resistance (R_f)							**8.04**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **1110.3 tons**

So,

q_{ult} = Ru + Rf,

= **2615.6 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	33	°
Nc	=	9.00	
Nγ	=	35.19	
Nq	=	30.40	
Length	=	2800.00	cm
Pd	=	3.16	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 28m and 1.2m
2615.6 tons.

Factor of Safety = 2.5

Allowable bearing capacity = 1046.24 tons

11.2.1 Lateral Load Capacity

As per IS:2911(PartI/Sec2)

D=	Dia of pile		=	1.20	m
L_1=	Free length of pile		=	0	m
E=	Young's modulus of plie material=5000xsqrt(fck)		=	295804.0	kg/cm2
I=	$p*D^4/64$		=	1.0E+07	cm4
f =	Blows 10-35	Medium Sand	=	33.33	Blows (Av
K_1=	Constant		=	0.717	kg/cm3
T=	$(EI/K_1)^{1/5}$		=	334.72	
L_1/T=			=	0.00	
L_f/T=	(from fig.2 of Appendix B)		=	2.20	
Depth of Fixity(L_f)=			=	736.37	cm
(L_1+L_f)=			=	7.36	**m**
For Fixed head Pile		$Y = Q(L_1+L_f)^3/(12EI)$			
Y = lateral deflection			=	5	mm
Q = Lateral capacity of pile			=	45243.18	kg
			=	452.43	kN
		Say	=	**452**	**kN**

BRIDGE NO. 130

Standard Penetration Test Result

Bore Hole at Bridge No. 130

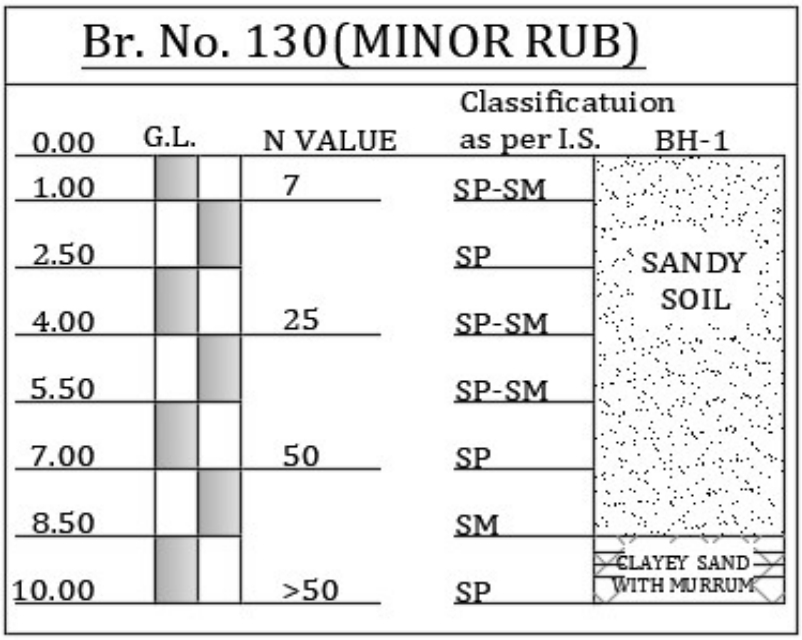
Date of Field Test - 27-12-2020 **Bore Hole NGL - 227.59**

BH - Coordinates - E 3142646.399, N 683125.66

Field Data

Depth below ground Level (m)	N-values BH-1 N	Corrected	Description	BH Levels	Soil Classification
1.00	7	15	Sandy Soil	226.59	SP-SM
2.50	UDS	-	Sandy Soil	225.09	SP
4.00	25	43	Sandy Soil	223.59	SP-SM
5.50	UDS	-	Sandy Soil	222.09	SP-SM
7.00	>50	-	Sandy Soil	220.59	SP
8.50	UDS	-	Clay sand with Murrum	219.09	SM
10.00	>50	-	Clay sand with Murrum	217.59	SP

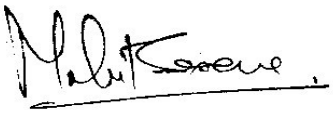
BH Terminates at 10.50m



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	0.00	0.00	0.81	1.59	3.96	10.57	9.97
Coarse Sand (%)	0.00	0.00	0.29	0.41	0.25	5.06	1.96
Medium Sand (%)	0.00	0.00	0.63	4.92	0.67	14.25	6.82
Fine Sand (%)	91.17	95.82	92.87	84.33	92.57	53.86	77.05
Clay And Silt Size (%)	8.83	4.18	5.40	8.76	2.55	16.25	4.20
Atterberg Limit							
Liquid Limit (%)	24.78	24.80	23.94	22.66	22.01	21.68	21.43
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.69	2.68	2.68	2.65	2.67	2.66	2.67
Void Ratio		0.71		0.67		0.60	
Density							
Moisture Content(%)	11.26	11.37	6.55	9.69	6.89	13.11	13.06
Bulk Density(kN/m^3)		17.17		17.07		18.39	
Dry Density (kN/m^3)		15.41		15.56		16.26	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.00		0.00		0.06	
Angle of Internal Friction (degree)		33		33		35	



BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 6.10 L = 8.00

ϒ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.72	15.00	0.04	32.00	35.49	23.18	30.22	1.15	1.15	0.70
1.72	16.00	0.04	32.00	35.49	23.18	30.22	1.15	1.15	0.70
1.72	17.00	0.04	32.00	35.49	23.18	30.22	1.15	1.15	0.70

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.06	1.03	1.03	1.00	6.10	1.72	53.38	**1.80**	**23.76**	0.71
1.06	1.04	1.04	1.50	6.10	2.58	61.78	**1.80**	**27.78**	0.71
1.06	1.06	1.06	2.00	6.10	3.43	70.39	**1.80**	**31.89**	0.71

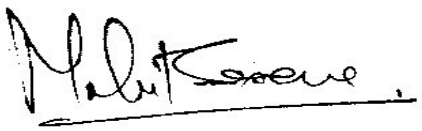
ϒ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.72	15.00	0.04	22.78	18.05	8.66	8.20	1.15	1.15	0.70
1.72	16.00	0.04	22.78	18.05	8.66	8.20	1.15	1.15	0.70
1.72	17.00	0.04	22.78	18.05	8.66	8.20	1.15	1.15	0.70

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.05	1.02	1.02	1.00	6.10	1.72	15.56	**1.50**	9.09
1.07	1.04	1.04	1.50	6.10	2.58	18.37	**1.50**	9.20
1.10	1.05	1.05	2.00	6.10	3.43	21.24	**1.50**	10.05

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	Mixed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	1.00	6.10	53.38	15.56	23.76	**18.18**	**18.18**
2		1.50	6.10	61.78	18.37	27.78	**18.39**	**18.39**
3		2.00	6.10	70.39	21.24	31.89	**20.10**	**20.10**

Factor of Safety Taken 3

Water Correction factor taken 0.8



Embankment at ROR

Standard Penetration Test Result

Bore Hole at Embankment at ROR

Date of Field Test - 27-12-2020 **Bore Hole NGL - 224.751**

BH - Coordinates - E 3143578.579, N 682842.763

Field Data

Depth below ground Level (m)	N-values BH-1			BH Levels	Soil Classification
	N	Corrected	Description		
1.00	12	19	Sandy Soil	223.75	SM
2.50	UDS	-	Sandy Soil	222.25	SM
4.00	16	18	Sandy Soil	220.75	SM
5.50	UDS	-	Sandy Soil	219.25	SM
7.00	22	20	Sandy Soil	217.75	SM
8.50	UDS	-	Sandy Soil	216.25	SP-SM
10.00	40	32	Sandy soil with Gravel	214.75	SM
11.50	UDS	-	Sandy soil with Gravel	213.25	SM
13.00	23	16	Sandy soil with Gravel	211.75	SM
14.50	UDS	-	Sandy soil with Gravel	210.25	SM
16.00	25	16	Sandy Soil	208.75	SM
17.50	UDS	-	Sandy Soil	207.25	SM
19.00	32	19	Sandy soil with Gravel	205.75	SM
20.50	UDS	-	Sandy soil with Gravel	204.25	SM
22.00	31	17	Sandy soil with Gravel	202.75	SM
23.50	UDS	-	Sandy soil with Gravel	201.25	SM
25.00	32	16	Moorum with Gravel	199.75	SM

Standard Penetration Test Result

Bore Hole at Embankment at ROR

Date of Field Test - 27-12-2020 **Bore Hole NGL - 224.751**

BH - Coordinates - E 3143578.579, N 682842.763

Field Data

Depth below ground	N-values				
	BH-1				
26.50	UDS	-	Moorum with Gravel	198.25	SP-SM
28.00	58	27	Moorum with Gravel	196.75	SM
29.50	UDS	-	Moorum with Gravel	195.25	SM
31.00	27	12	Moorum with Gravel	193.75	SM
32.50	UDS	-	Sandy soil with Gravel	192.25	SM
34.00	32	13	Sandy soil with Gravel	190.75	SP-SM
35.50	20	8	Sandy soil with Gravel	189.25	SM
37.00	17	6	Sandy Soil	187.75	SM

Bore Hole Terminated at 37.50m

Water Found at 18.0m Level

EMBANKMENT AT ROB LOCATION -1

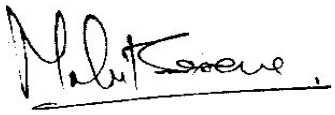
	G.L.	N VALUE	Classificatuion as per I.S.	BH-1
0.00				
1.00		12	SM	
2.50			SM	
4.00		16	SM	SANDY SOIL
5.50			SM	
7.00		22	SM	
8.50			SP-SM	
10.00		40	SM	
11.50			SM	SANDY WITH GRAVEL
13.00		23	SM	
14.50			SM	
16.00		25	SM	SANDY SOIL
17.50			SM	
19.00		32	SM	
20.50			SM	SANDY WITH GRAVEL
22.00		31	SM	
23.50			SM	
25.00		32	SM	
26.50			SP-SM	MURRUM SOIL WITH GRAVEL
28.00		58	SM	
29.50			SM	
31.00		27	SM	
32.50			SM	SANDY WITH GRAVEL
34.00		32	SP-SM	
35.50		20	SM	SANDY SOIL
37.00		18	SM	

Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**1.0m**	**2.5m**	**4.0m**	**5.5m**	**7.0m**	**8.5m**	**10.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fine Gravel (%)	4.79	6.16	12.71	0.71	23.51	5.36	15.55
Coarse Sand (%)	15.74	4.20	10.33	1.94	11.56	7.71	9.06
Medium Sand (%)	10.98	7.42	9.11	7.05	10.02	10.20	14.75
Fine Sand (%)	48.79	66.46	48.62	76.76	40.74	69.87	43.88
Clay And Silt Size (%)	19.70	15.76	19.23	13.55	14.17	6.86	16.77
Atterberg Limit							
Liquid Limit (%)	22.26	23.55	21.44	23.01	26.17	24.13	24.66
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.65	2.67	2.68	2.64	2.63	2.66	2.67
Void Ratio		0.72		0.65			
Density							
Moisture Content(%)	7.52	11.43	8.72	9.53	6.93	4.86	7.76
Bulk Density(kN/m^3)		16.99		17.26		17.81	
Dry Density (kN/m^3)		15.25		15.75		16.99	
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.06		0.05		0.03	
Angle of Internal Friction (degree)		29		30		30	

e= GYw/Yd-1

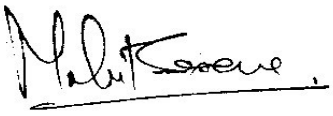


Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**11.5m**	**13.0m**	**14.5m**	**16.0m**	**17.5m**	**19.0m**	**20.5m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	0.94	2.82	8.13	7.52	5.78	7.5	1.9
Coarse Sand (%)	1.50	4.03	14.51	11.10	6.97	9.5	0.9
Medium Sand (%)	7.41	16.65	6.90	13.04	4.49	13.2	5.1
Fine Sand (%)	77.27	52.78	58.07	52.57	67.38	51.2	70.5
Clay And Silt Size (%)	12.88	23.72	12.38	15.77	15.38	18.59	21.67
Atterberg Limit							
Liquid Limit (%)	20.40	22.37	24.31	28.28	23.45	24.91	26.89
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.67	2.67	2.67	2.66	2.66	2.67	2.69
Void Ratio	0.54		0.67		0.61		0.65
Density							
Moisture Content(%)	6.15	7.73	10.65	4.55	9.63	8.16	7.70
Bulk Density(kN/m^3)	18.05		17.36		17.76		17.27
Dry Density (kN/m^3)	17.00		15.69		16.20		16.03
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)	0.06		0.06		0.08		0.07
Angle of Internal Friction (°)	31		32		32		31

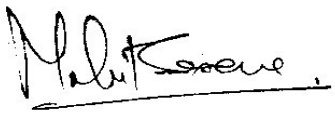
e= GYw/Yd-1



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**						
	Depth						
Gradation Analysis	**22.0m**	**23.5m**	**25.0m**	**26.5m**	**28.0m**	**29.5m**	**31.0m**
Cobble (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Coarse Gravel (%)	0.00	0.00	0.00	0.00	0.00	0.0	0.0
Fine Gravel (%)	7.08	1.13	3.36	0.28	4.41	0.8	2.1
Coarse Sand (%)	11.08	1.41	15.59	0.81	2.15	2.3	8.8
Medium Sand (%)	13.64	3.16	10.80	11.50	12.42	16.5	25.6
Fine Sand (%)	51.28	76.40	56.47	77.51	60.94	58.8	48.5
Clay And Silt Size (%)	16.92	17.89	13.78	9.89	20.08	21.57	14.91
Atterberg Limit							
Liquid Limit (%)	27.30	25.25	30.10	26.05	25.31	21.08	26.89
Plastic Limit (%)	-	-	-	-	-	-	-
Plasticity Index (%)	NPI	NPI	NPI	NPI	NPI	NPI	NPI
Sp. Gravity	2.68	2.68	2.67	2.69	2.66	2.68	2.69
Void Ratio		0.69		0.62			
Density							
Moisture Content(%)	6.14	8.48	6.58	10.26	4.07	3.87	5.53
Bulk Density(kN/m^3)		16.87		17.95			
Dry Density (kN/m^3)		15.55		16.28			
Shear Strength Parameters							
Unit Cohesion (kg/cm^2)		0.06		0.03			
Angle of Internal Friction (degree)		29		29			



Laboratory Test Results

LABORATORY TEST RESULTS :

Soil Properties	**BH-1**				
	Depth				
Gradation Analysis	**32.5m**	**34.0m**	**35.5m**	**37.0m**	
Cobble (%)	0.00	0.00	0.00	0.00	
Coarse Gravel (%)	0.00	0.00	0.00	0.00	
Fine Gravel (%)	18.65	10.61	19.55	0.98	
Coarse Sand (%)	12.82	21.50	6.57	1.37	
Medium Sand (%)	13.85	14.00	10.57	4.91	
Fine Sand (%)	40.64	42.27	50.45	74.09	
Clay And Silt Size (%)	14.04	11.61	12.86	18.65	
Atterberg Limit					
Liquid Limit (%)	24.59	25.85	27.85	25.57	
Plastic Limit (%)	-	-	-	-	
Plasticity Index (%)	NPI	NPI	NPI	NPI	
Sp. Gravity	2.63	2.61	2.64	2.65	
Void Ratio					
Density					
Moisture Content(%)	10.41	6.61	4.54		
Bulk Density(kN/m^3)					
Dry Density (kN/m^3)					
Shear Strength Parameters					
Unit Cohesion (kg/cm^2)					
Angle of Internal Friction (degree)					

BEARING CAPACITY OF SOIL AS PER IS : 6403-1981

(ISOLATED FOUNDATION)

Footing Type - Rectangle B = 5.00 L = 8.00

Ɣ	N	C	Fi	Nc	Nq	Ny	Sc	Sq	Sy
1.70	18.00	0.55	28.00	25.80	14.72	16.72	1.13	1.13	0.75
1.70	19.00	0.55	28.00	25.80	14.72	16.72	1.13	1.13	0.75
1.70	19.00	0.55	28.00	25.80	14.72	16.72	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	Q	Void Ratio
1.13	1.07	1.07	2.00	5.00	3.40	43.65	**1.66**	**20.09**	0.72
1.13	1.10	1.10	3.00	5.00	5.10	54.43	**1.66**	**25.35**	0.72
1.13	1.13	1.13	4.00	5.00	6.80	65.80	**1.66**	**45.73**	0.65

Ɣ	N	C	Fi'	Nc	Nq'	Ny'	Sc	Sq	Sy
1.70	18	0.55	19.65	14.83	6.40	5.39	1.13	1.13	0.75
1.70	19	0.55	19.65	14.83	6.40	5.39	1.13	1.13	0.75
1.70	19	0.55	19.65	14.83	6.40	5.39	1.13	1.13	0.75

Dc	Dq	Dy	Df	B	q	Qd	√Nfi	25mm Settlement
1.11	1.06	1.06	2.00	5.00	3.40	15.61	**1.42**	10.67
1.17	1.09	1.09	3.00	5.00	5.10	19.82	**1.42**	11.27
1.23	1.11	1.11	4.00	5.00	6.80	24.22	**1.42**	11.27

S. No.	Bore Hole No.	Depth in M	Width in M	Allowable Bearing Pressure in t/m^2				
				General Shear Failure Criteria	Local Shear Failure Criteria	MIxed Shear Failure Criteria	Settlement Criteria (50mm)	Adopted
1	**1**	2.00	5.00	43.65	15.61	20.09	**21.33**	**20.09**
2		3.00	5.00	54.43	19.82	25.35	**22.54**	**22.54**
3		4.00	5.00	65.80	24.22	45.73	**22.54**	**22.54**

Factor of Safety Taken 3

Water Correction factor taken 0.8

Maximum N Value Taken -50

Maximum Phi Taken -35°

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.06	29.00	0.002	
5.5	8.5	0.05	30.00	0.002	
8.5	11.5	0.03	30.00	0.002	
11.5	14.5	0.06	31.00	0.002	
14.5	17.5	0.06	32.00	0.001	Submerged Taken
17.5	20.5	0.08	32.00	0.001	
20.5	22.3	0.07	31.00	0.001	

1 For 1.2m Dia. and 20m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.27	120686	29.00	0.555	**18.20**
5.5-8.5	300.00	620.00	1	0.80	113143	30.00	0.578	**52.45**
8.5-11.5	300.00	920.00	1	1.33	113143	30.00	0.578	**86.83**
11.5-14.5	300.00	1220.00	1	1.87	113143	31.00	0.601	**126.96**
14.5-17.5	300.00	1520.00	1	2.25	113143	32.00	0.625	**159.00**
17.5-20.5	300.00	1820.00	1	2.47	113143	32.00	0.625	**175.04**
20.5-22.3	180.00	2000.00	1	2.66	67886	31.00	0.601	**108.40**
Total Ultimate Shaft Resistance (R_f)								**726.88**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.06	120686	2002.96	**2.00**
5.5-8.5	300.00	1	0.3	0.05	113143	1849.25	**1.85**
8.5-11.5	300.00	1	0.3	0.03	113143	1011.89	**1.01**
11.5-14.5	300.00	1	0.3	0.06	113143	1980.74	**1.98**
14.5-17.5	300.00	1	0.3	0.06	113143	2163.40	**2.16**
17.5-20.5	300.00	1	0.3	0.08	113143	2590.31	**2.59**
20.5-22.3	180.00	1	0.3	0.07	67886	1472.76	**1.47**
Total Ultimate Shaft Resistance (R_f)							**13.07**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **635.70 tons**

So,

q_{ult} = Ru + Rf,

= **1375.65 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	30	°
Nc	=	9.00	
Nγ	=	22.40	
Nq	=	20.10	
Length	=	2000.00	cm
Pd	=	2.72	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 20m and 1.2m

1375.65 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **550.26 tons**

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	29.0	0.002	
5.5	8.5	0.1	30.0	0.002	
8.5	11.5	0.0	30.0	0.002	
11.5	14.5	0.1	31.0	0.002	
14.5	17.5	0.1	32.0	0.001	Submerged Taken
17.5	20.5	0.1	32.0	0.001	
20.5	26.3	0.1	31.0	0.001	

1 For 1.2m Dia. and 24m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.27	120686	29.00	0.555	**18.20**
5.5-8.5	300.00	620.00	1	0.80	113143	30.00	0.578	**52.45**
8.5-11.5	300.00	920.00	1	1.33	113143	30.00	0.578	**86.83**
11.5-14.5	300.00	1220.00	1	1.87	113143	31.00	0.601	**126.96**
14.5-17.5	300.00	1520.00	1	2.25	113143	32.00	0.625	**159.00**
17.5-20.5	300.00	1820.00	1	2.47	113143	32.00	0.625	**175.04**
20.5-26.3	580.00	2400.00	1	2.80	218743	31.00	0.601	**368.41**
Total Ultimate Shaft Resistance (R_f)								**986.89**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.06	120685.7	2002.96	**2.00**
5.5-8.5	300.00	1	0.3	0.05	113142.9	1849.25	**1.85**
8.5-11.5	300.00	1	0.3	0.03	113142.9	1011.89	**1.01**
11.5-14.5	300.00	1	0.3	0.06	113142.9	1980.74	**1.98**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2163.40	**2.16**
17.5-20.5	300.00	1	0.3	0.08	113142.9	2590.31	**2.59**
20.5-26.3	580.00	1	0.3	0.07	218742.9	4745.56	**4.75**
Total Ultimate Shaft Resistance (R_f)							**16.34**

Ultimate Base Resistance:

$$\mathbf{R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p}$$

R_u = **701.8 tons**

So,

$\mathbf{q_{ult}}$ = Ru + Rf,

= **1705.0 tons**

γ	=	0.001	kg/cm3
D	=	120	cm
ø' (taken)	=	30	°
Nc	=	9.00	
Nγ	=	22.40	
Nq	=	20.10	
Length	=	2400.00	cm
Pd	=	3.01	kg/cm2
Ap	=	11310	cm2

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 24m and 1.2m

1705.0 tons.

Factor of Safety = 2.5

Allowable bearing capacity = **682.00 tons**

Calculations of Pile Capacity as per IS 2911

Soil properties and layer thicknesses considered for pile capacity

Soil Layers (m)		Cohesion (kg/cm^2)	Ø (deg)	Bulk density (γ) kg/cm^3	Water Table Condition
From	Upto				
2.3	5.5	0.1	29.0	0.002	
5.5	8.5	0.1	30.0	0.002	
8.5	11.5	0.0	30.0	0.002	
11.5	14.5	0.1	31.0	0.002	
14.5	17.5	0.1	32.0	0.001	Submerged Taken
17.5	20.5	0.1	32.0	0.001	
20.5	30.3	0.1	31.0	0.001	

1 For 1.2m Dia. and 28m length

Ultimate Shaft Resistance:

The value of the `K' has been taken as 1.0

Depth (m)	Segment (cm) Length	Commulative Depth (cm)	K	P_{di} (kg/cm^2)	Asi (cm^2)	δ (1.0 of ø)	tan δ	ΣKPditan δ Asi
2.3-5.5	320.00	320.00	1	0.27	120686	29.00	0.555	**18.20**
5.5-8.5	300.00	620.00	1	0.80	113143	30.00	0.578	**52.45**
8.5-11.5	300.00	920.00	1	1.33	113143	30.00	0.578	**86.83**
11.5-14.5	300.00	1220.00	1	1.87	113143	31.00	0.601	**126.96**
14.5-17.5	300.00	1520.00	1	2.25	113143	32.00	0.625	**159.00**
17.5-20.5	300.00	1820.00	1	2.47	113143	32.00	0.625	**175.04**
20.5-30.3	980.00	2800.00	1	2.80	369600	31.00	0.601	**622.49**
Total Ultimate Shaft Resistance (R_f)								**1240.96**

Depth (m)	Segment (cm) Length of	K	α	C (kg/cm^2)	As (cm^2)	α C As	Ultimate side Resistance. (tons)
2.3-5.5	320.00	1	0.3	0.06	120685.7	2002.96	**2.00**
5.5-8.5	300.00	1	0.3	0.05	113142.9	1849.25	**1.85**
8.5-11.5	300.00	1	0.3	0.03	113142.9	1011.89	**1.01**
11.5-14.5	300.00	1	0.3	0.06	113142.9	1980.74	**1.98**
14.5-17.5	300.00	1	0.3	0.06	113142.9	2163.40	**2.16**
17.5-20.5	300.00	1	0.3	0.08	113142.9	2590.31	**2.59**
20.5-30.3	980.00	1	0.3	0.07	369600.0	8018.4	**8.02**
Total Ultimate Shaft Resistance (R_f)							**19.62**

Ultimate Base Resistance:

$$R_u = Ap\ (½D.\gamma.N_\gamma + P_d\ N_q) + A_pN_cC_p$$

R_u = **701.8 tons**

So,

q_{ult} = Ru + Rf,

= **1962.3 tons**

				0.475
γ	=	0.001	kg/cm3	
D	=	120	cm	375
ø' (taken)	=	30	°	
Nc	=	9.00		
Nγ	=	22.40		87.084
Nq	=	20.10		
Length	=	2800.00	cm	
Pd	=	3.01	kg/cm2	
Ap	=	11310	cm2	

Therefore, ultimate load bearing capacity of a single bored cast in-situ pile of length 28m and 1.2m

1962.3 tons.

Factor of Safety = 2.5

Allowable bearing capacity = 784.94 tons

11.2.1 Lateral Load Capacity

As per IS:2911(PartI/Sec2)

D=	Dia of pile		=	1.20	m
L_1=	Free length of pile		=	0	m
E=	Young's modulus of plie material=5000xsqrt(fck)		=	295804.0	kg/cm2
I=	$p*D^4/64$		=	1.0E+07	cm4
f =	Blows 10-35	Medium Sand	=	19.00	Blows (Av
K_1=	Constant		=	0.430	kg/cm3
T=	$(EI/K_1)^{1/5}$		=	370.72	
L_1/T=			=	0.00	
L_f/T=	(from fig.2 of Appendix B)		=	2.20	
Depth of Fixity(L_f)=			=	815.58	cm
(L_1+L_f)=			=	8.16	**m**
For Fixed head Pile		$Y = Q(L_1+L_f)^3/(12EI)$			
Y = lateral deflection			=	5	mm
Q = Lateral capacity of pile			=	33299.97	kg
			=	333.00	kN
		Say	**=**	**333**	**kN**

Annexure

(A) SETTLEMENT CRITERION

1. Peck Method:-

The net safe bearing (t/m^2)for a settlement 25mm is expressed as (Peck, Hanson and Thorburn procedure)

$$q = 0.041\ N_{av}\ C_w\ S\ (\ t/m^2\ )$$

Where

N_{av} = Corrected average N value

C_w =Water Table Correction Factor = $0.5+0.5\ \frac{D_w}{(D_f+B)}$

B = Width of foundation

D_r = Depth of foundation

D_w = Depth of water table below the ground surface

S = Allowable settlement in mm

2. Bowles's Method :-

$qn\rho = 0.073NW_gR_d$ for B=< 1.2 m and

$qn\rho = 12.2\ N((B+0.3)/B)^2W_gR_d$ for B=> 1.2 m

3. IS : 8009 (Part-I)-1976

The safe bearing pressure can be calculated using readymade chart for any value of permissible settlement, given width of footing and corrected value. For this report, Settlement is calculated from graph provided in the code and settlement is taken as 25mm and 50mm.

(B) SHEAR FAILURE CRITERION

1. IS : 6403-1981

The following formulae have been used for calculating ultimate net bearing capacity as per IS : 6403-1981 and this is similar to one proposed by Vecic.

(a) In case of general shear failure -

$$q_d = cN_c\, s_c\, d_c\, i_c + q(N_q-1)s_q\, d_q\, i_q + 0.5\, B\gamma\, N_\gamma\, S_\gamma\, d_\gamma\, i_\gamma\, w'$$

(b) In case of local shear failure –

$$q'_d = 0.67cN'_c\, s_c\, d_c\, i_c + q(N'_q-1)s_q\, d_q\, i_q + 0.5\, B\gamma\, N'_\gamma\, S_\gamma\, d_\gamma\, i_\gamma\, w'$$

Where,

N_c, N'_c, Nq, N'q N_γ N'_γ = Bearing capacity factors

C = Unit Cohesion

B = Width of strip footing

s_c, s_q, s_γ = Shape factors

γ = Bulk unit weight of foundation soil

q'_d = Net ultimate bearing capacity based on general shear failure

w' = Correction factor for location of water table

f = Angle of shearing resistance of soil in degrees

Note :- If the relative density is greater than 70% and the void ratio is less than 0.55, the shear failure is considered as General shear failure. On the other hand, if the relative density is smaller than 20% and the void ratio is greater than 0.75, the failure is local shear failure. For relative density between 20% and 70% and the void ratio between 0.55 to 0.75, the bearing capacity factors are obtained by interpolation between the general shear failure and local shear failure.

(C) LOAD CARRYING CAPACITY OF THE PILE

The load carrying capacity of a single pile of 1.20m and 1.50m dia with 20m length has been calculated as per IRC 78-2014. the diameter of the pile (d) has been taken as 1.20m and spacing between the piles as 3d. the critical length of the proposed pile i.e.20d i.e 20 x 1.20 = 24m. for 1.2m dia and 30.0m for 1.5 dia pile, the overburden pressure will increase up to this depth and will remain constant thereafter for purpose of calculation.

The total ultimate pile load capacity is given by:

$$q_{ult} = R_u + R_f,$$

Where,

R_u = ultimate base resistance.

R_f = ultimate shaft resistance.

Ultimate Base Resistance: $R_u = Ap\ (½D.\gamma.N\gamma + P_d\ N_q) + A_pN_cC_p$

Where

A_p = Cross sectional area of base of pile

D = pile diameter in cm

γ = Effective unit weight of soil at pile tip in kg/cm^3

N_q & N_γ = Bearing capacity factors based on angle of internal friction at pile tip

N_c = Bearing capacity factor usually taken as 9

C_p = Average cohesion at pile tip

P_d = Effective overburden pressure at pile tip.

Ultimate Shaft Resistance: $R_f = \Sigma K\ P_{di}\ \tan\delta\ A_{si} + \alpha\ C\ A_s$

Where

K = Coefficient of earth pressure.

P_{di} = Effective overburden pressure in kg/ cm^2 along the embedment of pile for the ith layer where i varies from 1 to n.

δ = angle of wall friction between pile and soil in degrees. taken as equal to angle of internal friction of soil.

A_{si} = surface area of pile shaft in cm 2 in the ith layer, where i varies froln 1 to n.

As = Surface area of pile shaft in cm^2

α = Reduction factor

C = Average cohesion in kg/ cm^2 throughout the embedded length of pile

Top 2.3m soil not taken into consideration; the same has been ignored while calculating the pile load carrying capacity.

(D) SCALE OF WEATHERING GRADES OF ROCK MASS

Terms	Description	Grade	Interpretation
Fresh	No visible sign of rock material weathering; perhaps slight discoloration on major discontinuity surfaces.	I	CR > 90 %
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discoloured by weathering.	II	CR between 70 % to 90 %
Moderately Weathered	Less than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.	III	CR between 50 % to 70 %
Highly Weathered	More than half of the rock material is decomposed or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones	IV	CR between 10 % to 50 %
Completely Weathered	All rock material is decomposed and / or disintegrated to soil. The original mass structure is still largely intact.	V	CR between zero to 10 %
Residual Soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI	CR = Zero % But N > 50

RELATION BETWEEN RQD AND IN-SITU ROCK QUALITY

RQD CLASSIFICATION	RQD (%)
Excellent	90 to 100
Good	75 to 90
Fair	50 to 75
Poor	25 to 50
Very Poor	00 to 25

CLASSIFICATION OF ROCK WRT COMPRESSIVE STRENGTH

ROCK STRENGTH	COMPRESSIVE STRENGTH (Kg/cm^2)
Extremely weak	< 20
Very Weak	20 to 100
Weak	101 to 250
Average	251 to 500
Strong	501 to 1000
Very Strong	1001 to 2500
Extremely Strong	> 2500

(E) Axial Load Capacity of Socketed Pile in Rock

Qu = Re + Raf = Ksp .qc.df.Ab + As Cus
Q allow= (Re/3) + (Ra/6)

Where,
Qu = Ultimate capacity of pile socketed into rock in Newtons
Q allow = Allowable capacity of Pile
Re = Ultimate end bearing
Raf = Ultimate side socket shear
Ksp = An empiricalco-efficient whose value ranges from 0.3 to 1.2 as per the table below for the rocks where core recovery is reported, and cores tested for uniaxial compressive strength.

qc = Average unconfined compressive strength of rock core below base of pile for the depth twice the diameter/least lateral dimension of pile in MPa
Ab = Cross-sectional area of base of pile

df = Depth factor = $1 + 0.4 \times \frac{\text{Length of Socket}}{\text{Diameter of Socket}}$
However, value of df should not be taken more than 1.2
As = Surface area of socket
Cus = Ultimate shear strength of rock along socket length,
= 0.225 Vqc , but restricted to shear capacity of concrete of the pile, to be taken as 3.0 MPa for M 35 concrete in confined coudition, which for other strength of concrete can be modified by a factor V(fck/35)

(CR+RQD)/2	Ksp
30%	0.3
100%	1.2

(F) Axial Load Capacity of Pile in Weak Rock

This method is applicable when cores and/or core testing result are not available, or when geo-material is highly fragmented. The shear strength of geo-material is obtained from its correlation with extrapolated SPT values for 300 mm of penetration as given in table below:

$Qu = Re + Raf = C_{ub} N_c A_b + C_{us} A_s$

Q allow= (Re/3) + (Ra/6)

where

Cub = Average shear strength below base of pile, for the depth equal to twice the diameter/least lateral dimension of pile, based on average 'N' value of this

Cus = Ultimate shear strength along socket length, to be obtained from table, based on average 'N' value of socket portion. This shall be restricted to shear capacity of concrete of the pile, to be taken as 3.0 Mpa for M 35 concrete in confined condition, which for other strengths of concrete can be modified by a factor √(fck/35)
Intermediate values Cub
and Cus can be interpolated linearly.

L = Length of socket.

Nc = 9

Qallow = Allowable capacity of pile.

The extrapolated values of 'N' greater than 300 shall be limited to 300 while using this method.

Geotechnical Investigation Reports
For

1.2 Bridge No. 132 (Chainage 51+773.032)

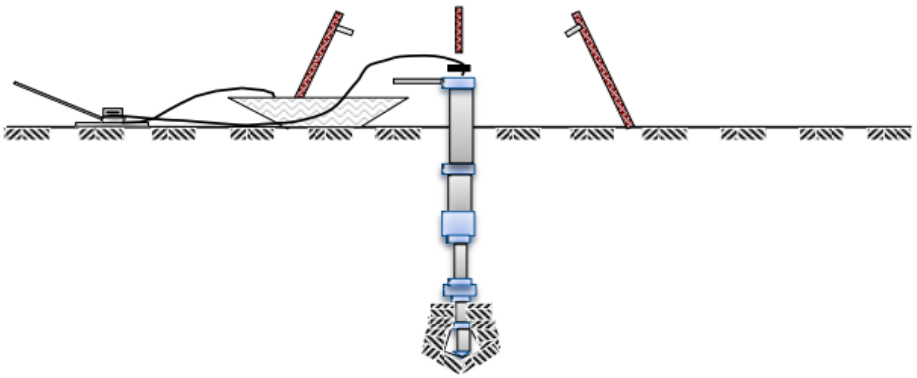
ALLUMERA ENGINEERING SOLUTIONS PVT LTD

(NABL Accredited and ISO 9001:2015 Certified Agency)

SOIL INVESTIGATION TEST REPORT

Document No. SIT-KCC-14-08-2024

Project :	C1: Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining walls, and other miscellaneous works in connection with laying of new BG Double railway line of HORC Project from Km. 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.
Client :	Haryana Rail Infrastructure Development Corporation Limited
General Consultant :	GC-HORC-(RITES Limited In Consortium with SMEC International Pvt. Ltd.)
Contractor :	KCC Buildcon Private Limited



Location : Bridge No. 132 (Chainage 51+773.032)

Testing Date : 02/08/2024 To 03/08/2024

Reporting Date : 14/08/2024

ALLUMERA ENGINEERING SOLUTIONS PVT LTD

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- BORE LOG
- SIEVE ANALYSIS & GRAIN SIZE DISTRIBUTION

SAFE BEARING CALCULATIONS BASED ON IS 6403(Part –I) 1981

Allumera Engineering Solutions Pvt. Ltd. Delhi

GEO-TECHNICAL INVESTIGATION REPORT

Subsurface exploration location:
Sample collection method: Split spoon sampler

INTRODUCTION

GENERAL

With a view to determine subsoil information for identification of the soil strata, detailed subsurface investigations were carried out. The soil samples were collected and tested for soil identification as per the IS codes 1498-1970. This report presents the results and analysis of the field investigations and laboratory tests, conducted as part of the soil investigations programme. Based on these results the classification and nature of the soil strata has been presented with concluding Remarks at each location.

FIELD INVESTIGATION

DRILLING

A borehole was drilled on the designated locations using 150 mm as diameter. Two drill rods of length 3.0m and 1.5 m was used to drill the borehole. Casing pipe was used to prevent caving in of the borehole to maintain stability. Augur boring was adopted for the method of boring. Machine operated auger was used to drill the bore which was further extended with the help of drill rods.

TEST METHOD

Standard penetration test was conducted at the sites as per IS 2131 to determine N value at every 1.5m or change of strata. As per client guideline, refusal was decided at a depth if rock strata is encountered or as per IS 2131 when the number of blows increases the count of 100 for 30cms.

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- **SAMPLING**

Disturbed soil samples were collected using split spoon sampler at every 1.5 m or 3m depth of the borehole, for conducting relevant laboratory tests. Representative soil samples were collected with sampling tubes. The soil samples were collected in polythene bags and labelled after sealing.

- **PROJECT ALIGNMENT**

The site was proposed at **HORC(KCC)-C1.** The boreholes were conducting using 150 mm diameter at every Points at the scope of the work.

RESULTS AND ANALYSIS OF INVESTIGATIONS

- **BOREHOLE**

The borehole at this site was started after the removal of top soil. The samples collected from the borehole were used to conduct the sieve analysis. The samples were collected in the polybags and were sealed.

- **SIEVE ANALYSIS**

Dry sieve analysis was conducted on the samples collected at every depth by using a standard set of sieves as per IS 1498. Since dry sieve analysis was performed, the IS sieve used was 0.075 mm to 4.75 mm. It was noted that appreciable amount of fine (%passing 75 micron more than 12%) was present in the soil samples collected from the site. The grain size distribution curve shows the presence of sand as well as silt and clay in different proportions.

- **N VALUE**

The standard penetration test was conducted as per IS 2131, at various depths in the borehole to determine the N- values. The values collected from the site were corrected as per the recommendations of IS 2131. The corrected values are listed in Table 1 (attached in annexure) with the expected type of strata based on samples collected. Various additional details including type of soil, corrected N values, soil classification, thickness and water level depth can also be found in the annexure bore log.

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➢ FINDINGS OF GEOTECHNICAL INVESTIGATION

The classification of subsoil strata met at this site was done according to IS: 1498 -1970. From the bore logs given enclosed with the report, the test results can be summarized as below-

The subsoil strata are medium dense to very dense up to the depth of exploration. The detail description of subsoil strata encountered along with various laboratory test results are presented in the respective bore logs given in soil profile is enclosed as ANNEXURE- A. The subsoil profile depicting the distribution of the various subsoil strata along with observed "N" values with depth together with other test results are given in soil profile is enclosed as ANNEXURE- A.

Subsoil profile was identified as SM (Silty Sand) based on the grain size distribution .Also, the observed N values were corrected for Overburden pressure as per the IS code provisions. The GWT was not observed so there was no need to do the correction for dilatancy. The corrected N values of bore holes are presented in Table 1.

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Bore log Annexure

ANNEXURE - A

Project :	C1: Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining walls, and other miscellaneous works in connection with laying of new BG Double railway line of HORC Project from Km. 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.			
Location :	Ch. 51+773.032 (BR-132), C-1	**BORELOG**	**Start Date:**02/08/24	**End Date:** 03/08/24
			Weather: Clear	**Water Table:** Nil
			GWT: NIL	**Bore Dia.** 150mm
Type of Boring:	Auger & Shell		**Depth of Bore Hole:** 20 m	

Depth (m)	Thick (m)	Description (Soil Type) as per IS:1498-1970	Legend	SPT Count (N)	%Gravel	%Sand	%Fine
1.5	1.5m	Silty Sand (SM)		25	0	70.25	29.75
3.0	1.5m	Silty Sand (SM)		25	0	75.25	24.75
4.5	1.5m	Silty Sand (SM)		27	0	78.5	21.5
6.0	1.5m	Silty Sand (SM)		29	1.25	69.75	29.0
7.5	1.5m	Silty Sand (SM)		32	0.25	51.5	48.25
9.0	1.5m	Silty Sand (SM)		30	0.5	41.25	58.25
10.5	1.5m	Silty Sand (SM)		53	0.5	51	48.5
12.0	1.5m	Silty Sand (SM)		53	4.5	82.25	13.25
13.5	1.5m	Silty Sand (SM)		61	5.15	60.04	34.81
15.0	1.5m	Silty Sand (SM)		59	1.5	71.0	27.4
16.5	1.5m	Silty Sand (SM)		61	1.5	55.5	43.0
18.0	1.5m	Silty Sand (SM)		60	0.75	62.37	36.88
19.5	1.5m	Silty Sand (SM)		63	0.58	66.74	32.68
END OF BORING							

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CORRECTED N VALUE AS PER IS 2131-1981

TABLE 1

Bore-01					Unit Weight : 16.8 kN/m3		
Bore Depth (m)	GRAVEL %	SAND %	SILT & Clay %	N Value	Overburden	CN (Corr. F)	Corr. N
1.5	0	70.25	29.75	25	25.20	1.46	36.57
3.0	0	75.25	24.75	25	50.40	1.23	30.77
4.5	0	78.5	21.5	27	75.60	1.10	29.57
6.0	1.25	69.75	29.0	29	100.80	1.00	28.97
7.5	0.25	51.5	48.25	32	126.00	0.92	29.58
9.0	0.5	41.25	58.25	30	151.20	0.86	25.91
10.5	0.5	51	48.5	53	176.40	0.81	43.04
12.0	4.5	82.25	13.25	53	201.60	0.77	40.67
13.5	5.15	60.04	34.81	61	226.80	0.73	44.40
15.0	1.5	71.0	27.4	59	252.00	0.69	40.87
16.5	1.5	55.5	43.0	61	277.20	0.66	40.31
18.0	0.75	62.37	36.88	60	302.40	0.63	37.90
19.5	0.58	66.74	32.68	63	327.60	0.60	38.11

****End of the Report****

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Geotechnical Investigation Reports
For

1.3 Bridge No. 132A (Chainage 51+973.032)

ALLUMERA ENGINEERING SOLUTIONS PVT LTD

(NABL Accredited and ISO 9001:2015 Certified Agency)

SOIL INVESTIGATION TEST REPORT

Document No. SIT-KCC-16-08-2024

Project :	C1: Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining walls, and other miscellaneous works in connection with laying of new BG Double railway line of HORC Project from Km. 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.
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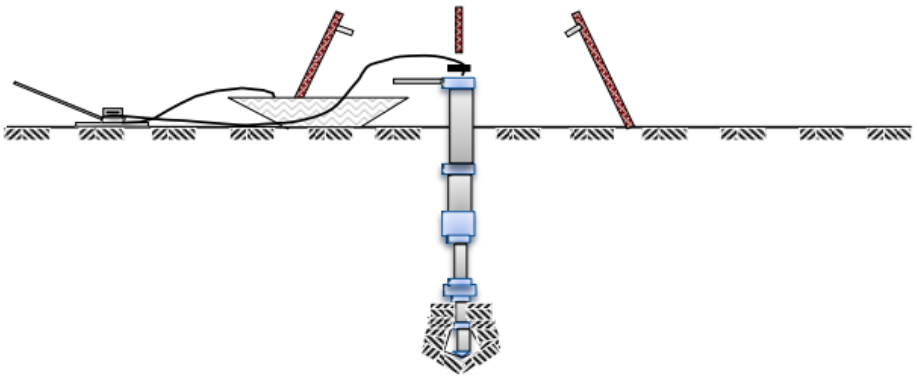

Location : Bridge No. 132A (Chainage 51+973.032)

Testing Date : 03/08/2024 To 07/08/2024

Reporting Date : 16/08/2024

ALLUMERA ENGINEERING SOLUTIONS PVT LTD

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SAFE BEARING CALCULATIONS BASED ON IS 6403(Part –I) 1981

Allumera Engineering Solutions Pvt Ltd. Delhi

GEO-TECHNICAL INVESTIGATION REPORT

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TEST METHOD

Standard penetration test was conducted at the sites as per IS 2131 to determine N value at every 1.5m or change of strata. As per client guideline, refusal was decided at a depth if rock strata is encountered or as per IS 2131 when the number of blows increases the count of 100 for 30cms.

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- **SAMPLING**

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- **SIEVE ANALYSIS**

Dry sieve analysis was conducted on the samples collected at every depth by using a standard set of sieves as per IS 1498. Since dry sieve analysis was performed, the IS sieve used was 0.075 mm to 4.75 mm. It was noted that appreciable amount of fine (%passing 75 micron more than 12%) was present in the soil samples collected from the site. The grain size distribution curve shows the presence of sand as well as silt and clay in different proportions.

- **N VALUE**

The standard penetration test was conducted as per IS 2131, at various depths in the borehole to determine the N- values. The values collected from the site were corrected as per the recommendations of IS 2131. The corrected values are listed in Table 1 (attached in annexure) with the expected type of strata based on samples collected. Various additional details including type of soil, corrected N values, soil classification, thickness and water level depth can also be found in the annexure bore log.

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➢ FINDINGS OF GEOTECHNICAL INVESTIGATION

The classification of subsoil strata met at this site was done according to IS: 1498 -1970. From the bore logs given enclosed with the report, the test results can be summarized as below-

The subsoil strata are medium dense to very dense up to the depth of exploration. The detail description of subsoil strata encountered along with various laboratory test results are presented in the respective bore logs given in soil profile is enclosed as ANNEXURE- A. The subsoil profile depicting the distribution of the various subsoil strata along with observed "N" values with depth together with other test results are given in soil profile is enclosed as ANNEXURE- A.

Subsoil profile was identified as SM (Silty Sand) based on the grain size distribution .Also, the observed N values were corrected for Overburden pressure as per the IS code provisions. The GWT was not observed so there was no need to do the correction for dilatancy. The corrected N values of bore holes are presented in Table 1.

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Bore log Annexure

ANNEXURE - A

Project :	C1: Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining walls, and other miscellaneous works in connection with laying of new BG Double railway line of HORC Project from Km. 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.				
Location :	Ch. 51+973.032 (BR-132A), C-1	**BORELOG**	**Start Date:**03/08/24	**End Date:** 07/08/24	
			Weather: Clear	**Water Table:** Nil	
			GWT: NIL	**Bore Dia.** 150mm	
Type of Boring:	Auger & Shell		**Depth of Bore Hole:** 32 m		

Depth (m)	Thick (m)	Description (Soil Type) as per IS:1498-1970	Legend	SPT Count (N)	%Gravel	%Sand	%Fine
1.5	1.5m	Silty Sand (SM)		3	0	67.25	32.75
3.0	1.5m	Silty Sand (SM)		11	0	57.25	42.75
4.5	1.5m	Silty Sand (SM)		18	1	61.4	37.6
6.0	1.5m	Silty Sand (SM)		20	1.95	50.3	47.75
7.5	1.5m	Silty Sand (SM)		23	1	48.6	50.4
9.0	1.5m	Silty Sand (SM)		26	1.15	71.05	27.8
10.5	1.5m	Silty Sand (SM)		28	1.90	56.85	41.25
12.0	1.5m	Silty Sand (SM)		34	2.05	51.35	46.60
13.5	1.5m	Silty Sand (SM)		49	1.05	63.12	35.83
15.0	1.5m	Silty Sand (SM)		50	0	73.05	26.95
16.5	1.5m	Silty Sand (SM)		53	1.65	64.25	34.10
18.0	1.5m	Silty Sand (SM)		59	0	64.45	35.55
19.5	1.5m	Silty Sand (SM)		63	1.55	52.80	45.65
21.0	1.5m	Silty Sand (SM)		77	2.35	58.95	38.70
22.5	1.5m	Silty Sand (SM)		84	1.85	72.7	25.45
24.0	1.5m	Silty Sand (SM)		89	2.65	51.1	46.25
25.5	1.5m	Silty Sand (SM)		79	1.40	48.45	50.15
27.0	1.5m	Silty Sand (SM)		83	1.55	48.00	50.45
28.5	1.5m	Silty Sand (SM)		90	0	41.55	58.45
30.0	1.5m	Silty Sand (SM)		93	0	43.05	56.95
31.5	1.5m	Silty Sand (SM)		92	0	40.3	59.70
END OF BORING							

CORRECTED N VALUE AS PER IS 2131-1981

TABLE 1

Bore-01					Unit Weight : 16.8 kN/m3		
Bore Depth (m)	GRAVEL %	SAND %	SILT & Clay %	N Value	Overburden	CN (Corr. F)	Corr. N
1.5	0	67.25	32.75	3	25.20	1.46	4.39
3.0	0	57.25	42.75	11	50.40	1.23	13.54
4.5	1	61.4	37.6	18	75.60	1.10	19.72
6.0	1.95	50.3	47.75	20	100.80	1.00	19.98
7.5	1	48.6	50.4	23	126.00	0.92	21.26
9.0	1.15	71.05	27.8	26	151.20	0.86	22.45
10.5	1.90	56.85	41.25	28	176.40	0.81	22.74
12.0	2.05	51.35	46.60	34	201.60	0.77	26.09
13.5	1.05	63.12	35.83	49	226.80	0.73	35.67
15.0	0	73.05	26.95	50	252.00	0.69	34.64
16.5	1.65	64.25	34.10	53	277.20	0.66	35.02
18.0	0	64.45	35.55	59	302.40	0.63	37.27
19.5	1.55	52.80	45.65	63	327.60	0.60	38.11
21.0	2.35	58.95	38.70	77	352.80	0.58	44.68
22.5	1.85	72.7	25.45	84	378.00	0.56	46.80
24.0	2.65	51.1	46.25	89	403.20	0.54	47.66
25.5	1.40	48.45	50.15	79	428.40	0.52	40.71
27.0	1.55	48.00	50.45	83	453.60	0.50	41.18
28.5	0	41.55	58.45	90	478.80	0.48	43.03
30.0	0	43.05	56.95	93	504.00	0.46	42.87
31.5	0	40.3	59.70	92	529.20	0.44	40.90

****End of the Report****

Allumera Engineering Solutions Pvt. Ltd. Delhi

Chandan Kumar

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APPENDIX 1

DRAWING LIST

1. GENERAL

The Bid Documents contains a set of reference/Bid drawings that are applicable to the Contract Works. The Bider shall incorporate into the Bid only those drawings from that set which amplify aspects of the Contractor's Technical Proposals. General information drawings will not be included in the Contract. The dimensions mentioned in the Bid drawings are indicative and may vary as per the design of the Contractor.

The List of Drawings issued with the Bid documents is stated in Part-2 Works Requirements - Bid Drawings and Documents.

APPENDIX – 2

CONTRACT KEY DATES AND COMPLETION DATE

Key Dates	Weeks from Commencement Date	Description of Stage	Delay Damage for each week of delay or part thereof for non-achieving the key dates
Key Date 1	2	Submission of Initial Works Programme with all activities	
Key Date 2	10	Submission & approval of Design and drawings of Manesar station.	0.05% of the Accepted Contract Price per week or part thereof.
Key Date 3	12	Submission and approval of Detailed Works Programme (resources & cost loaded) incorporating all comments of Engineer.	0.05% of the Accepted Contract Price per week or part thereof.
Key Date 4	21	Submission & approval of Design and drawings of 90% works of MNS-01 Contract.	0.05% of the Accepted Contract Price per week or part thereof.
Key Date 5	26	Completion of Structures of Manesar Station Building up to 2nd floor level.	0.05% of the Accepted Contract Price per week or part thereof.
Key Date 6	34	Completion and finishing of IMD Buildings in all respects	0.05% of the Accepted Contract Price per week or part thereof.
Key Date 7	52	Completion and finishing of Manesar Station Building in all respects	0.05% of the Accepted Contract Price per week or part thereof.

APPENDIX 3

WORKS AREAS AND TEMPORARY POWER SUPPLY

3. WORK AREA (WITHIN LAND BOUNDARY OF HORC, KMP AND IR) ACCESS DATES

3.1 General

"Works Areas" means the areas of the Site within the land boundaries of HORC including the land in the boundaries of KMP and any additional areas which may be obtained by the Contractor at their own cost and agreed by the Engineer as additional working area .

a) The dates on which Work Areas (within ROW) are available to the Contractor for the commencement of the Works are defined as Work Area Access Dates (AD).

b) The Work Area Access Dates that apply to this Contract are stated in terms of days after the Commencement Date of the Works.

c) Where Work Areas are to be made available to the Contractor, they shall be available within the specified day. Where Work Areas are to be vacated, they shall be released not later than midnight on the specified day.

3.2 Work Area Access Schedule

The access to and possession of Works Area (within ROW) shall be made available as per Part A Contract Data of Special Conditions of the Contract (SCC).

3.3 ELECTRICAL GENERAL

Temporary electrical Site installations and distribution systems shall be in accordance with:-

(a) Indian Electricity Rules

(b) The Power Companies' Supply Rules;

(c) Electricity and its subsidiary Regulations;

(d) IEE Wiring Regulations (16^{th} Edition);

(e) BS 7375 Distribution of Electricity on Construction and Building Sites;

(f) BS 4363 Distribution Assemblies for Electricity Supplies for Construction and Building Sites; and

(g) BS 6164 Safety in Tunnelling in the Construction Industry.

(h) Any other applicable national standards

3.4 MATERIALS, APPLIANCES AND COMPONENTS

All materials, appliances and components used within the distribution system shall comply with BS 4363 and BS 7375 Appendix A.

3.5 DESIGN CONSIDERATIONS

(i) Distribution equipment utilised within the temporary electrical distribution system shall incorporate the following features:-
   (a) flexibility in application for repeated use;
   (b) suitability for transport and storage;
   (c) robust construction to resist moisture and damage; and
   (d) safety in use.

(ii) All cabling shall be run at high level whenever possible and firmly secured to ensure they do not present a hazard or obstruction to people and equipment.

(iii) The installation on Site shall allow convenient access to authorised and competent operators to work on the apparatus contained within.

3.6 MAINS VOLTAGE

(i) The Site mains voltage shall be as per the Electricity Authority, 415V/ 3 phase 4 wire system.

   (a) Single phase voltage shall be as per the Electricity Authority, 230V supply.

   (b) Reduced voltages shall conform to BS 7375.

(ii) Types of Distribution Supply

The following voltages shall be adhered to for typical applications throughout the distribution systems:

   (a) fixed plant - 415V/ 3 phase;

   (b) movable plant fed by trailing cable - 415V /3 phase;

   (c) installations in Site buildings - 230V /1 phase;

   (d) fixed flood lighting - 230V/ 1 phase;

   (e) portable and hand held tools - 115V /1 phase;

   (f) Site lighting (other than flood lighting) - 115V /1 phase; and

   (g) portable hand-lamps (general use) - 115V /1 phase.

(iii) When the low voltage supply is energised via the Employer's transformer, any power utilised from that source shall be either 415V 3 phase or / 230V. 1 phase as appropriate. The Contractor shall carry out any conversion that may be necessary to enable him to use power from that source.

3.7 PROTECTION OF CIRCUITS

(i) Protection shall be provided for all main and sub-circuits against excess current, under and over voltage, residual current and earth faults. The protective devices shall be capable of interrupting (without damage to any equipment or the mains or sub-circuits) any short circuit current that may occur.

(ii) Discrimination between circuit breakers, circuit breakers and fuses shall be in accordance with:-

(a) BS 88;

(b) BS EN 60898;

(c) BS 7375; and

(d) Any other appropriate Indian Standards.

3.8 EARTHING

(i) Earthing and bonding shall be provided for all electrical installations and equipment to prevent the possibility of dangerous voltage rises and to ensure that faults are rapidly cleared by installed circuit protection.

(ii) Earthing systems shall conform to the following standards:-

(e) IEE Wiring Regulations (16th Edition);

(b) BS 7430;

(c) BS 7375; and

(d) IEEE Standard 80 Guide for Safety in AC Substation Grounding.

3.9 PLUGS, SOCKET OUTLETS AND COUPLERS

Low voltage plugs, sockets and couplers shall be colour coded in accordance with BS 7375, and constructed to conform to BS EN 60309. High voltage couplers and 'T' connections shall be in accordance with BS 3905.

3.10 CABLES

(i) Cables shall be selected after full consideration of the conditions to which they will be exposed and the duties for which they are required. Supply cables up to 3.3KV shall be in accordance with BS 6346.

(ii) For supplies to mobile or transportable equipment where operation of the equipment subjects the cable to flexing, the cable shall conform to one of the following specifications appropriate to the duties imposed on it:

(a) BS 6708 flexible cables for use at mines and quarries;

(b) BS 6007 rubber insulated cables for electric power and lighting; and

(c) BS 6500 insulated flexible cords and cables.

(iii) Where low voltage cables are to be used, reference shall be made to BS 7375. The following specifications shall also be referred to particularly for underground cables:-

(a) BS 6346 for armoured PVC insulated cables; and

(b) BS 6708 Flexible cables for use at mines and quarries.

(iv) All cables which have a voltage to earth exceeding 65 V (except for supplies from welding transformers to welding electrodes) shall be of a type having a metal sheath and/or armour which shall be continuous and effectively earthed. In the case of flexible or trailing cables, such earthed metal sheath and/or armour shall be in addition to the earth core in the cable and shall not be used as the sole earth conductor.

(v) Armoured cables having an over sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring.

(vi) For resistance to the effects of sunlight, overall non-metallic covering of cables shall be black in colour.

(vii) Cables which have applied to them a voltage to earth exceeding 12 V but not normally exceeding 65 V shall be of a type insulated and sheathed with a general purpose or heat resisting elastomer.

(viii) All cables which are likely to be frequently moved in normal use shall be flexible cables.

Flexible cables shall be in accordance with BS 6500 and BS 7375.

3.11 LIGHTING INSTALLATION

(i) Where Site inspection of the Works is required during the nights, the Lighting circuits shall be run separate from other sub-circuits and shall be in accordance with BS 7375 and BS 4363.

(ii) Voltage shall not exceed 55 V to earth except when the supply is to a fixed point and where the lighting fixture is fixed in position.

(iii) Luminaries shall have a degree of protection not less than IP 54. In particularly bad environments where the luminaries are exposed to excesses of dust and water, a degree of protection to IP 65 shall be employed.

(iv) The Contractor shall upgrade the lighting level to a minimum of 200 lux by localised lighting in all areas where required by the Engineer,.

(v) Mechanical protection of luminaries against damage by impact shall be provided by use of wire guards or other such devices whenever risk of damage occurs.

3.12 ELECTRICAL MOTORS

(i) Totally enclosed fan cooled motors to BS 4999:Part 105 shall be used.

(ii) Motor control and protection circuits shall be as stipulated in BS 6164. Emergency stops for machinery shall be provided.

3.13 INSPECTION AND TESTING

Electrical installations on Site shall be inspected and tested in accordance with the requirements of the IEE Wiring Regulations (16th Edition)

3.14 IDENTIFICATION

Identification labels of a type reviewed without objection by the Engineer shall be affixed to all electrical switches, circuit breakers and motors to specify their purpose.

3.15 MAINTENANCE

(i) Strict maintenance and regular checks of control apparatus and wiring distribution systems shall be carried out by an electrician (duly qualified to carry out the said checks) to ensure safe and efficient operation of the systems. The Contractor shall

submit for review by the Engineer details of his maintenance schedule and maintenance works record.

(ii) All portable electrical appliances shall be permanently numbered (scarf tag labels or similar) and a record kept of the date of issue, date of the last inspection carried out and the recommended inspection period.

APPENDIX 4

PROJECT CALENDAR

4. GENERAL

4.1. For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 5 days week - Monday through Friday, except for National (Govt. of India) Holidays.

4.2. The Project Weeks shall be commenced on a Monday. A day shall be deemed to commence at 0001 hour on the morning of the day in question. Where reference is made to the completion of an activity by a particular week, this shall mean by midnight on the Sunday of that week. Requirements for the computation of Key Date are given in Appendix 2 to the Works Requirements.

4.3. A 7-day week calendar shall be adopted for various (Work) programme schedules for scheduling purposes. For Project purposes, the presentation shall be in 'Week"' units.

APPENDIX – 5

INTERFACE, COORDINATION AND COOPERATION WITH OTHER PARTIES

5.1 LIST OF CONTRACT PACKAGES IN HORC

S. No.	Package	Name of Work
1.	C-1	Priority Section - Construction of Earthwork, Bridges, Station Buildings, Retaining Walls and other miscellaneous works in connection with laying of New BG Double Railway line of HORC Project from Km 49.7 to Km 55.6 and its connectivity (new BG single line) from proposed Manesar Station of HORC to existing Patli Railway Station of IR Network.
2.	T-1	T-1: Laying of Track and track related works including supply of ballast, special sleepers, switches and crossings track fittings but excluding supply of Rails and line Sleepers in connection with laying of New BG Double Railway Line of HORC project from Km 32.00 to Km 61.5 and its connectivities to IR Network from Manesar to Patli Stations and New Patli to Patli & New Patli to Sultanpur Stations.
3.	Br-1	Fabrication, assembly & launching of 1X76.2 m span Open Web Girder (OWG) each over three lines on NH-352W (Pataudi Road) between Manesar and Patli stations including supplying & fixing of H-beam sleepers in connection with laying of New BG Double Railway Line of HORC project at Km 54.498.
4.	C-23	Design and Construction of Civil Works (Earthwork, Bridges, Station Buildings, Retaining Walls and other miscellaneous Works) from km 29.68 to km 49.70 & from km 55.60 to km 61.50 and its connectivities to IR network from New Patli to Patli station & New Patli to Sultanpur station including modifications/civil works at Sultanpur Station in connection with laying of New BG Double Railway line of HORC project.
5.	C-4	Composite Contract package in connection with New BG Railway Line of HORC project for: (i) Design & Construction of Twin Tunnel using NATM and Cut & Cover method from km 24.850 to km 29.580; (ii) Design & Installation of Ballastless Track (excluding supply of rails) from km 24.843 to km 29.680; (iii) Detailed Design, Supply, Installation, Testing & Commissioning of General Electrical Services including Supply, Erection, Testing and Commissioning of 11kV HT/LT Power and Control Cable Network,

S. No.	Package	Name of Work
		GIS Substation (11/0.433) kVA, Tunnel lighting system, etc. from km 24.843 to km 29.680; (iv) Design & Construction of Embankment, Bridges and other miscellaneous works from km 12.00 to km 18.00.
6.	C-5	**Contract Package C-5:** Composite Contract package in connection with New BG Double Railway Line of HORC project between stations Prithla and Dhulawat for: (i) Design and Construction of Civil Works (Earthwork, Bridges, Stations and Retaining Walls) from km -2.296 to km 12.00 & km 18.00 to km 20.942; (ii) Design & Construction of viaduct from km 20.942 to km 24.844; (iii) Design & Construction of Ballastless track from km 20.842 to km 24.844; and (iv) Design, Supply, Installation, Testing & Commissioning of General Electrical Services from km -2.296 to km 12.00 and Km 18.00 to Km 24.844
7.	C-6	Design and Construction of Civil Works (Earthwork, Bridges, Station Buildings, Retaining Walls & other miscellaneous Works) and General Electrical Services works from km 61.50 to km 125.98 and its connectivities to IR network from proposed Badsa Station of HORC to Existing Sultanpur station and proposed Mandothi station to existing Asaudha Station in connection with laying of New BG Double Railway line of HORC Project.
8.	SYS-1	**Contract Package SYS-1:** Design, Supply, Installation, Testing & Commissioning of 2x25kV, 50Hz, AC, High Rise Overhead Electrification (OHE), Power Supply System and SCADA in connection with laying of New BG Double Railway Line from Prithla to New Harsana Kalan of Haryana Orbital Rail Corridor (HORC) Project from Km (-) 2.099 to Km 125.98 Including Rigid Overhead Conductor System (ROCS) in Tunnel Portion i.e from km 24.850 to km 29.580 and its connectivity to IR/DFC networks at New Prithla, Patli, Sultanpur, Asaudah and New Harsana Kalan including modifications in New Prithla, Sultanpur, Asaudah and New Harsana Kalan Station Yards (approximately 145 RKM and 315 TKM).
9.	SYS-2	Design, Supply, Installation & Commissioning of Signalling & Telecom system in connection with laying of New BG Railway Double line of HORC Project from Prithla station (Ch: Km (-) 2.296 to New Harsana Kalan Junction (Ch: Km 125.98 Km) and single line connectivity from Manesar to Patli station of IR, from New Patli Junction to Patli station of IR, New Patli

S. No.	Package	Name of Work
		Junction Station to existing Sultanpur station of IR, Badsa Junction to Sultanpur Station, from Mandothi Junction to existing Asaudha station of IR including modifications in IR stations at Patli, Farukhnagar, Garhi Harsaru, Asaudha, Sonipat, Rathdana and DFCCIL stations New Prithla and New Tauru.
10.	T-2	Design, Supply and laying of Track and Track related works in connection with laying of New BG Double Railway Line of HORC project from Km -2.296 to Km 24.87, Km 29.06 to Km 32.00 and from Km 61.50 to Km 125.98 including its connectivities from proposed Badsa station of HORC to existing Sultanpur station on IR Network and proposed Mandothi station to existing Asaudha Station on IR Network.
11.	Patli-Manesar (OHE)	Design, Supply, Erection, Testing & Commissioning of 25kV, 50 HZ, Single Phase, High Rise OHE System for Electrification Works including foundations, structures and all ancillary equipments for (i) Electrification of Maruti Suzuki Railway Yard" and "General Electrical works of proposed Station Building in Maruti Yard in connection with Railway Siding for Maruti Suzuki India Ltd. Manesar" and (ii) OHE modification of PATLI YARD area including provision of double line Sectioning Post (SP) with CB arrangement & SCADA Equipment at PATLI STATION and electrification of PATLI-MANESAR Single line connectivity in connection with HORC Project, in the State of Haryana.
12.	MNS-01	Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.

Notes:

1. The above list is only tentative and has been provided for giving an overview of the Project to the Bidders. However, it may undergo change in future at the sole discretion of HRIDC/HORCL.
2. Automatic Signalling System is proposed for HORC project.

5.2 GENERAL

5.2.1 This Appendix describes the Contractor's responsibilities with regard to interface management and coordination and includes interfacing with other contractors employed by the Employer (referred to as "Interfacing Contractors" hereinafter), and Interfacing Parties including entities such as local authorities, statutory bodies, public utility companies, private service providers, consultants or contractors whether or not specifically mentioned in the Contract. This responsibility is not limited to a particular number of Interfacing Contractors and Interfacing Parties, and all interfaces as required in the Contract are the sole responsibility of the Contractor.

5.2.2 Interfaces internal to the Contract are the sole responsibility of the Contractor and are not covered by this Appendix.

5.3 RESPONSIBILITIES OF THE CONTRACTOR

5.3.1 So as to ensure that the whole Project including Interfacing Contractors' works as well as the Contractor's Works shall be executed in the most efficient manner in the best interest of the Employer, the Contractor shall:

a) Take the lead in the management of the coordination process with Interfacing Contractors and Interfacing Parties.

b) Accord access to the Site and/or services to any related party in the Contract including members of the Interfacing Contractors, Interfacing Parties and the Engineer/Employer.

c) Not impede the work of the Interfacing Contractors and Interfacing Parties and shall accord them all reasonable opportunities and facilities.

5.3.2 The Contractor shall, in accordance with the Works Requirements, coordinate and integrate the:

a) Contractor's own Works under the Contract with the works of the Interfacing Contractors and Interfacing Parties.

b) Works of the Interfacing Contractors and Interfacing Parties.

5.3.3 The Contractor shall comply with any instruction which the Engineer may give. The Contractor's responsibilities shall neither be mitigated nor in any way affected by virtue of similar responsibilities being placed on the Interfacing Contractors. The Contractor shall be responsible for the detailed coordination of his manufacturing, installation, construction, testing and commissioning activities.

5.3.4 The Contractor shall carefully review any pertinent information made available by the Engineer relating to the nature and programming of all related parties' contracts and use such information in his planning of the Works.

5.3.5 The Contractor shall communicate and exchange information directly with the Interfacing Contractors and Interfacing Parties with a copy to the Engineer for information. Information as necessary to fulfil the Contractor's interface obligations shall be directly requested and obtained from the Interfacing Contractors and Interfacing Parties with a copy to the Engineer for information and receipt acknowledged.

5.3.6 The Contractor shall ensure that the Contractor's requirements, including any design inputs to other packages, are provided to all related parties of the Interfacing Contractors and Interfacing Parties before the cut-off dates as identified in the Interface Management Plan to be developed by the Contractor and consented to by the Engineer

5.3.7 Where other contracts requiring interface are yet to be awarded, the Contractor shall proceed with coordination activities with the Engineer, until such time as the Interfacing Contractors are employed by the Employer.

5.3.8 The Contractor shall take all reasonable steps to ensure that the Works are integrated with the manufacture, installation, execution and testing of such other works and shall in particular but without limitation to:

a) Comply with any instruction which the Engineer may give for the integration of the Works with the design of any other part of the Project;

b) Consult, liaise and cooperate with those responsible for carrying out such other works, including where necessary, in the preparation of the respective designs and drawings, thepreparation of coordinated programmes, method statements, coordination drawings and specifications together with arrangements of service priorities and zoning to coordinate the priorities of tasks and division of the area together with the items mentionedpreviously; and

5.3.9 Participate in the Integrated Testing and Commissioning of the Works with the Interfacing Contractors and Interfacing Parties and demonstrate to the satisfaction of theEngineer that the Works have been constructed in a manner compatible with the works of the Interfacing Contractors and Interfacing Parties.

5.3.10 There shall be a continuous requirement for coordination by the Contractor between Interfacing Contractors/Interfacing Parties.

5.3.11 During the Works the Contractor shall provide within the Site the facilities including, but not limited to, staging, storage and unloading, and temporary storage areas for the temporary use of Interfacing Contractors and/or Interfacing Parties, as may reasonably be required during the construction/installation and commissioning process. Where separate locations need to be provided for each of the Interfacing Contractors and/or Interfacing Parties, prior to construction commencing, specific details shall be coordinated and agreed between the Contractor and the Interfacing Contractors and/or Interfacing Parties.

5.3.12 The Contractor shall attend meetings with Interfacing Contractor and Interfacing Parties (if necessary) and raise/provide correspondence in this regard in accordance with the Works Requirements and/or as instructed by the Engineer. The identity of the Interfacing Contractor(s) and/or Interfacing Parties may not be known before the execution of the

Contract but this shall not be a grounds for the Contractor to object to the subsequent appointment of any Interfacing Contractor and/or Interfacing Party.

5.3.13 The Contractor shall in accordance with the requirements of the Contract and instructions of the Engineer coordinate his own Works with the works of Interfacing Contractors and/or Interfacing Parties strictly adhering to the Coordination and Interfacing Programme and shall accord the Interfacing Contractors and/or Interfacing Party's all reasonable opportunities for carrying out their works

5.3.14 If the Contractor suffers delay by reason of failure caused by any Interfacing Contractor/Interfacing Party to meet the specified installation interfacing and/or coordination completion dates resulting in delay beyond the extent which could be reasonably foreseen by an experienced contractor at the time when the Coordination and Interfacing Programme is formulated and consented by the Engineer, then the Engineer shall take such delay into consideration in determining any extension of time to which the Contractor is entitled under the Contract

5.3.15 If any act or omission of the Contractor, whether directly or indirectly, results in the delay in execution of the works of an Interfacing Contractor and/or Interfacing Party associated with the execution of the project, the matter shall be settled by the Engineer

5.3.16 All requests for information or clarification, acknowledgement of receipt of information and any official communication between the Contractor and Interfacing Contractors/Interfacing Parties shall be made in writing with a copy to the Engineer for information.

5.3.17 The Contractor shall notify the Engineer in writing of any problems encountered in obtaining necessary information and/or lack of cooperation from an Interfacing Contractor/Interfacing Party. In the event that the Engineer considers that the resolution of an interface is not proceeding satisfactorily, the Engineer shall review the matter and establish a coordinated plan directing the Contractor and the Interfacing Contractors/ Interfacing Parties regarding the required action.

5.3.18 The Contractor shall prepare minutes recording all the matters discussed and agreed at all the meetings.

5.3.19 The Contractor shall ensure that copies of all correspondence, drawings, meeting minutes, programmes, etc. relating to the Contractor's coordination and interfacing meetings with the Interfacing Contractors and Interfacing Parties or the sharing of correspondence, drawings, programmes, etc. are issued to all concerned parties and the Engineer no later than seven days from the date of such meetings and the date of issue of such correspondence, drawings, programmes, etc.

5.3.20 Should it appear to the Engineer that the Three Month Rolling Programme does not conform with the Coordination and Interfacing Programme, the Contractor shall be required to revise all such programmes so as to conform to the approved Contractual Works Programme.

5.4 INTERFACE ADMINISTRATION SYSTEM

5.4.1 The Contractor shall establish an Interface Administration System (the "IAS") and participate in the activities with the Interfacing Contractors and Interfacing Parties. The IAS shall include, but not be limited to, the following provision of:

a) An Interface Manager who shall be responsible for and the authority to resolve interface matters to the satisfaction of the Engineer;

b) The necessary support team for the IAS;

c) Procedures and details for response to, confirmation of and making written agreements with regard to interfaces;

d) Details of the arrangement for attendance at coordination and interface meetings (including those that may be arranged by Interfacing Contractors, Interfacing Parties or the Engineer). The representatives of Contractor, Interfacing Contractors and Interfacing Parties shall be empowered to make agreements on coordination and interfaces. The Contractor shall arrange regular meetings for the Engineer to monitor the status of coordination and interfaces and may arrange special coordination and interface meetingsas may be necessary to resolve specific issues. The Engineer can

require the Contractor to arrange a special coordination and interface meetings if necessary. The Contractor may request assistance from the Engineer to arrange coordination and interface meetings on particular subjects;

e) Details to the Engineer of regular status information and/or details of coordination and interfaces including copies of relevant correspondence and material; and

f) Details to the Engineer of access to information for the purpose of conducting audits on interface compliance and for confirming that interface coordination and interface management is proceeding consistently with the requirements of the Contract.

5.4.2 CONSTRUCTION INTERFACE

a) Construction coordination and interface shall be required throughout the duration of the Contract and shall commence from the time of the LOA until the Taking Over of the Works.

b) The Contractor shall coordinate and interface with the Interfacing Contractors and Interfacing Parties to execute the respective construction activities efficiently.

c) The Contractor shall cooperate with Interfacing Contractors and Interfacing Parties on all Site- related matters including but not limited to Site access and occupation, safety, verification of work compatibility and survey control, etc. The Contractor shall advise the Interfacing Contractors and Interfacing Parties in advance when a construction item is ready for site inspection to verify compatibility with the Interfacing Contractors' and Interfacing Parties' needs and shall facilitate access to the Site for the Interfacing Contractors and Interfacing Parties.

d) At or near the completion of the construction of any interface-related element of the Contractor's Work, the Contractor shall:

   i) Advise the Interfacing Contractors and Interfacing Parties that the as-constructed interface-related Works can be inspected and provide the necessary access to the Site and its occupation.

   ii) Agree in writing to the Interfacing Contractors and Interfacing Parties, and as consented bythe Engineer, on the adoption of any Interfacing Contractors' and/ or Interfacing Parties' applicable comments on the constructed Works.

e) On advice from the Interfacing Contractor or Interfacing Party that an as-constructed interface- related element is ready for inspection, the Contractor shall:

f) Conduct on-site inspections of the Works elements and give comments in writing to the Interfacing Contractor and/or Interfacing Party.

g) Agree in writing to the Interfacing Contractor or Interfacing Party that the as-constructed Works meet the coordination and/or interface requirements.

h) Prior to applying for a Taking-Over Certificate, the Contractor shall obtain written confirmation from each Interfacing Contractor and each Interfacing Party, that the interface elements meet the requirements of the Interfacing Contractors and Interfacing Parties. If any Interfacing Contractor or Interfacing Party withholds such confirmation, the Engineer shall decide on further action, as requested by the Contractor prior to the issue of a Taking-Over Certificate.

i) Where Contractor's Works are identified as failing to meet the requirements of the Contract and such shall impact the Interfacing Contractors' works or Interfacing Parties' works, the Contractor shall submit the proposed remedial measures to the Engineer for review and shall copy the same to the Interfacing Contractors and/or Interfacing Parties.

j) The Contractor shall coordinate and interface with the Engineer with respect to all construction/installation activities and shall follow the Engineer's instructions for requesting access for such activities.

k) The Contractor shall undertake construction/ installation in accordance with the approved (Contractual) Works Programme. The Contractor shall coordinate and interface with Interfacing Contractors and/or Interfacing Parties for the planning and execution of the testing and commissioning activities.

5.5 INTERFACE DOCUMENTS

5.5.1 Preparation of Interface Documents

The Contractor shall prepare as required the following coordination and interface documents which shall be used to completely define the Contractor's coordination and interface details:

a. Interface Table;

b. Coordination and Interfacing Programme; and

c. Interface Management Plan (IMP).

These coordination and interface documents shall be submitted for review by the Engineer in order to obtain the Engineer's Approval. For all subsequent updates, these documents shall be submitted to the Engineer for information, review and comment. A summary of principal issues with suitable solutions shall be included in each Monthly Progress Report.

5.6 INTERFACE TABLE FOR SUPPLY AND INSTALLATION ITEMS

5.6.1 The Interface Table shall include at least (but without limitation) the items related with the Contractor's Contract described in Appendix 5. The Interface Table, which describes the relationships between the Contractor and Interfacing Contractors and/or the Interfacing Parties and their roles and responsibilities, shall be submitted to the Engineer for consideration after further development of Interface Table.

5.6.2 The Interface Table shall indicate the demarcation of scope of responsibilities between the Contractor and the Interfacing Contractors and the Interfacing Parties.

5.6.3 Within sixty (60) days of notification from the Engineer of the identity of each Interfacing Contractor, the Contractor shall develop and submit to the Engineer an Interface Table that is mutually acceptable to both the Contractor and the Interfacing Contractors and Interfacing Parties.

5.7 COORDINATION AND INTERFACING PROGRAMME

5.7.1 The Contractor shall prepare and submit a Coordination and Interfacing Programme to the Engineer in accordance with the Works Requirements and/or as instructed by the Engineer as detailed below.

5.7.2 The Coordination and Interfacing Programme shall be submitted to the Engineer for consent within sixty (60) days from the Letter of Acceptance (LOA) to allow for checking and monitoring by the Engineer.

5.7.3 The Coordination and Interfacing Programme shall include detailed activities describing all aspects of the works of Interfacing Contractors and Interfacing Parties to meet all Sections or Milestones given in the Contract and be clearly linked to other programmes such as the (Contractual) Works Programme (or Work Segment Programmes) to streamline the Works and the works of the Interfacing Contractors and Interfacing Parties.

5.7.4 The Coordination and Interfacing Programme shall indicate the physical areas to which the Interfacing Contractors and Interfacing Parties require access, with access dates, durations required and the required degree of completion of the Works prior to the access dates by Interfacing Contractors and Interfacing Parties.

5.7.5 It is the Contractor's responsibility to ensure timely coordination with the Interfacing Contractors and Interfacing Parties to review, revise and finalise his Coordination and Interfacing Programmes so as not to affect the progress of the Works and/or the works of the Interfacing Contractors and Interfacing Parties.

5.7.6 The Contractor shall note that the following conditions apply to the works of the Interfacing Contractors and/or Interfacing Parties:

a) The Interfacing Contractors and/or Interfacing Parties shall not have exclusive access to any part of the Site except with the consent of the Engineer;

b) The Contractor shall take note that concurrent time allocations for certain areas may be given to more than one Interfacing Contractors and or Interfacing Parties. The Contractor shall coordinate the Works in such areas with the works of the Interfacing Contractors and/or Interfacing Parties and report to the Engineer for his review and consent;

c) The absence of a Coordination and Interfacing Programme date or construction/ installation period for the Interfacing Contractors and/or Interfacing Partiesin a specific area shall not prejudice the right of the Engineer to establish a reasonable Coordination and Interfacing Programme date or construction/installation period for thatarea;

d) The Contractor and the Interfacing Contractors shall comply with the Sections or Milestones and other successive activities specified in the Coordination and Interfacing Programme.

5.8 INTERFACE MANAGEMENT PLAN (IMP)

5.8.1 The Contractor shall develop and submit to the Engineer, within sixty (60) days from the LOA, an IMP for all interface issues that may arise during the construction, testing and commissioning of the Works, in consultation with the Interfacing Contractors / Interfacing Parties and the Engineer. The IMP shall allow adequate time periods for each of the Interfacing Contractors/ Interfacing Parties and the Contractor to install their Plant, equipment and Materials in the designated areas.

5.8.2 The IMP shall:

a) Identify all the systems and sub-systems and facilities with interfacing requirements;

b) Define as far as possible the authority and responsibility of the contractor's, theInterfacing Contractor's and interfacing party's involved in interface management and development;

c) Identify the information to be exchanged, together with the management and technical skills required for the associated development of the works, at each phase of the contractor's and Interfacing Contractor's and Interfacing Parties' project life-cycles;

d) Address the Contractual Works Programme (or Work Segment Programmes) of the Contract to meet the Contractor's sections or Milestones and the Interfacing Contractors' sections or milestones and highlight any programme risks requiring the Engineer's attention;

e) Include relevant consideration of the requirements of "Environment Social Health and Safety Manual" as described in Appendix 13;

f) Address the supply, installation, testing and commissioning programmes of the Contractto meet Interfacing Contractors' Sections or Milestones, and highlight any programme risks requiring management attention; and

g) Indicate dates for commencement and completion of each principal activity by the Contractor and those of the Interfacing Contractors and Interfacing Parties, including delivery and installation of Plant, equipment and Materials.

5.8.3 After the Engineer reviews and issues approval to the IMP, the Contractor shall execute the Works accordingly.

5.8.4 The Contractor shall raise and apprise the Engineer immediately of any difficulty in developing a mutually acceptable IMP.

5.8.5 Employer's / Engineer's Input

a) The Employer or Engineer or both will coordinate the activities of the Contractor with reference to interfacing with third parties during all the phases of the Contract.

b) The Employer or Engineer, within the scope of the relevant Contract provisions, may assist the Contractor in the following fields:

(1) Coordination and interface with state and local authorities for the timely receipt of required permits, certificates and approvals related to the construction process;

(2) Coordination and interface with state and local authorities for the implementation of acquisition procedures for any additional land areas that may be required by the Contractor; and

(3) Any other fields or activities related to the Contract as may be required for the purposes of facilitating the Contractor's performance.

c) The Engineer shall conduct a coordination and interface meeting with the interfacing parties every fortnight with the Contractor which may be attended by the Employer. The primary objective of the meeting will be to review progress of the coordination and interface activities.

d) The support and assistance of the Employer and/or the Engineer shall not release the Contractor of any of his obligations under this Contract.

5.9 DETAILED INTERFACE DESCRIPTION (DID)

5.9.1 The DID is the document that provides a clear technical description of each of interface in the Interface Table.

5.9.2 Any revision to the DID shall be mutually acceptable to both the Interfacing Contractors and Interfacing Parties. Only then shall this be submitted to the Engineer for his review.

5.9.3 DID shall contain the following items:

S. No.	Detailed Interface Description
1	Item number and name of interface in Interface Table
2	Name of the Contractor and Interfacing Contractor/Interfacing Party
3	Confirmation Table of both the Contractor and Interfacing Contractor/Interfacing Party
4	Creation date and modification date
5	Correction history
6	The following items shall be described: physical interface, functional interface, protocols, software and data interface, naming conversion, design constrains, environmental conditions, and drawings
7	Reference Documents

5.10 CONTENTS OF INTERFACE MANAGEMENT PLAN

Interface Management Plan (IMP) should be prepared including necessary contents referring Table 1. The intention of each section is described by the text inside angle brackets.

Table1: Sample Contents of Interface Management Plan

1	Introduction	
	1.1	Purpose of Document <Describe the methodology to be adopted by the Contractor in managing all interface issues >
	1.2	Overview <Project overview of the Contractor and the Interfacing Contractor>
2	Resource Management	
	2.1	Organization and Roles & Responsibilities
	2.2	Resource Requirement <Detailed description of the manpower, tools, logistics shall be included in this section>
3	Interface Requirements	
	3.1	Allocation of Interfacing Requirements <This is an introduction to Section3.2>
	3.2	Interface Description between Contractors <Task Allocation Table (TAT) shall be included in this section>
	3.3	Areas of Concern <Process for managing the interface concern>
4	Process Management	
	4.1	Change of Interfacing Requirement <The process for the management of interface requirement change shall be addressed in this section.>
	4.2	Verification and Validation of Interfacing Requirements <The approach to be adopted by the Contractor to manage verification and validation of interfacing requirements shall be addressed in this section.>
	4.3	Testing and Commissioning on Interfaces <The approach to be adopted by the Contractor for the management of Interface in the Testing and Commissioning stage shall be addressed in this section.>

	4.4	Quality Procedures <All Contractor's internal quality procedures applicable for the interface management shall be listed here.>
	4.5	Systems Assurance Plans <Considered requirement of the Systems Assurance.>
5	Document Management	
	5.1	Reference Documents <All applicable reference documents shall be listed in this section.>
	5.2	Structure of Reference Documents <The Structure of reference documents shall be addressed in this section.>
	5.3	Version Control of Interface Documents <Configuration management of interface documents shall be addressed in this section.>
6	Communication	
	6.1	Terms of Reference of Interface Meetings <The terms of reference of interface meetings shall be addressed here.>
	6.2	Exchange of Information between Contractors <The process for the exchange of information between the pair-wise contractors shall be stated here.>
	6.3	Submission to Employer <The approach to be adopted by the pair-wise contractors on the Submission of the Interface Management Plan to Employer shall be described here.>
	6.4	Request for Employer Attention <The criteria and methodology on requesting for Employer attention shall be mentioned here.>
7	Interface Hazard Management	
	7.1	Strategy and Approach
8	Programme	
	8.1	Key Activities <Include schedule of meetings, schedule of exchange of information, etc.>

	8.2	Section and Milestone <Include Design Freeze Dates, Integrated Test Dates, Critical Items dates, etc. Should include reference to appropriate programmes so that any future changes in programme date need not result in resubmission of this plan for approval.>
	8.3	Critical Items/ Critical Paths <This section shall highlight all the critical items and critical paths to the Employer.>

5.11 INTERFACE TABLE

Item No.	Item Description	Civil Contractor (C-1)	MNS-01 and SYS-2 Contractors
1.	Handing/Taking over of site for Construction of Manesar Station Building.	C-1 Contractor shall provide access to MNS-01 Contractor.	(i) MNS-01 Contractor shall take access to Manesar Station (ii) MNS-01 Contractor shall complete the structural works upto 2nd floor and provide access to the C-1 Contractor for construction of Platform.
2.	Handing/Taking over of site for completion of balance works of IMD Building.	C-1 Contractor shall provide access to MNS-01 Contractor.	MNS-01 contractor shall complete the balance works of IMD Buildings
3.	Handing over of Formation for construction of S&T Huts	C-1 Contractor shall complete the formation works at the location of S&T huts and provide access to MNS-01 Contractor.	MNS-01 contractor shall complete the S&T Huts and Hand over to SYS-2 Contractor.

5.12 Interface requirements specified above are by no means exhaustive and it remains the Contractors' responsibilities to develop, update and execute jointly Interface Requirements during design & throughout the execution of Works, to ensure that:

i. all interface issues between the Contracts/Systems are satisfactorily resolved;
ii. design, supply, installation and testing of equipment are fully co-ordinated; and
iii. all equipment and facilities supplied under the Contracts are fully compatible with each other, whilst meeting the requirements of the respective Specifications.

APPENDIX 6

PROGRAMME REQUIREMENTS

6. GENERAL

6.1 PURPOSE OF PROGRAMME

6.1.1 There are two primary purposes for the requirement of Programme (Scheduling) information described in this document:

a) Evaluation of Bid.

b) Status Reports during Construction

To provide the Engineer with status reports for managing, monitoring and coordinating the awarded contracts during their execution within the overall multi-contract project schedule.

The requirements are organized in two stages. The first stage is a requirement for all Bidders and shall be submitted as part of Bid. The second stage is a requirement of the Employer and describes a series of reports to be submitted by the Contractor to the Engineer during the execution of contract, following the award of contract.

6.1.2 The Bider/Contractor shall programme his work at all times to meet the Key Date stated in Appendix 2 to the Works Requirements and the specified interface periods for the design and installation of the Works with those of the Interfacing Contractors and shall during the progress of the Works constantly monitor his progress against the programmes described below.

6.1.3 The Bider/Contractor shall include in all programmes his work obligations towards shared access, shared Site areas and other coincident or adjacent Works Areas.

6.1.4 The Works Programme, and all more detailed or revised versions, shall be submitted to the Engineer in hard copy as well as soft copy for his consent in accordance with the provisions of the GC.

6.2 METHODOLOGY

6.2.1 The computerized Critical Path Method (CPM) network using the Precedence Diagramming Method (PDM), has been selected by the Employer as the technique for contract management system and in co-coordinating the multi-contract project. This technique shall also be employed by the Bider in preparing their Bid submissions and by the Contractor in their Construction Stage submissions.

6.2.2 Unless otherwise agreed by the Engineer, all programmes submitted by the Contractor shall be produced using computerized Critical Path Method (CPM) Networks developed implementing the Precedence Diagramming Method (PDM) with Cost Loaded Charts and Tables.

6.2.3 The Contractor shall implement and use throughout the duration of the Contract, a computerized system to plan, execute, maintain and manage the planning, design, pre-construction, construction, and sub-contracts in executing the CPM scheduling by PDM. The reports, documents and data provided shall be an accurate representation of the current status of the Works and of the work remaining to be accomplished; shall provide a sound basis for

identifying problems, deviations from the planned works, and for making decisions; and shall enable timely preparation of the same for presentation to the Engineer.

6.3 PROGRAMME MANAGEMENT SOFTWARE

6.3.1 CPM programming software used shall be Primavera Project Planning (P6) Program - Ver 21.12 or later. Any other compatible system capable of direct file interchange capability with software program used by the Employer - Primavera (P6), Ver 21.12 or later can be used with Engineer's consent. Scheduling software and relevant instruction manuals, licensed for use in connection with the contract, shall be provided by the Contractor according to the Employer's specifications.

6.3.2 The Bider may use a system other than Primavera but will be required to demonstrate that full electronic data transfer to Primavera is available and that the various levels of reporting and coding capabilities are at least equivalent to Primavera. Compatibility and comparable performance between Primavera and the Bider's proposed system shall be demonstrated in his Bid submission. Should compatibility not be demonstrated to the Employer's satisfaction the Contractor shall utilise Primavera for development, start using, updating and revision of all the Programmes during the duration of the Contract. Upon the Engineer's consent of a system other than Primavera, the Contractor shall supply the Engineer with an original licensed copy, including manuals and approved training of the software and any subsequent versions thereof at no extra cost.

6.4 POST CONTRACT AWARD

6.4.1 The Contractor shall develop his Bid Programme into the Initial Works Programme including an outline Narrative Statement and submit its more detailed version as per the key dates mentioned in Appendix 2 to the Engineer for approval.

6.4.2 The first Three Month Rolling Programme shall be submitted within thirty (30) days of the date of commencement and all subsequent editions shall accompany the Monthly Progress Report. The Monthly Progress Reports shall also include a Programme Update as described below. These programmes shall subsequently be updated as described below.

6.4.3 The Contractor shall take into account the programmes of Interfacing Contractors while finalizing the Works Programme It is the Contractor's responsibility to ensure timely co-ordination with the Interfacing Contractors to review, revise and finalise his Work Programme so as not to affect the progress of Works/ and or the works of the Interfacing Contractors. The Detailed Works Programme when approved by the Engineer after incorporating requirement of Interfacing Contractors shall form the Baseline Programme and shall be called "Programme" against which actual progress of the Contract shall be reckoned. As the work progresses, it may be necessary to update/ revise the Baseline programme but such updating shall only be carried out with the prior consent of the Engineer or when directed by them.

6.4.4 For Initial & Detailed Work Programme submission, one (1) original and three (3) copies each of the following Programmes and Reports shall be submitted to the Engineer:

a) Programme: Baseline CPM Network

b) Programme: Baseline Milestone based Cost Activity Schedule

c) Baseline Schedule Report

d) Narrative Statement

e) Baseline Physical Progress 'S' curve

f) Baseline Resource Charts

6.4.5 The Engineer shall review and comment on the Contractor's programmes and information submitted under this Clause. The Engineer will confirm his consent or otherwise of the submissions within thirty (30) calendar days.

6.4.6 The Engineer shall require the Contractor to re-submit within thirty (30) calendar days if he is of the opinion that the programmes and information submitted by the Contractor is unlikely to meet the Contract Key Date.

6.4.7 If in the opinion of the Engineer, any of the Contractor's revised programmes or Baseline Schedule Report is not acceptable, it shall be construed as a failure of the Contractor to meet the Contract Key Date.

6.4.8 Notwithstanding the above, the Engineer may at any time during the course of the Contract require the Contractor to reproduce the computer-generated Baseline Schedule Report described above to reflect actual activity dates and generate schedules based upon "what if" statements. The initial computer-generated report after receiving the Engineer's consent will serve as the base against which the contract progress will be measured. Any changes to the Report reflected in subsequent Baseline Schedule Reports shall also require the Engineer's consent.

6.4.9 Failure to include any element of work required for performance of the Contract shall not relieve the Contractor from completing all works required under the Contract to achieve the original or any extended key completion date.

6.5 WORKS PROGRAMME

6.5.1 The Works Programme shall show the Contractor's plan for organising and carrying out whole of the Works.

6.5.2 The Works Programme shall be a computerised Critical Path Method (CPM) network developed using the Precedence Diagramming Method (PDM) and shall be present in bar chart and time-scaled network diagram format to a weekly or monthly time scale.

6.5.3 Tasks in the Works Programme shall be sufficiently detailed to describe activities and events that include, but are not limited to, the following:

a) Key Date,

b) all physical work to be undertaken in the performance of the Contract obligations, including Temporary Works,

c) the requested date for issue of any drawings or information by the Engineer,

d) incorporation of principal aspects of the Design Submission Programme,

e) procurement of major materials and the delivery and/or partial delivery date on-Site of principal items of Contractor's Equipment,

f) any off-site work such as production or pre-fabrication of components,

g) installation of temporary construction facilities,

h) interface periods with Interfacing Contractors or utility undertakings,

i) design, supply and/or construction activities of sub-contractors,

j) any outside influence which will or may affect the Works.

6.5.4 The Works Programme shall show achievement of all Key Date.

6.5.5 Activity descriptions shall be unique, describing discrete elements of work. Any activity creating an imposed time or other constraint shall be fully defined by the Contractor.

6.5.6 The Works Programme shall be organised in a logical work-breakdown-structure including work stages and phases, and shall clearly indicate the critical path(s).

Each activity in the Works Programme shall be coded to indicate:

a) Activity ID and Activity Code.

b) The Engineer may request additional activity coding to the extent available without restraint to the Contractor's utilisation of the programme software. When requested the Contractor shall add the required additional coding to the Programme. The Contractor shall use additional code fields as requested to comply with the requirements and for the use of the Contractor.

6.5.7 Activity duration shall not exceed two (2) weeks, unless otherwise consented to by the Engineer, except non-construction activities such as submittals, submittal reviews, procurement and delivery of materials or equipment and concrete curing. The Contractor shall submit a Programme/Project Calendar cross reference clearly indicating the allowance for holidays.

6.5.8 The Works Programme, in each submission, shall be accompanied by an Activity Report and a Narrative Statement as described below in both electronic and hard copy format (time scale logic diagrams in A1 size, reports in A4 size).

6.5.9 Activity Report shall list all activities, and events in the Works Programme, sorted by activity identification number.

The Activity Report shall include the following for each activity and event:

a) activity identification number and description,

b) duration expressed in Days,

c) early and late start, & early and late finish dates. Planned start and finish dates,

d) calculated total float and free float,

e) predecessor(s) and successor(s), accompanying relationships and lead/lag duration,

f) imposed time or date constraints,

g) calendar.

6.5.10 Narrative Statement

The Narrative shall be a comprehensive statement of the Contractor's plan and approach for the execution of the Works and the achievement of Key Date, handover dates, submission dates and any intermediate dates. It shall incorporate outline method statements in respect of

major items of work including construction sequences and primary item of plant, Construction Equipment, Temporary Works and the like. It shall fully explain the reasons for the main logic links in the Programme and include particulars of how activity durations are established. This shall include estimated quantities, production rates, hours per shift, work days per week and a listing of the major items of Construction Equipment planned for use on the project. Activities, which may be expedited by use of overtime or additional shifts, shall be identified and explained. A listing of holidays, and other special non-work days being used for the computer reports shall be included.

6.5.11 Baseline Physical Progress 'S' Curve

The Contractor shall also submit a forecast Cumulative Physical Progress 'S' curve based on the time-phased distribution of cost in the CPM Network Logic Diagram, expressed in percentage terms. This ‘S’ curve shall be generated from the computerized CPM Network Logic Diagram.

6.5.12 Baseline Resource Charts

The Contractor shall also submit a Resource Charts, generated from the Contractor's CPM Network Diagram, showing the anticipated manpower and main Construction Equipment usage during the execution of the Project.

As an additional monitoring facility, indicator resources shall be assigned to relevant activities for the major items of work. Indicator resources shall be directly allocated for excavation (cum.), piling (no.), diaphragm walling (m.), concrete (cum.), tunnel lining (m), etc. Resource indicators may be input as a daily rate, expected required rate, or as an activity total in the relevant units. These are purely indicative quantities and do not form part of contract.

6.5.13 All submissions of proposed Works Programmes subsequently, after approval of the Initial Works Programme, shall include the actual physical progress of work and forecast of the remaining work. Actual progress shall be stated in percent complete, remaining duration, and actual start and finish dates for each activity in the Works Programme.

6.6 INITIAL WORKS PROGRAMME

6.6.1 The Initial Works Programme submitted as under Clause 6.4 above need not include the full details. It should be a condensed version with combined activities of longer. The outline Narrative Statement shall be in sufficient detail to clearly show the Contractor's intention.

6.6.2 After the Engineer’s consent to the Initial Works Programme, the Contractor shall submit to the Engineer an expanded and more detailed version of the Initial Works Programme containing all of the information and detail required as per Key Date mentioned in Appendix 2.

6.6.3 Such submission shall make use of the Bid Programme submitted earlier but refined to include the best estimates of dates for the work of Interfacing Contracts which has impact on the Contractor's programme. Such programmes shall be amended subsequently to incorporate the actual dates/ schedule of the affecting contracts. It is the Contractor's responsibility to ensure timely co-ordination with the Interfacing Contractors to finalise the Initial Programme, without affecting progress of the work.

6.7 WORKS PROGRAMME REVISIONS

6.7.1 The Contractor shall immediately notify the Engineer in writing of the need for any changes in the Works Programme, whether due to a change of intention or of circumstances or for any other reason. Where such proposed change affects timely completion of the Works or any other Key Date the Contractor shall within fourteen (14) days of the date of notifying the Engineer submit for the Engineer's consent its proposed revised Works Programme and accompanying Narrative Statement. The proposed revised Works Programme shall show the sequence of operations of any and all works related to the change and the impact of changed work or changed conditions.

6.7.2 If at any time the Engineer considers the actual or anticipated progress of the work reflects a significant deviation from the Works Programme, he may request the Contractor to submit a proposed revised Programme which together with an accompanying Activity Report and Narrative Statement, shall be submitted by the Contractor within fourteen (14) days after the Engineer's instruction. The proposed revised Works Programme shall show the sequence of operations of any and all work related to the change and the impact of changed work or changed conditions.

6.7.3 All activities that have negative float must be analysed by the Contractor to identify the impact on the timely completion of the Works or on the achievement of Key Date.

6.8 THREE MONTH ROLLING PROGRAMME

6.8.1 The Three-Month Rolling Programme shall be an expansion of the current Works Programme, covering sequential periods of three months. The Three-Month Rolling Programme shall provide more detail of the Contractor's plan, organisation and execution of the work within these periods. In particular, the Contractor shall expand each activity planned to occur during the next three (3) month period, if necessary, to a daily level of detail.

6.8.2 The Three-Month Rolling Programme shall be developed as a Critical Path Method (CPM) network, and shall be presented in bar chart and time-scaled network diagram format. Bar charts shall be presented on an A4 and time-scaled networks diagrams on an A1 size reproducible media. Tasks in the programme shall be derivatives of and directly related to tasks in the approved Works Programme.

6.8.3 The Contractor shall describe the discrete work elements and work element inter-relationships necessary to complete all works and any separable parts thereof including work assigned to sub-contractors.

6.8.4 Activity duration shall not exceed two (2) weeks unless otherwise consented to by the Engineer.

6.8.5 Each activity in the Three-Month Rolling Programme shall be coded, or described so as clearly to indicate the corresponding activity in the Works Programme.

6.9 THREE MONTH ROLLING PROGRAMME REVISIONS AND UPDATE

6.9.1 The Three-Month Rolling Programme shall be extended forward each month as described under Clause 6. 4 above. Each submission of the Three-Month Rolling Programme shall be accompanied by a Programme Analysis Report, describing actual progress to date, and the forecast for activities occurring over the next three-month period.

6.9.2 If the Three Month Rolling Programme is at variance with the Works Programme, the Programme Analysis Report shall be accompanied by a supporting Narrative Statement

describing the Contractor's plan for the execution of the activities to be undertaken over the three-month period, including programme assumptions and methods to be employed in achieving timely completion.

6.9.3 The Contractor shall revise the Three-Month Rolling Programme or propose revisions of the Works Programme, or both, from time to time as may be appropriate to ensure consistency between them.

6.10 THREE WEEK ROLLING BAR CHART SCHEDULE

Once a week, on a day mutually agreed to by the Engineer and the Contractor, a meeting will be held to assess progress by the Contractor during the previous work week. The Contractor shall submit a construction schedule listing activity completed and in-progress from the previous week and the activities scheduled for the succeeding two weeks based on the detailed Works Programme. Copies of the schedule shall be submitted on A3 sized paper.

6.11 PROJECT CALENDAR

For the Project, the Contractor shall adopt 7 days a week calendar, identical calendar for the purpose of programming and Execution of Works. Official documents shall be transacted during 5 days week - Monday through Friday, except for National (Govt. of India) Holidays. For Project purposes, a week begins at 0001 hours on a Monday and ends at 2359 hours on a Sunday. The completion of an activity or the achievement of an event when given a week number shall be taken to mean midnight on the Sunday at the end of the numbered week. An access date or activity start date when given as a week number shall be taken to mean 0001 hours on a Monday of the Numbered week.

6.12 PROGRAMMING PERSONNEL

The Contractor shall submit, as part of its Staff Organization Plan, the names and required information for the staff to be employed on Works Programming. The Works Programmer shall hold reputable professional qualifications and relevant experience as per Attachment C-1 to Works Requirements – Construction .The programmer shall be employed by the Contractor full time on the Contract until the completion or such earlier time.

6.13 PROGRAMME AND REPORT SUBMISSION FORMAT

The Contractor shall submit one (1) original and three (3) copies and a soft copy of all submissions to the Engineer. All submissions shall be in A0, A1, A3 or A4 size, as appropriate except as may otherwise be agreed by the Engineer.

The format for all Programme and Report submissions shall be strictly in accordance with the format or as requested by the Engineer.

APPENDIX 7

MEETINGS

7. MEETINGS

7.1 Kick-Off Meeting

The Engineer shall hold Kick-Off Meeting within 7 calendar days from the Commencement Date. Purpose of the Meeting is formally to notify all parties concerned under the Contract that the project has begun, and every party has a common understanding and his role from the Commencement Date until issuance of the Taking-Over Certificate.

At the Kick-Off Meeting, followings will be, but not limited, discussed.

a) Outline of the Works

b) Communication rules (process, emails, approvals, etc.)

c) Other matters regarding proceeding and management of the Contract.

d) Profile of the Site

e) Time Schedule List of Contractual Events/Submissions, including Milestones, Time(s) for Completion and Defects Notification Period(s).

f) Introduction of key persons of the Contractor and Employer, with role, Function and authority of each person.

g) Role and responsibility of Emergency notification process.

7.2 Regular Meetings

7.2.1 The Engineer shall hold regular meetings with the Contractor as necessary for the proper management and co-ordination of the Works. The Contractor's representative and other personnel as considered necessary by the Engineer, shall attend such meetings.

7.2.2 Within twenty eight (28) days after the Commencement Date, the Engineer and the Contractor's Representative shall agree upon a programme for weekly and monthly meetings covering the first three (3) months after such twenty eight (28) days. The Contractor's Representative shall make sure that the Contractor's Personnel designated to attend meetings make themselves available for the meetings. The Engineer shall prepare the agenda for the meetings and the relevant documents to be submitted to the meeting, including as a minimum the minutes of the previous meeting. Thereafter, the programme for weekly and monthly meetings shall be updated monthly in the monthly progress meetings.

7.2.3 The Engineer may initiate ad-hoc meetings as and when the need arises, through prior consultation with the Contractor's Representative where possible, and the Contractor's Representative and other Contractor's Personnel designated by the Engineer and/or the Contractor's Representative shall attend such meetings. The Engineer shall prepare a proposed agenda of the meeting, for prior consultation with the Contractor's Representative where possible.

7.3 Monthly Progress Meeting

A Monthly Progress Meeting shall be called by the Engineer and shall be held every month within three (3) days following issuance of the Contractor's Monthly Progress Report. If the day specified, is not a working day, then the meeting shall be heldon the next working day after the specified date. The Engineer shall notify the Contractor of any change in the date or time, or both, of the meeting. The main purpose of the meeting is to discuss progress of the Works and if there is any delay in progress, being encountered by the Contractor, the Contractor shall indicate the cause of delay and present the method of recovery.The results of the discussions of the meeting shall be included in the Contractor's next MonthlyProgress Report to be provided.

7.4 Co-ordination Meeting

The Contractor shall organize co-ordination meetings as required with related parties. Before conducting such co-ordination meetings with the related parties, the Contractor shall give prior notice and agenda of the meeting to the Engineer and the Employer.

7.5 Meetings called by the Contractor

The Contractor's Representative may request the Engineer to meet him and other Contractor's Personnel whenever necessary to discuss the issues pertaining to the Works and the Contract. The Engineer shall comply with the request where physically possible. The Contractor shall prepare a proposed agenda for the meeting and submit it to the Engineer when making request for the meeting.

7.6 Other Meetings

The Contractor's Representative shall attend, and shall arrange for representatives of the Subcontractors, public departments, transportation companies, utility undertakings and other contractors employed by the Employer to attend, meetings when required by the Engineer. The Contractor shall inform the Engineer in 48 hours (or such a shorter period as agreed by the Engineer) before conducting meetings with the public departments, transportation companies, utility undertakings and/or the other contractors and shall give the Engineer an opportunity to attend such meetings.

7.7 Minutes of Meetings

The Engineer in principle shall be responsible for the preparation of the minutes of meetings, circulating it to the parties who attended the meeting before the next relevant meeting. The Engineer shall also be responsible for the minutes of ad-hoc meetings in a similar manner, unless otherwise agreed with the Employer.

7.8 MONTHLY PROGRESS REPORTS

7.8.1 GENERAL

The Contractor shall submit to the Engineer, a Monthly Progress Report. The first report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates. It shall be submitted in a format to which the Engineer shall have given his consent and shall contain sections/sub-sections.

7.8.2 FINANCIAL STATUS

a) A narrative review of all significant financial matters, and actions proposed or taken in respect to any outstanding matters.

b) A spread sheet summarising each activity, the budget, costs incurred during the period, costs to date, costs to go, cost forecast (total of costs to date and costs to go) and cost variance (difference between cost forecast and budget).

c) A spread sheet indicating the status of all payments due and made.

d) A report on of the status of any outstanding claims. The report shall in particular provide interim updated accounts of continuing claims.

7.8.3 PHYSICAL PROGRESS

a) It shall describe the status of work performed, significant accomplishments, including critical items and problem areas, corrective actions taken or planned and other pertinent activities, and shall, in particular, address interface issues, problems and resolutions.

b) It shall include a simplified representation of progress measured in percentage terms compared with percentage planned as derived from the Works Programme.

7.8.4 PROGRAMME UPDATE (For Entire Project)

a) The monthly Programme Update which shall be prepared by recording actual activity completion dates and percentage of activities completed up to the end of the month together with estimates of remaining duration and expected activity completion based on current progress. The Programme Update shall be accompanied by an Activity Report and a Narrative Statement. The Narrative Statement shall explain the basis of the Contractor's submittal:

(1) Early Work and Baseline Submittals – explains determination of activity duration and describes the Contractor's approach for meeting required Key Date as specified in the Contract.

(2) Updated Detail Programme Submittals – state in narrative the Works actually completed and reflected along Critical Path in terms of days ahead or behind allowable dates. Specific requirements of narrative are:

i. If the Updated Detailed Work Programme indicates an actual or potential delay to Contract Completion date or Key Date, identify causes of delays and provide explanation of Work affected and proposed corrective action to meet Key Date or mitigate potential delays. Identify deviation from previous month's critical path.

ii. Identify by activity number and description, activities in progress and activities scheduled to be completed.

iii. Discuss Variation Order Work Items, if any.

b) The Programme Status which shall:

(1) show Works Programme status up to and including the current report period, display Cumulative progress to date and a forecast of remaining work.

(2) be presented as a bar-chart size A3 or A4 and as a time-related logic network diagram on an A1 media, including activity listings;

c) The Activity Variance Analysis which shall analyse activities planned to start prior to or during the report period but not started at the end of the report period as well as activities started and/or completed in advance of the Works Programme.

7.8.5 KEY DETAILS STATUS

A report on the status of all Key details due to have been achieved during the month and forecasts of achievement of any missed Key details, and those due in the next month.

7.8.6 THREE MONTH ROLLING PROGRAMME

The monthly issue of the Three-Month Rolling Programme.

7.8.7 PLANNING AND CO-ORDINATION

a) A summary of all planning/co-ordination activities during the month and details of outstanding actions.

b) A schedule of all submissions and consents/approvals obtained/outstanding.

7.8.8 PROCUREMENT REPORT

a) A summary of all significant procurement activities during the month, including action taken to overcome problems.

b) A report listing major items of plant and materials which will be incorporated into the Works. The items shall be segregated by type as listed in the Specifications and the report should show as a minimum the following activities:

(1) purchase Order Date - Scheduled/Actual,

(2) manufacturer/Supplier and Origin,

(3) letter of Credit Issued date,

(4) manufacturer/Supplier Ship Date - Scheduled/Actual,

(5) method of Shipment,

(6) arrival Date in India- Scheduled/Actual.

7.8.9 SAFETY

A review of all safety aspects during the month including reports on all accidents and actions proposed to prevent further occurrence.

7.8.10 ENVIRONMENTAL AND SOCIAL

A review of all the environmental and social issues during the past month to include all monitoring reports, mitigation measures undertaken, and activities to control environmental impacts.

APPENDIX 8

DELETED

8 Deleted

APPENDIX 9

DOCUMENTS, DRAWING AND CAD STANDARDS

9. General

A document may consist of document cover, revision history, table of contents, text and attachment(s) in this sequence where applicable.

1) Cover format (Times New Roman)
2) Heading and name of client shall be on top, in capital, size 10.
3) Name of the project in bold letters, size 22.
4) Content of document in bold capitals, size 16.
5) Document reference number in bold capitals, size 12.
6) Company name: capitals, size 14.
7) Company logo in size 35 x 40 (W x H) mm.
8) Address of the company in regular letters, size 10.
9) Document Format (Time New Roman)
10) General Regulations
11) Letter size: 12.
12) Paper size A4 (A3 is used for table and figures).
13) Periods and semicolons shall be placed right after the preceding letter or number.
14) The space between paragraphs and headings shall be 1.15 lines.
15) Main headings shall be placed in number order, with a period placed right after the number, followed by a space, with a heading text in bold capital letters. For example.:

9.1 IN BOLD CAPITAL

Other headings are placed in number order, with a period placed right after the number, followed by a space, with a heading in regular letters. For ex.:

a) In normal letter.

b) Notes

Notes relating to tables shall be included in the table; in case they are not able to be included, it shall be clearly specified that they are notes relating to a particular table reference.

The text of notes is usually given in italics.

9.2 Language of Communication and Units

The language for communications shall be the English language. The Contractor shall utilize the SI system of measurement units.

9.3 Photographs

The Contractor shall take digital photographs of the Works at least on monthly basis and include them in the Contractor's Monthly Progress Reports. These photographs shall be taken at locations agreed with the Engineer as appropriate to record progress, quality and other relevant aspects of the Works. The number of the photographs shall be sufficient to cover all aspects of the Works in progress.

The digital photograph shall be colour jpeg image format with standard aspect ratio 4:3 and resolution of 300 DPI for all graphics in the printing. Read Only Memory (ROM) based electronic media of digital photographs shall be included as an integral part of the submittal. The locations and directions of the photographs taken shall be marked on a key plan of the Site, to be included in the submittal.

Each photograph shall be properly numbered and dated and include a brief explanatory note of the subject matter of the photograph, for ease of understanding.

Immediately before the issue of any Taking-Over Certificates for Works or Sections, the Contractor shall commission a professional photographer (or any person with equivalent skills) and take photographs of (where applicable, the interior to be taken by wide angle lenses) of exterior and all salient sections and features of the Works, for record purposes. The Contractor shall submit to the Engineer for approval as an integral part of the As-Built Documents, four (4) separately bound sets of colour prints of such record photographs, including one (1) set of Read Only Memory (ROM)-based electronic media containing an original jpeg image file of each photograph in accordance with the directory and naming convention agreed with the Engineer. The number of colour print images in a set shall not exceed 100, and each hard copy set of photographs shall be of A4 size with a cover page indicating information such as date, titles of the project and the Contract, and name of the Employer and the Contractor. Each of the photographs shall be properly numbered, dated and include a brief explanatory note of the subject matter.

9.4 Videos

On a monthly basis, or earlier if directed by the Engineer, the Contractor shall take digital video records to record the progress of the Works on Site (minimum duration of each to be ten minutes, covering all the areas of the Site where works are ongoing) as agreed with the Engineer, and submit the videos every month along with the Monthly Progress Report. The first video shall be made before the Commencement of the Works on the Site.

Within twenty-eight (28) days of receipt of the Letter of Acceptance, but in no case later than the Commencement Date, the Contractor shall submit to the Engineer a proposal for the provision of digital video recordings along with commentary of the progress of the Works.

The videos shall be taken by a competent person from an approved professional service provider (or any person with equivalent skills). The video shooting locations are to be identified in the afore mentioned proposal. This video should be submitted in a video format acceptable to the Engineer, with or without editing.

Immediately before the issue of the Taking-Over Certificate for the whole of the Works, the Contractor shall complete video recording and start editing the videos taken, to produce a 60-minute digital video-audio presentation with a suitable title. Each section of the video shall indicate the date on which it was taken. The presentation material shall have narration in English. The Contractor shall use a professional service provider to video, edit and produce the presentation material.

9.5 DRAWING AND CAD STANDARDS

a) The purpose of this document is to define the minimum Drafting and CAD standard to be achieved by the Contractor for all drawings produced by the Contractor for the purpose of the works.

b) By defining a common format for the presentation of drawings and CAD files, the exchange of drawn information is improved and will maximize the use of CAD in the coordination process.

c) All submissions shall be made in accordance with the Works Requirements in a format reviewed without objection and in accordance with the requirements in:

i. The Contract;

ii. The Document submittal instructions to Consultants and Contractors.

d) Paper and drawing sizes shall be "A" series sheets as specified in BS3429.

e) The following software (latest and updated version) compatible with Intel-Windows based computers shall be used, unless otherwise stated, for the various required electronic submissions.

Document Type	**Electronic Document Format**
Text Documents	**MS Word**
Spread Sheets	**MS Excel**
Data Base Files	**MS Access**
Presentation Files	**MS PowerPoint**
Programmes	**Primavera for Windows, Suretrack**
AutoCAD Graphics	**AutoCAD**
Photographic	**Adobe Photoshop**
Desktop Publishing	**Page Make 6.5,5**
CADD Drawings	**AutoCAD**

f) Media for Electronic File Submission - Email

One copy shall be submitted unless otherwise stated in CD-ROM

g) Internet File Formats/Standards

The following guidelines shall be followed when the Contractor uses the Internet browser as the communication media to share information with the Employer.

a) All the data formats or standards must be supported by Microsoft Internet Explorer (latest version) running on windows professional (latest version).

b) The following list shows the file types and the corresponding data formats to be used on Internet. The Contractor shall comply with them unless prior consent is obtained for a different Data format from the Works Requirements:

File Type	Data Format
Photo Image	Joint Photographic Experts Group (JPEG)
Image other than Photo	GIF to JPEG
Computer Aid Design files (CAD)	Computer Graphics Metafile (CGM)
Video	Window video (.avi)
Sound	Wave file (.wav)

h) The following states the standards to be used on Internet when connecting to database(s). The Contractor shall comply with them unless prior consent is obtained for a different standard from the Works Requirements

Function to be Implemented	Standard to be Complied With
Database connectivity	Open Database Connectivity (ODBC)
Publishing hypertext language on the World Wide Web	Hypertext Markup Language (HTML)

The hard copy of all documents shall be the contractual copy.

1) GENERAL REQUIREMENTS

General:

i) The Contractor shall adopt a title block similar to that used in the Drawings for all drawings prepared under the Contract.

ii) Each drawing shall be uniquely referenced by a drawing number and shall define both the current status and revision of the drawing.

iii) The current status of each drawing shall be clearly defined by the use of a single letter code as follows:

P	-	Preliminary Design Drawing
D	-	Definitive Design Drawing
C	-	Construction Reference Drawing
W	-	Working Drawing
B	-	As-Built Drawing
M	-	As Manufactured Drawing
E	-	Employer's Drawing

Types of drawings:

i) 'Design drawings' mean all drawings except shop drawings and as-built drawings.

ii) 'Working drawings' are design drawings of sufficient detail to fully describe the Works and adequate to use for construction or installation.

iii) 'Site drawings and sketches' are drawings, often in sketch form, prepared on site to describe modifications of the Working drawings, where site conditions warrant changes that do not invalidate the design.

iv) 'Shop drawings' are special drawings prepared by the manufacturer or fabricator of various items within the Works to facilitate manufacture or fabrication.

v) 'As-built drawings' show the Works exactly as constructed or installed. They are usually prepared by amending the working drawings to take into account changes necessitated by site conditions and described in Site drawings. These drawings shall be completed on a regular basis as the works progress, and shall not be left until completion of the entire works.

2) COMPUTER AIDED DESIGN STANDARDS

a) Introduction
Scope of Use

Data input procedures between the Engineer and contractors must be co- ordinated, and the key parameters used to form CAD data files must be standardized. The production of all CAD data files shall comply with the following requirements.

b) Objectives

The main objectives of the CAD standards are as follows:

i. To ensure that the CAD data files produced for Project are co-ordinated and referenced in a consistent manner.

ii. To provide the information and procedures necessary for a CAD user from one discipline or external organization to access (and use as background reference), information from a CAD data file prepared by another discipline or external

organization.

iii. To standardize the information contained within CAD data files which may be common to more than one discipline such as drawing borders, title boxes, grid lines etc.

iv. To establish procedures necessary for the management of CAD data files.

v. To ensure all contractors use 'Model space' and "Paper space' in the production of their CAD files.

c) General

i. To facilitate co-ordination between contractors, it is a requirement that all drawings issued by contractors for co-ordination or record purposes shall be produced using CAD methods. Drawings shall be issued in digital format in addition to the paper copies.

ii. The intent of the issue of digital information is to aid the related design by others. The definitive version of all drawings shall always be the paper or polyester film copies which have been issued by the contractor or organization originating the drawing.

iii. (Drawings and drawing packages issued for co-ordination, record purposes or for acceptance shall be accompanied by a complete set of the corresponding CAD data files.

iv. Any contractor or organization making use of the CAD data from others shall be responsible for satisfying himself that such data is producing an accurate representation of the information on the corresponding paper drawing which is satisfactory for the purpose for which he is using it. Provided the general principles of this section have been achieved by the originator of the CAD data, contractors making use of the CAD data from others shall not be entitled to require alterations in the manner in which such CAD data is being presented to them.

v. In particular, automatic determination of physical dimensions from the data file shall always be verified against the figured dimensions on the paper or polyester drawings. Figured dimensions shall be taken as correct where discrepancies occur.

vi. The purpose is to ensure that total co-ordination is achieved between the CAD 'Model Space" file and the "Paper Drawing" output during the revision cycle of the design and production process. Duplicated data in "Model and Paper Space" file will not be acceptable unless an automatic update link exists between the two data sets. "Paper Space" files are not typically required as part of the CAD Media Receipt from contractors, unless specifically requested.

d) CAD Quality Control Check

(i) Random CAD Quality Control Audits will be carried out by Engineer on all CAD media received and transmitted.

(ii) These checks DO NOT verify the technical content of the CAD data received or transmitted (as this is the responsibility of the originating organization), however compliance with Project CAD and Drafting Standards shall be checked.

(iii) In addition, all contractors who transmit and receive CAD data from the Project shall have CAD quality control procedures in place. A typical control procedure shall contain CAD data quality checking routines coupled with standards for CAD data transmittal and archiving.

e) CAD Data Transfer Media and Format

i. Data exchange format between the Engineer and the Contractor, shall be as follows:

Documents including design sheets, tables and figures: Word (*.docx), Excel (*.xlsx) and PDF (*.pdf).

Drawings: Autodesk's AutoCad 2016 or higher release. Electronic Data

Transfer Media: Pen Drive/Hard disk.

ii. All documents/drawings shall be labelled on the data shield with: Name of Company/ Consultant

Project Tile Document/Drawing Filenames

iii. The Contractor shall ensure the supplied media is free from virus.

f) CAD Media Receipt & Transmittal

i. CAD Media Transmittal (from the Contractor to Engineer) – this will consist of the following:

a) CAD Digital Media (disk(s), CD's or tape(s)) shall typically contain CAD "Model Space" and "Paper Space" files.

b) CAD data sheet

c) CAD issue/revision sheet

d) CAD quality Checklist confirming compliance

e) Plot of each "Model Space" file issued on an A1 drawing sheet (to best fit).

ii. The above CAD media will be collectively known as "CAD Media Transmittal Set". The CAD data file transmittal format required by Employer' Representative from all contractors shall be in AutoCAD (version 14)

iii. All CAD media received from contractors will be retained by Engineer except for SCSI disk (if used) as an audit trial/archive of a specific contractor's design evolution.

iv. CAD Media Receipt (from Engineer to the Contractor)

a. CAD Media should normally be obtained from the respective interfacing contractor(s), but should Engineer issue CAD media it will consist of the following:

a) CAD Digital Media (disk(s) or tape(s) typically contain only CAD "Model Space" files.

b) CAD data sheet

c) CAD issue/revision sheet

b) The above CAD media will be collectively known as the "CAD Media Receipt Set". The CAD data file transmittal format used by Engineer to all contractors will be in AutoCAD (version 14).

c) Each CAD transmittal disk/tape will be labelled with proper disk label as approved by the Engineer. Any CAD data transmitted without this label is assumed to be provisional information not to have been quality checked and therefore not formally issued.

a) Revisions

i. All "Revisions", 'In Abeyance' and 'Deletions' shall be located on a common layer. This layer can be turned on or off for plotting purposes.

ii. The following example text indicates the current CAD file revision, i.e., "Revision [A]". This shall be allocated to a defined layer on all CAD "Model Space" files, in text of a size that will be readable when the CAD "Model Space" file is fitted to the screen, with all levels on.

iii. Libraries, Blocks, & Block Names

a. All Construction Industry symbols produced as CAD Cells shall typically conform to British Standard BS1192 – part 3.

b. All Blocks created shall be Primitive (i.e., Not Complex) and shall be placed Absolute (i.e. NOT Relative).

c. The Contractor's specific block libraries shall be transmitted to Engineer together with an associated block library list containing the filename (max. 6 characters) and block description. The contractor shall ensure that the library is regularly updated and circulated to all other users, together with the associated library listing.

d. All Blocks of a common type, symbols or details should initially be created within a CAD "Model Space File" specifically utilized for that purpose. These files will be made available on request by Engineer.

e. All Blocks created will typically be 2D unless 3D is specifically requested. In both instances they shall have an origin at a logical point located within the extents of each Block's masked area or volume.

b) CAD Dimensioning

Automatic CAD Dimensioning will be used at all times. Any dimensional change must involve the necessary revision to the model space file. If the CAD Quality Control Checks find that the revisions have not been correctly carried out, the rejection of the entire CAD submission will result.

c) CAD Layering

All CAD elements shall be placed on the layers allocated for each different discipline. The layer naming convention to be adopted by the Contractor shall be submitted for acceptance and inclusion within these standards.

d) Global origin, Location & Orientation on the Alignment Drawing.

Location or Plan information in "Model Space" files shall coincide with the correct location and orientation on the Project grid for each specific contract.

Location plans shall have at least three setting out points shown on each CAD "Model Space" file. Each setting out point shall be indicated by a simple cross-hair together with related Eastings and Northings co-ordinates. The Civil Contractor(s) will establish the three setting out co-ordinates for their respective works, which will then be used by all other contractors including the Contractor.

e) Line Thickness and Colour

To assist plotting by other users, the following colour codes will be assigned to the following line thickness/pen sizes.

Colour	Code No	Line Thickness
Red	10	0.18
White	7	0.25
Yellow	2	0.35
Brown	34	0.5
Blue	130	0.7
Orange	30	1.0
Green	3	1.4
Grey	253	2.0

f) CAD Utilization of 2D & 3D Files

Although the project standard is 2D CAD files, certain disciplines and contractors may use 3D CAD files for specific applications or where the isolated use of 3D aids the design and visualization process (i.e. Architecture, Survey and Utilities). In these specific instances 3D CAD data will only be transmitted if all other users can use this data. If this is not the case, a 3D to 2D translation shall be processed by the creator prior to issue.

g) CAD File Numbering

Contractors CAD File Numbering shall be described in 5.2.1 above. Employer CAD File Numbering Unlike most of the contractors, Employer will not be required to produced numerous CAD files. This will follow the numbering system Except that the status of the drawing in 5.2.1 (E) shall be "E".

h) CAD File Naming Convention – General

CAD "Model Space" files shall be named in accordance with general drawing conventions

APPENDIX- 10

CONSTRUCTION & SITE MANAGEMENT

10. THE SITE

10.1 Location and Boundaries

10.1.1 Works Areas are those areas identified in Appendix 3 to these Works Requirements.

10.1.2 Within 56 days from Commencement Date, the Contractor shall submit detailed and comprehensive Site Environmental, Social, Health and Safety plan (Appendix 13 of Works Requirements) based on Environmental, Social, Health and Safety (ESHS) manual.

10.1.3 Within 28 days of the date commencement, the Contractor shall submit detailed Quality Plan (Appendix 11 of Works Requirements) demonstrating the proposed method of achieving the required quality standards of the Employer as defined in the Works Requirements.

10.1.4 Normal working hours at site will be as stated in the Contract Data. However, the Contractor, if required, shall carry out work during night hours or in shifts with the approval of the Engineer. No increase in rates or extra payments shall be admissible for night work.

10.2 ACCESS TO THE SITE

10.2.1 The Contractor shall be deemed to have inspected, examined and made himself fully familiar with the access routes necessary for the proper execution of the Works and accounted for in the Accepted Contract Amount any costs arising in connection with the accessibility to the ROW. The Employer will not be responsible for any claims which may arise from the use of or otherwise in connection with any access route. The Employer does not guarantee the suitability or availability of any particular access route and will not entertain any claim for any non- suitability or non-availability of any such route for use (whether continuous or otherwise) during the Contract Period.

10.2.2 The Contractor shall make its own arrangements for access required to the Site. The Contractor shall negotiate with the landowners or other appropriate government agencies to seek temporary occupation of land and seeking necessary permission for construction of temporary access roads.

10.3 CONTRACTOR OPERATIONS OUTSIDE THE SITE

10.3.1 The Contractor shall be solely responsible for acquiring any additional land (land in addition tothe Site) required by him for his Temporary Works areas outside the ROW, at his own expense,including maintaining and reinstating the same on completion of the Works to the entire satisfaction of the landowner and the Engineer.

10.3.2 The Contractor shall make the necessary arrangements with landowners and relevant government authorities for any work to be undertaken outside the Site. Two copies of all the relevant documents/ permissions/ agreements, etc., as required by the Engineer in respect of the land arranged by the Contractor outside the Site, shall be submitted to the Engineer. Before commencing operations, the Contractor shall also submit to the Engineer a detailed plan and a programme of the Works to be carried out in the works area, including areas outside the Site.

10.3.3 When using and/or occupying works areas on existing public roads, the Contractor shall undertake all necessary procedures and mitigation measures as per the requirements set by the relevant authorities.

10.3.4 The Contractor shall submit to the Engineer proposals for the use and occupation of such works areas. Any such proposal shall be submitted to the Engineer at least twenty-eight (28) days prior to the start of the programmed use of the specific works area.

10.3.5 On completion of the Works, the land arranged by the Contractor outside the Site shall be restored back to its original condition to the entire satisfaction of the land owner and the Engineer.

10.4 SITE SECURITY

10.4.1 The Contractor shall be wholly responsible for security on the Site and any other areas being used by him or any Subcontractors for the purposes of the Contract. The Contractor shall implement and cause Subcontractors to implement proper security management procedures in accordance with the approved security management plan described in Appendix 13 (Environmental, Social, Health and Safety Management Manual)

10.4.2 The Contractor shall assign on the Site an appropriate safety and security organisation headed by experienced and professionally qualified safety and security personnel, who shall be primarily responsible for the Contractor's security services and shall fully cooperate with the Employer's security organization throughout the Time for Completion.

10.4.3 The Contractor shall prepare and submit to the Engineer for approval a security management plan (it may be included in the Environment, Social, Health and Safety Management Plan) fully complying with not only the relevant applicable Laws but also the regulations of the Employer which may be imposed from time to time on the Project within fifty six 56) days from the Commencement Date.. The plan shall include detailed procedures for daily security management operations as described in Appendix 13 (ESHS Manual) of General Specifications.

10.5 Possession of Third Parties Facilities

10.5.1 The definition of "Possession" to be applied in this Clause is 'possession of a segment or stretch of the Works and/or Indian Railways (IR) track(s) and/or other related authorities required by the Contractor from the Employer and/or IR and/or other related authorities for execution of the Works during the Time for Completion and/or after issue of the Taking- Over Certificate and during the Defects Notification Period for maintenance / rectification of any defects in the Works.

10.5.2 While undertaking construction activities within an existing railway line or road under the Contractor's Possession, the Contractor shall abide by the rules/guidelines included within the relevant manuals of Indian Railways and/or the National Highways Authority of India (NHAI)/Public Works Department (PWD)/ Panchayats/ Municipal Corporations and/or any other authority.

10.5.3 The Contractor shall undertake any construction activities on existing 'live' or operating lines only after the grant of Possession by the relevant authorities.

10.5.4 An area under the Contractor's Possession is the sole responsibility of the Contractor and all issues relating to safe working within that area, including the movement of traffic, are his responsibility.

10.5.5 If the Contractor has more than one work front within the same Possession, one person shall be nominated by the Contractor as the person responsible for the coordination for all work fronts within the Possession.

10.5.6 The Contractor shall ensure that construction activities shall be undertaken strictly within the area which is under the Contractor's Possession.

10.5.7 The Contractor shall appoint a responsible person who shall coordinate with the Employer, IR/ relevant authorities, Interfacing Contractors and Interfacing Parties as applicable and who shall act as the Possession Coordinator for the Contractor. The person appointed shall have experience of IR/ relevant authorities operations and shall be fully aware of IR Rules and Regulations related to possession of track for construction of railway works and in accordance with IR/ relevant authorities regulations to issue Possession requests. For the purposes of the Works, such person shall be duly certified in accordance with the said Rules and Regulations, if required.

10.5.8 The Contractor shall use Possessions on the line as follows:

10.5.9 For each particular Possession and depending on the duration and the location of the Possession, alternative route(s) may be required, such alternative diversion route(s) if required to be constructed, shall be at the Contractor's cost.

10.5.10 The normal alternative mode of transport will be proposed by the Contractor, and the route and timings of this alternative transport are to be agreed with the Engineer / IR / Road Authorities / Panchayat prior to obtaining Possessions.

10.5.11 The Employer shall provide assistance necessary to the Contractor to enable him to obtain the Possessions required by him, subject to being approved by IR, NHAI or relevant authorities. No claim shall be entertained by the Employer on this account.

10.5.12 The Contractor's request for Possession shall include a technical and organizational schedule and submit the same to the Engineer for his consent.

10.5.13 The Contractor shall submit his requests for Possessions well in advance as per requirements of relevant authorities.

10.6 Damage and Interference

10.6.1 General

Work shall be carried out in such a manner that there is no damage to or interference with:

a) watercourses and drainage system,

b) Utilities,

c) Structures (including foundations), roads including street fixtures or other properties;

d) Public or private vehicular or pedestrian access, and

e) Monuments, graves or burial grounds other than to the extent that it is necessary for them to be removed and reinstated to permit the execution of the Works.

10.6.2 Heritage structures shall not be damaged or disfigured on any account. The Contractor shall inform the Engineer as soon as practicable of any items which are not stated in the Contract to be removed or diverted but which the Contractor considers necessary to be removed or diverted to enable the Works to be carried out. Such items shall not be removed or diverted until the approval of the Engineer has been obtained.

10.6.3 Assets/ items of the Employer, Indian Railway (IR), Other Contractors and any other entities and relevant authorities which include, but are not limited to, water, sewage, gas authority, electrical, OFC communication cables etc. carried out shall be replaced / reinstated by the Contractor to the same condition as existed before the Works started and to the satisfaction of the Engineer and the concerned entity.

10.6.4 In case of damage to the existing cables, the Contractor shall have suitable procedure for cable joining under the technical supervision of IR or the relevant authority.

10.6.5 The Contractor shall indemnify the Engineer, Employer, Indian Railway, Other Contractors and relevant authorities against any damages or any penal action, any claim or legal action as a result of the damages.

10.7 Utilities

The Contractor shall follow the requirements on care for utilities as specified in this Appendix below.

10.8 Structures, Roads and Other Properties

10.8.1 The Contractor shall carry out a precondition survey of all roads and structures and drainage channels adjacent to the Site. Contractor originated deterioration of the roads and damage to adjacent structures and drainage facilities shall be reported to the Engineer with appropriate records.

10.8.2 The Contractor shall maintain / replace / reinstate to the same condition as existed before the Works started and to the satisfaction of the Engineer and the concerned entity.

10.9 Access

10.9.1 Where existing access to premises either public or private is damaged or unusable, alternative access shall be provided by the Contractor to enable the Works to proceed. The arrangements for the alternative access shall be as agreed by the Engineer, the relevant authorities and the owners of the premises affected.

10.9.2 Unless agreed otherwise, the permanent access shall be reinstated as soon as practicable after the Works are complete and the alternative access shall be removed immediately when it is no longer required, and the ground surfaces reinstated. Proper signage and guidance shall be provided for traffic/ users diversions.

10.10 Trees

10.10.1 Materials, including excavated materials, shall not be banked around trees. Trees shall always be protected from damages.

10.10.2 Unless otherwise consented to by the Engineer, trees shall not be trimmed or cut as stated in Appendix 13 [ESHS Manual]

10.11 Removal of monuments, graves, burial grounds and other obstruction

If any graves and other obstructions are required to be removed in order to execute the Works and such removal has not already been arranged, the Contractor shall draw the Engineer's attention to them in good time to make the necessary arrangement for authorization for removal.

10.12 Protection of the Other Adjacent Structures and Works

The Contractor shall take all necessary precautions during the construction to protect structures or works being carried out by others, adjacent to or within the Site from the effects of vibrations, undermining or any other earth movements or the diversion of water flow, arising from its work

10.13 Deleted

10.14 Site Clearance

The Contractor shall clear the Site as required by demolishing all buildings, structures, Borewells/wells (above and below ground such as brick, concrete, steel, etc.) and removing all rubbish outside the ROW. The dismantled structure shall be the property of the Contractor. Borewell/Wells shall be filled with sand in layers and watered. If any payment/compensation is payable to the structure's owner, the same shall be paid by the Employer to the structures owner. The Site shall also be cleared of vegetation, trees, stumps roots, etc. Cutting of trees and dismantling of structures within ROW in entire MNS-01 package wherever required for execution of the Works shall be done by the Contractor. Permission for cutting of trees , if any, will be obtained by the Employer. Compensatory plantation is not included in the Scope of the Works. All material so cleared from the site shall be the property of the Contractor and shall be disposed off by the Contractor outside the ROW. The cost for above items shall be deemed to be included in the price quoted for Schedule 'A'.

10.15 MOBILIZATION AND DEMOBILIZATION

10.15.1 General

a) The Contractor shall mobilize to the Site the Contractor's Equipment and the Contractor's Personnel as appropriate for the execution and completion of the Works in strict accordance with the requirements of the Contract.

b) The Contractor shall demobilize Contractor's Equipment and Contractor's Personnel from the Site as appropriate when they are no longer required to be on the Site.

10.15.2 Engineer's Consents

a) The Contractor shall inform the Engineer regarding mobilization of Contractor's Equipment, including that required for use by any Subcontractor, at least seven (7) days before the date planned for the mobilization of same to the Site. The Contractor should note that:
   i. the Contractor shall be solely responsible for the consequence of any such mobilization;
   ii. the relevant insurances shall be in place as evidenced by insurance documents included in the application;

b) The Contractor's Equipment shall be mobilized to the Site complete with all necessary spare parts, consumables and the like indispensable for proper operation and maintenance thereof. The Contractor shall provide maintenance facility complete with qualified maintenance personnel on or in the vicinity of the Site.

c) The Contractor shall obtain a written consent from the Engineer before removing any of the Contractor's Equipment from the Site or any managerial person among the Contractor's Personnel mobilized exclusively for the Contract. Provided that the proposed demobilization is in accordance with the Contractual Works Programme to which the Engineer has given consent and that the Contractor shall be solely responsible for any consequences of such demobilization, the Engineer shall not unreasonably withhold consent.

d) Although they are deemed intended for exclusive use on the Works as set forth in Sub-Clause4.17 of the General Conditions of the Contract, the Contractor may divert any of the Contractor's Equipment to other uses within the Site, provided that the Contractor's written undertaking to return the same to the Works whenever needed is submitted to the Engineer and the Engineer's written consent to such diversion is granted.

10.16 Records

In addition to the Monthly Progress Reports described in Appendix 7 of the Works Requirements, the Contractor shall submit to the Engineer, Site progress Reports on a daily basis including progress of the Works, details of the mobilization and demobilization of any of the Contractor's Equipment or any managerial person among the Contractor's Personnel.

Without undue delay after demobilization from the Site, the Contractor shall submit to the Engineer copies of certified evidence of lawful re-export from the Country of any Contractor's Equipment imported into the Country on a temporary basis exclusively for use on the Contract.

10.17 Mobilization

10.17.1 The Contractor shall mobilize to the Site the Contractor's Equipment and the Contractor's Personnel as appropriate for the execution of the design, construction and completion of the Works. An overall Mobilization Plan for the Works shall be submitted to the Engineer for his approval within 28 days after the Commencement Date.

10.17.2 Deleted.

10.17.3 The Mobilization Plan shall include, but not be limited to the following:

a) Details of each major item of Contractor's Equipment, i.e., the name, size and capacity etc. of each item.

b) The number of each equipment and the time of mobilization and duration of the use of each equipment.

c) The name and details of key personnel for each section of the Works and their responsibilities.

d) Details and time for installation of temporary facilities for the Works including temporary facilities for the Employer and the Engineer.

e) The numbers of Contractor's Personnel, including site engineers, administrative staff and labour in each trade category.

10.18 Demobilization

Demobilization shall be carried out in accordance with the provision of Sub-Clause 4.23 [Contractor's Operation on Site], and Sub-Clause 11.11 [Clearance of Site] of General Conditions. Upon receiving the Performance Certificate under Sub-Clause 11.9 [Performance Certificate], the Contractor shall carry out the Clearance of the Site and the Contractor shall

inform in writing to the Employer the completion of Demobilization or Clearance of Site and obtain the consent of the Employer. In case the Clearance of Site has not been completed in a specified period by the Contractor, the Employer may carry out the Clearance of Site. The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to payment by the Contractor of the costs reasonably incurred in connection with, or attributable to, such sale or disposal and reinstating and/or cleaning the Site, less an amount equal to the moneys from the sale (if any). In case the Taking-Over is conducted section by section, the Contractor shall inform in writing to the Employer the completion of Demobilization of the section and obtain the consent of the Employer or the Engineer as a representative or on behalf of the Employer.

10.19 SITE OFFICE FOR THE EMPLOYER/ ENGINEER

Contractor shall provide fully furnished Site offices (accommodation of size 50 sqm) with Air Conditioners, toilet facilities and other incidental facilities for the use of the Employer/Engineer. The land for the above Site Office shall be provided by the Employer free of cost. Offices shall be accessible only from a corridor within the building. The office will be provided with electronic surveillance system as approved by Engineer.

One pantry staff and one housekeeping staff shall be provided round the clock at site office.

Site Office shall be weatherproof, vermin proof, well insulated thermally and acoustically. Internal walls shall be soundproof. Electrical power/lighting, shall be provided to each room, including air-conditioning and heating to maintain the internal temperature within the range of 20 to 24 degrees Celsius at all times.

10.19.1 Internal doors shall be flush, fitted with door closers, mortice locks with keys and lever handles.

10.19.2 External doors shall be a pair of solid core doors, external quality, hung on heavy duty hinges, one leaf fitted with barrel bolts top and bottom and the other leaf fitted with a Yale or similar lock.

10.19.3 Windows, of area not less than 10% of the floor area, shall be provided to all rooms, securely barred, fitted with blinds and having opening sections fitted with locks and mosquito screens.

10.19.4 The Site office shall be provided with a continuous water supply and drainage to Kitchen, Washroom and Toilets. The Toilets shall be equipped with low level suites and be adequately ventilated through the ceiling.

10.19.5 Fire and Safety regulations shall be complied with and fire fighting equipment shall be provided in accordance with the statutory requirements.

10.19.6 The Contractor shall provide, erect, and maintain appropriate name boards as specified, for each of the offices. The working shall be agreed with the Engineer.

10.19.7 The Contractors shall provide as minimum the following new furniture and equipment for the exclusive use of the Engineer's Staff:

No.	Item	Nos.
1.	Desk with side drawers.	04
2.	Swivel Office Chair with arm rests	06
3.	Visitor's Chair	4

4.	Lockable Cupboard 2m high, with shelves.	04
5.	Wall Clock	2
6.	Coffee Machine	1
7.	Wifi internet connectivity with 100mbps	1
8.	Wastepaper baskets	4
9.	Potable Water-cooler cum dispenser	2
10.	Cups, glasses, plates, cutlery for 12 persons,	2
11.	Electric kettle, coffee and tea pots	2
12.	Office consumables including tea, coffee for the duration of site activities	As required
13.	Front Door Mat	As required
14.	Flashlight	3 sets
15.	Locker with Key (900x300x500)	As required

10.19.8 Deleted.

10.19.9 The Contractor shall provide brand new protective clothing and safety equipment for 10 persons for exclusive use of the Engineer's/Employer's Staff, comprising, as a minimum – Safety Helmets Safety Harness, Steel-toed construction boots (size to be notified), Gum boots, Day-Glo waistcoat, industrial safety goggles, Ear protectors. These shall be replaced as and when required, however, they shall be replaced at least once a year. The consumables for PPE kit i.e mask, ear plugs etc. shall be supplied on a daily basis.

10.19.10 The Contractor shall provide an adjacent shaded parking area for 6 vehicles.

The Contractor shall arrange for upkeep, service and security of the offices and compound. The office area shall be thoroughly cleaned and rubbish and waste to be removed, at least once a day as per current rules and regulations.

10.19.11 Deleted

10.20 SURVEY AND SETTING OUT

10.20.1 General

a) A survey shall be carried out of the Site to establish its precise boundaries and the existing ground levels within it. This survey shall include a drone cum photographic survey sufficient to provide a full record of the state of the Site before commencing the work with particular attention paid to those areas where reinstatement will be carried out later on. The survey shall be carried out before the site clearance wherever possible and in any case prior to the commencement of work in any Works Area. The survey shall be carried out by the Contractor and approved by the Engineer. Survey by drone shall also be done at all work places every one month.

b) The Contractor shall plan and programme for the validation of any Site data provided by the Employer and develop a Survey Plan and Programme.

(1) The Contractor shall revalidate/derive the elevations of Secondary Control Points (SCPs) and Tertiary Control Points (TCPs) using the Reduced Level (RL) of the

temporary Benchmarks established by the C-1 Contractor. Survey and levelling should be done using Total Station and Digital level. Thereafter, the Contractor shall establish a horizontal and vertical control system (x, y, z) at the Site which shall be approved by the Engineer. Final drawings and profiles shall be prepared based on the above Reduced Levels.

The Contractor shall summarize the results of their validation of the Site data and any additional surveys carried out in a Survey Report and develop a Site Location Map, and a Structure Setting-Out Map and submit them to the Engineer for consent. Finally, the Contractor shall set out the Works to commence the construction with consistent accuracy and entirely throughout the construction stages.

10.20.2 Deleted

10.20.3 Deleted

10.20.4 Deleted

10.21 Deleted

10.22 Deleted

10.23 Setting Out

a) The Contractor shall set out the Works at the Site. The Contractor shall ensure that all the Permanent Works are accurately set out.

b) The setting-out of the Works shall be carried out based upon the Drawings which have been issued with a approval and have been issued to the site ''For Construction''

c) The Contractor shall consistently apply the HORC Benchmarks to the setting-out.

10.24 Deleted

10.25 Geotechnical & Geological, Survey and Investigation

a) **Geotechnical, Geological Survey and Investigation:** The Contractor shall be responsible for carrying out independent detailed geotechnical/geological survey and investigation as per provisions of various codes, manuals and guidelines mentioned in the Contract.

b) **Geotechnical Interpretative Report**: The Contractor shall prepare and submit to the Engineer for review a Geotechnical Interpretative Report which includes site investigation results and the geotechnical interpretation of site investigation work in sufficient detail to confirm and justify parameters used in the design of the Works including temporary works. The report shall include full borehole logs, geological profile and descriptions of boreholes drilled by the Contractor. The requirements for this Report are described in the Works Requirements.

10.26 Other Related Surveys

The Contractor shall be responsible for carrying out validation of any Site data provided by the Employer and any other surveys considered necessary for the execution of the Works. Such surveys may include, but are not limited to, the following:

a) Site Survey

b) Utilities Survey including Adjacent Structures and Works

c) Environmental Survey

10.27 Temporary Facilities

10.27.1 General

a) The Contractor shall be entirely responsible for the provision, erection, maintenance and removal on completion of all required temporary facilities, as part of the Temporary Works, which are required for the proper execution and completion of the Permanent Works. Such temporary facilities shall include the Contractor's offices, laboratories, workshops, stores, utilities, services, accommodation, canteens, recreational and welfare facilities, health, safety, security and environmental protection facilities and the like, whether on or off the Site.

b) The Contractor's Personnel shall not be allowed to live on the Site. A limited number of security personnel designated to secure the Contractor's facilities will be permitted to stay after working hours subject to the approval of the Engineer. The Contractor shall make all necessary arrangements for suitable off-Site accommodation and transportation for the Contractor's Personnel.

c) All of the Contractor's temporary facilities on the Site or elsewhere within the Project site shall be designed, provided, erected, maintained and removed to the satisfaction of the Engineer and in strict accordance with applicable Laws. The Contractor shall obtain all necessary approvals and permits from the relevant authorities having jurisdiction for the provision, erection, operation, maintenance and removal of the Contractor's temporary facilities.

d) All of the Contractor's temporary facilities, other than those designated to remain, are to be removed on the completion of the Works and the ground surfaces reinstated to the satisfaction of the Engineer.

e) When deemed essential for the preservation or maintenance of health, safety, security and/or environmental protection, the Engineer may instruct the Contractor to modify the Contractor's temporary facilities, regardless of any approvals or consents previously given, and the Contractor shall promptly comply with such instructions. These instructions shall not constitute Variations.

10.28 Location of Area for Temporary Facilities

10.28.1 The Contractor shall be aware that the area for temporary facilities is not for the Contractor's exclusive use, and the Contractor shall cooperate fully with the Interfacing Contractors if it becomes necessary for the efficient use of a limited area among the said Interfacing Contractors.

10.28.2 The precise locations of the Contractor's Temporary Works including the temporary facilities within and outside the Site area shall be proposed by the Contractor and approved by the Engineer.

10.28.3 The Contractor shall submit drawings showing the proposed locations and outlines of the proposed temporary facilities. Drawings and details of the Temporary Works for a particular part of the Permanent Works may be submitted as part of the shop or working drawings and/or the work method statements forming part of the Contractor's Documents. These locations and outline drawings for the temporary facilities shall be submitted twenty-eight (28) days before commencing the construction of any temporary facility or twenty-eight (28) days after the Commencement Date. These drawings and outlines shall be updated whenever addition or removal of any facility is planned. Detailed drawings for any particular temporary facility, showing all necessary utilities and services, shall be submitted at least fourteen (14) days before the planned commencement date of construction thereof.

10.28.4 The areas for the Contractor's temporary facilities may also be used for temporary storage of excavated material suitable for reuse in embankment or fill for the Works, or for use by the Employer in future projects or on other works packages.

10.28.5 The Contractor shall dispose of all surplus topsoil and all subsoil materials arising from the Works in the designated area wherever available within the ROW of the Project as agreed by the Engineer. In case area for disposal of surplus soil is not available, the Contractor shall make his own arrangements outside the ROW and the Contractor shall bear all costs including royalty for using/disposing of excavated material unless otherwise specified in the Contract.

10.28.6 The Contractor is free to make his own arrangements for any additional areas required for the proper execution of the Works, and the costs of same shall be borne by the Contractor.

10.29 Contractor's Site Offices

10.29.1 The Contractor shall be responsible for identifying and establishing suitable facilities for the Contractor's office facilities as approved by the Engineer.

10.29.2 The Contractor's Site offices and facilities shall be provided within or in the vicinity of the work site, with all necessary facilities including furniture, office equipment, office supplies, utility services, sanitary system and vehicle parking. The Contractor shall establish their Site Office and Site Huts in close proximity to the Engineer's Offices.

10.30 Project Information Signboards

10.30.1 The Contractor shall provide project profile sign board at each of the Site Offices and at prominent public places along the alignment of the project as directed by the Engineer of a size, minimum 1.5 m x 2.5 m, and maintain them in good condition. All information on the signboards will be written in English and local language for separate signboard. The signboards will be positioned on a steel frame as directed by the Engineer. The Contractor shall submit proposals for the signboard materials, the text layout (in English and local language) and installation of the signboards at the Site Offices of the Engineer and the Contractor for Engineer' s approval. Each sign board shall show:

a) The name of the Project and the Works,
b) The Location Map,
c) The name of the Bank,
d) The name of the Employer,
e) The name of the Engineer,
f) The name of the Contractor,

g) Date of Commencement of the Works,
h) Time for Completion,
i) Cost of the Works and
j) All other details as required by the Engineer

10.30.2 The Contractor shall maintain the sign boards and remove them on completion of the Works or when instructed by the Engineer. The Contractor shall clean, update, maintain and replace the signboards if damaged, throughout the duration of the Contract. No additional payment shall be applicable for damaged signs which are required to be replaced.

10.30.3 Within twenty eight (28) days from the Commencement Date, the Contractor shall provide and install a Project information sign, as per the requirements for signboards at the Employer's/Engineer's Site Offices, at each of the entrance points to each Site Office location (both the Contractor's and Employer's/Engineer's offices) and the Site entrances, or, as directed by the Engineer.

10.30.4 The Contractor shall maintain the signboards and remove them on completion of the Works or when instructed by the Engineer, so as to inform the public of the implementation of the Works and the Project and to advise road users of on-going construction.

10.30.5 The Contractor shall clean, update, maintain and replace the signboards if damaged, throughout the duration of the Time for Completion. No additional payment shall be applicable for damaged signs which are required to be replaced.

10.31 First Aid Station

10.31.1 The Contractor shall construct, equip, and maintain First Aid stations at a sufficient number of appropriate locations on the Site and at each labour camp.

10.31.2 The Contractor shall comply with all requirements specified in the Works Requirements (including Appendix 13 [Environmental, Social, Health and Safety Management]) and the Conditions of Contract.

10.32 Labour Accommodation Camps

10.32.1 The Contractor shall supply, equip and maintain facilities as necessary for the living accommodation, feeding and welfare of its employees by providing, servicing, and maintaining a camp at appropriate location(s), as necessary.

10.32.2 The Contractor shall comply with all requirements specified in the Works Requirements (including Appendix 13 [Environmental, Social, Health and Safety Management]) and the Conditions of Contract.

10.33 Site Storage and Yards

10.33.1 The Contractor's Site storage areas and yards shall be utilized for, among other things, material and equipment storage, casting of precast structural elements, workshops, warehouses and secure storage.

10.33.2 The Contractor shall erect a 2.0 metres high chained security fence around the Site storage areas and yards, complete with suitable lighting and lockable gates.

10.33.3 The location of each Site storage area and yard shall be determined prior to the commencement of the works and the Contractor shall propose the locations and details of same and submit to the Engineer for consent.

10.34 Borrow Areas and Quarries

10.34.1 It shall be the responsibility of the Contractor to arrange for borrow areas (for fill material) and quarry sites (for ballast, aggregate and rock material) using his own resources. The Contractor shall be responsible for carrying out his own investigations to verify the availability, sufficiency, quality and quantity of materials from such sources. The Contractor may also arrange any additional borrow areas and quarry sites as required by him, all at his own discretion. No claim whatsoever shall be entertained by the Employer in this regard.

10.34.2 All costs and charges, including but not limited to permits, royalties, duties, taxes, rental or other costs associated with land or the temporary use of same, etc. as applicable, for arranging borrow areas and quarry sites and access thereto, including for the extraction of material therefrom, shall be borne by the Contractor.

10.34.3 Before commencing operations in each of the borrow areas and quarry sites, the Contractor shall submit a detailed plan of his operations and demobilization/grading and finishing/reinstatement, etc. in respect of the same to the Engineer for his approval, together with relevant drawings.

10.34.4 The quality of fill material, aggregates, etc. extracted from borrow areas and quarry sites shall meet the Works Requirements and be subject to the consent of the Engineer.

10.34.5 Borrow areas, quarry sites and the installation of rock crushers shall not be permitted within the ROW.

10.34.6 On completion of the Works, the Contractor shall leave borrow areas in a safe and stable condition.

10.34.7 The Contractor shall indemnify the Employer against all claims in relation to borrow areas and quarry sites both during the Time for Completion and after the Works are completed and taken over.

10.35 Stockpile Areas

10.35.1 The land available, if any, within the ROW may be used by the Contractor for storage of materials required for the project, subject to the consent of the Engineer.

10.35.2 The Contractor may also arrange any additional stockpile areas as required by him at his own discretion and cost.

10.35.3 The location and size of stockpile areas proposed by the Contractor shall be subject to consent of the Engineer. The Engineer's consent may be withheld, if:

a) in the opinion of the Engineer, a stockpile area or access thereto may be such as:
   i. would have a detrimental effect on the natural and social environment;
   ii. would disturb drainage system(s) around the stockpile areas;
   iii. would constitute a danger to the public; or
b) at the Engineer’s discretion, a stockpile would become too high.

10.35.4 Before commencing operations, the Contractor shall submit detail drawings of the proposed stockpile areas, together with the proposed method of operation, including stockpile heights, angles of repose, runoff / dust control measures, access road layouts, drainage, measures to be taken for restoration, all verified by appropriate calculations and analysis.

10.35.5 On completion of stockpiling operations, the Contractor shall reinstate stockpile area(s) to a safe and stable condition.

10.35.6 The Contractor shall indemnify the Employer against all claims in relation to stockpile area(s), both during the Time for Completion and after the Works are completed and taken over.

10.36 Contractor's Plants.

10.36.1 The Contractor shall plan, install, erect, maintain, dismantle and remove all plants required for the Works, including but not limited to major items such as concrete batching/mixing plants, rock crushers, casting yard, curing yard, stacking yard etc. of sufficient number and capacity to meet planned peak requirements during construction. The capacity of such plants shall be subject to consent by the Engineer. The location of concrete batching plants is subject to environmental approval from the appropriate authorities and shall not able to operate until such approval is obtained. All control and measuring equipment shall be regularly checked and calibrated and the Contractor shall regularly submit calibration certificates for same to the Engineer.

10.36.2 The land available, if any, within the ROW may be used by the Contractor for storage of materials, concrete batching/mixing plants, casting yards, curing yard and stacking yards subject to the consent of the Engineer. The Contractor shall arrange any additional areas as required by him at his own discretion and cost.

10.37 Material Testing Laboratories

10.37.1 The Contractor shall design, construct, equip, maintain, dismantle and remove all required material testing laboratories and associated facilities on the Site and / or at work areas as are required for the sampling and testing of materials as required in the Works Requirements. The Engineer's consent shall be obtained to the location of material testing laboratories.

10.37.2 Laboratory buildings shall be supplied with adequate electricity, water, air-conditioning, etc., and shall have sufficient area(s) for storing samples.

10.37.3 The laboratory equipment to be supplied and the methods of testing shall be in accordance with relevant International, Indian and/or other standards and codes as detailed in the Works' Requirements. All apparatus and equipment shall be brand new and of the latest design and manufactured by a reputable manufacturer. The proposed type and number of items of laboratory equipment shall be submitted to the Engineer for review and consent prior to purchase.

10.37.4 The laboratory equipment and apparatus shall be checked and calibrated before testing starts and thereafter at regular intervals as specified by the manufacturer and as directed by the Engineer. The Contractor shall regularly submit calibration certificates for same to the Engineer.

10.37.5 The Contractor shall complete the design, construction and installation of the laboratory facilities for operation within one hundred and forty (140) days after the Commencement Date

and operate and maintain the facilities until the issue of Taking-Over Certificate, unless otherwise authorized by the Engineer. The Contractor shall also make all facilities and services available to the Engineer as required. All sampling and testing to be undertaken shall be under the direct supervision of the Engineer. The material testing laboratory shall be staffed by Contractor's personnel fully experienced in the sampling and testing of materials, and quality control.

10.37.6 Any testing which may be required in accordance with the Works Requirements and which cannot be performed in the Contractor's laboratory due to lack of time or equipment shall be assigned to an independent organization having NABL accreditation and as duly consented to by the Engineer. The Contractor shall accept all results, instructions or restrictions stipulated by the Engineer based on such tests.

10.38 Wheel Washing Facilities

10.38.1 The Contractor is required to install wheel washing area within at the "Exit" points/gates of the construction area to ensure the removal of wheel/band dirt from construction vehicles and machines. Wheel washing area design shall be proposed in CEMP. As a part of the Contractor's method statement for the site preparation plans, wheel washing area shall be proposed and approved by the Engineer before the commencement of the work. The facilities are required to have access for cleaning out the sludge which collects together with provision for 2 high pressure hose connections and adequate water supply.

10.39 Temporary Roads

10.39.1 The Contractor at his own discretion construct and dismantle/alter/dispose of the temporary roads after the completion of Contract as directed by the Engineer.

10.39.2 Before constructing any temporary roads outside the ROW, the Contractor shall make all necessary arrangements, including payment if required, with the public authorities or landowners concerned, for the use of the required land and shall obtain the consent of the Engineer. Such consent will be dependent on the Engineer being satisfied with the Contractor's proposals for items such as capacity, signage, lighting and surface quality of the temporary road, together with proposed maintenance arrangements. Such consent shall not relieve the Contractor from any of its responsibilities under the Contract.

10.39.3 The Contractor shall note that temporary road shall not be for the Contractor's exclusive use and shall be subject to relocation or restrictions at his cost during the execution of the Works as and when such relocation or restriction is inevitable. Except in an emergency, the Contractor will be given a prior notice of any such relocation or restriction. The road layout and design proposal shall be revised and re-submitted to the Engineer for consent whenever road arrangements are to be modified for whatsoever reasons.

10.39.4 Within forty-two (42) days after the Commencement Date and consequent to the surveys performed by the Contractor, the Contractor shall submit for the Engineer's review and approval of the proposed design, including layout, and details of the temporary road, fences, protection to underground pipes and culverts at road-crossing points and all additional temporary pipes and culverts that shall be provided by the Contractor, to sustain road traffic, irrigation and drainage flow in all existing streams, irrigation canals and ditches, drainage canals and ditches, and utilities or services, whether buried or exposed, all of which, in the opinion of the Engineer, are necessary for the proper execution of the Works.

10.39.5 During the transportation of Goods and Contractor's Personnel, the Contractor shall be responsible for keeping all railways, roads, bridges, watercourses, utilities services, etc. free from damage and from spillage of construction materials, detritus, oils, etc. and shall repair any damage howsoever caused to any such structure or property (whether on or off the Site) by Contractor's Equipment (including that of any Subcontractor). In that respect the Contractor will be required to carry out a condition survey of all roads and other facilities in and adjacent to the works area which will show in detail the state of those items prior to the commencement of construction. The full records shall be submitted to the Engineer and the status monitored throughout the course of construction with further records maintained.

10.39.6 At the junction of temporary roads with existing roads, the Contractor shall provide suitable traffic marshals to warn and regulate the traffic as per the requirements.

10.39.7 The Contractor shall be responsible for upholding and protecting all slopes at the boundaries of the Site against slippage into adjacent properties. As adjacent areas may be irrigated, this requirement will also therefore include the provision of temporary coffering as appropriate.

10.39.8 All temporary roads, culverts, ditches and the like required for the Contractor's or Subcontractors' or any other Contractor's operations shall be provided and maintained by the Contractor, kept in good condition by cleaning, watering, rolling, grading, repairing and maintaining, all to the approval of the Engineer.

10.39.9 If the Engineer has provided drawings or details of any temporary works, then such drawings or details shall be understood to be indicative of the minimum required standard only. The Contractor shall remain responsible for the design of Temporary Works.

10.39.10 Unless otherwise approved by the Engineer, the demolition of any existing roads, culverts, etc. shall not commence until the replacement facilities therefore have been completed by the Contractor.

10.39.11 When any of the temporary approach roads are no longer required, or earlier if so directed by the Engineer, the Contractor shall carefully dismantle the temporary bridge or road, and remove and dispose of all surplus materials in compliance with the applicable Laws, and reinstate the area to its original condition to the approval of the Engineer.

10.40 Vehicles

10.40.1 The Contractor shall provide all necessary vehicles required for the transportation and movement of Goods and Contractor's Personnel, including but not limited to trucks, cranes, trailers, cars, motorcycles, etc.

10.40.2 The Contractor shall provide competent and licensed drivers and operators for all such vehicles. Vehicles shall be licensed and insured in accordance with the applicable Laws and the Contractor shall be responsible for all servicing, repairs and maintenance required.

10.41 Contractor's Equipment

10.41.1 The Contractor shall ensure that all Contractor's Equipment whether on or in the vicinity of the Site, including apparatus, machinery, vehicles and other similar things to be operated by him or his Sub-Contractors for the execution and testing of the Works, are maintained and operated in a good and safe condition.

10.41.2 All lifting and hoisting equipment shall be regularly certified in accordance with the applicable Laws, and the safe working load limits shall not be exceeded.

10.41.3 The Contractor shall operate and maintain an equipment repair facility within or in the vicinity of the Site, so that downtime of Contractor's Equipment can be minimized. Temporary fuel and lubricant stores shall be properly designed, constructed, secured, fire- and spill-guarded, and be well ventilated so as to comply with the relevant applicable Laws.

10.42 Utilities for Temporary Facilities

10.42.1 Power Supply and Lighting:

i. Electric power supplies for the Contractor's temporary facilities, including but not limited to Contractor's camps, offices, Site, work areas and other facilities as described herein, shall be arranged by the Contractor.

ii. The Contractor shall install, operate and maintain its own electrical distribution systems for the electrical supply required for his temporary facilities as described in paragraph (1) above.

iii. The Contractor shall also furnish, install and keep operational the diesel power generating facilities of such capacity as the Contractor considers necessary to prevent any interruption to the progress of the Works.

iv. The Contractor shall ensure adequate lighting is provided for all his operations at the Site and the temporary facilities and camp according to the National Building Code of India (2016).

10.42.2 Water Supply

i. The Contractor shall design, install, operate and maintain water supply systems including pumps, piping systems, valves, storage tanks etc., at the Site with respect to:

a) Industrial water supply system
For construction use the water quality shall meet the quality requirements in the Works Requirements.

b) Potable water supply system
For supply to all the Contractor's temporary facilities including but not limited to Contractor's camps, offices, Site, work areas and other facilities for human consumption and use.

ii. In case the Contractor plans to install bore well(s) for water supply, he shall thoroughly investigate the relevant legislation and regulations imposed by the competent authorities and the installation shall be subject to approval by the said competent authorities and/or consent of the Engineer.

iii. Throughout the Time for Completion the Contractor shall take samples from all water supplies at regular intervals and test it for suitability for the intended use.

10.42.3 Sanitation and Sewerage

i. All operational parts of the Site, offices, workshops, fabrication yards, laboratory, camp and other facilities, etc. shall be provided with sanitation and sewage handling and disposal systems complying with the statutory requirements and applicable Laws, codes and standards.

ii. If required, portable sanitary facilities including chemical toilets shall be provided and maintained by the Contractor for the use of all personnel at all work locations.

iii. All the requirements of the Works Requirements (including Appendix 13 [Environmental, Social, Health and Safety Management] of the General Specifications) and the Conditions of Contract shall also be complied with.

10.42.4 Waste and Garbage Disposal

i. The Site and the work areas shall be kept clean and free of detritus at all times.

ii. The Contractor shall collect waste material and garbage from Site, camp, offices, yards, workshops, etc. on a daily basis and dispose of same in an approved disposal area(s) and as per guidelines prescribed by local and governmental authorities having jurisdiction. No waste of any kind shall be deposited in any watercourses.

iii. All the requirements of the Works Requirements (including Appendix 13 [Environmental, Social, Health and Safety Management Management] of the General Specifications) and the Conditions of Contract shall also be complied with.

10.42.5 Fencing, Site Security and Safety

i. The Contractor shall be responsible for the security and safety of the Site. Accordingly, the Contractor's temporary facilities including offices, workshops, fabrication yards and storage compounds, campsites, all construction areas, storage areas shall be adequately fenced, gated, lighted and guarded on a twenty-four hour, seven days a week basis. Firefighting equipment shall be provided in accordance with the applicable Codes and the requirements of local authorities.

ii. Any storage facilities for explosives shall comply with the relevant Laws and regulations of India and shall be situated at locations approved by the competent authorities. Detonators and fuses shall be stored in facilities separate from explosives. In no case shall detonators and fuses be transported in the same vehicle as explosives. Storage facilities for explosives, detonators, fuses, etc. shall be secure, kept locked and the keys shall be accounted for at all times.

iii. All the requirements of the Works Requirements (including Appendix 13 [Environmental, Social, Health and Safety Management Management] of the General Specifications) and the Conditions of Contract shall also be complied with.

iv. The Contractor shall be responsible for any losses occurring within the Site premises.

10.42.6 Inspection by the Employer or Engineer

The Employer and the Engineer have the right at any time to inspect any part of the Contractor's temporary facilities and to require immediate rectification to comply with the specified requirements.

10.42.7 Final Clean-Up

i. Upon the completion of Works, or when any of the Contractor’s Equipment and/or temporary facilities have fulfilled or completed their function, the Contractor shall dismantle and demobilize such Contractor’s Equipment and/or temporary facilities and remove all equipment, machinery, materials, refuse, debris, objectionable material, and reinstate, including filling, grading and dressing all areas to their original condition prior to completion of the Works.

ii. The Contractor shall not proceed with any demobilization and/or removal of temporary facilities and equipment without the prior consent of the Engineer.

10.43 Maintenance of Temporary Facilities

10.43.1 The Contractor shall provide all necessary maintenance requirements and shall keep the temporary facilities and other areas established for the Works, clean, tidy and litter-free.

10.43.2 The Contractor shall be responsible throughout the Time for Completion for keeping the Site and temporary facilities to the satisfaction of the Engineer.

10.43.3 The Contractor shall maintain all existing security fences required for the Works until completion of the Works. Existing fences which interfere with construction operations, shall not be relocated or dismantled, until written permission has been obtained from the fence owner.

10.44 Damage to Existing Property

10.44.1 The Contractor shall be responsible for any and all damage that may occur to any existing structures, works, materials, or equipment that is due to any operation(s) for which the Contractor is responsible, including any operation(s) of any Subcontractor.

10.44.2 The Contractor shall repair or replace any damaged structures, works, materials, or equipment to the satisfaction of the Engineer.

10.44.3 The Contractor shall be responsible for all damage to roads, railway infrastructure, curbs, sidewalks, highways, shoulders, embankment, ditches, drains, culverts, bridges, or other public or private property, which may be caused by their construction activities and shall indemnify for losses due to such damages.

10.45 UTILITIES

10.45.1 General

a) The Contractor shall at all times work with due diligence to ensure the safety of all personnel and property from injury and damage from known ("Charted Utilities") and unknown utilities ("Uncharted Utilities").

b) The Contractor shall always take care of concerning buried Charted and Uncharted Utilities and if any such Utilities infringe the work, the Contractor shall make the area affected safe and ensure that no unauthorised member of the workforce or members of the public shall enter such area.

c) Contractor shall be responsible for relocation/diversion/shifting/modification of all charted (except specified otherwise) and uncharted utilities infringing the Works.

d) Contractor shall indemnify the Employer against any losses/claim/damage cost to any damage to utility/services during execution of Works.

10.46 Utilities, Services and Facilities

10.46.1 The Utilities are categorised as (i) Charted Utilities, which have been identified by the Employer and may be affected during the execution of the Works. and, (ii) Uncharted Utilities, which are not known and would get identified during the execution of the Works.

10.46.2 Charted Utility

There are no Charted Utilities.

10.46.3 Uncharted Utility

i. The Uncharted Utilities will be those unknown utilities which get identified during execution of the Works. These may be identified during Ground Penetration Survey or anytime during execution of the Works.

10.46.4 The Contractor shall do a general survey and Ground Penetrating Radar (GPR) Survey of the Site after possession and notify the Engineer of Charted & Uncharted Utilities, which may obstruct the works and need to be relocated.

10.46.5 For all Charted & Uncharted Utilities requiring relocation identified by the Contractor in the Utilities survey, the Contractor shall inform the Engineer and provide relevant details, including but not limited to, the following:

i. location of the Utility;

ii. date on which Utility was encountered;

iii. nature and size of the Utility;

iv. condition of the Utility

v. type of the Utility & its owner:

a) Electrical cables;

b) OFC & Telecom cables;

c) Gas pipelines;

d) Water/sewerage/drainage/storm water/hume pipelines;

e) Irrigation pipelines/channels;

f) Telecom towers;

g) Overhead Water tanks and others overhead tanks;

h) Others, if any

vi. Reasonable estimate of time required for shifting of Unchartered Utilities.

vii. The information shall also cover the details of the agency/department carrying out the utility shifting.

10.46.6 The trial trenching, arrangements and working methods to be employed in respect of such Charted & Uncharted Utilities which warrants removal/relocation, including proposed protection measures, diversions, reinstatements in consultation with utility owner shall be done within 56 days after Handing Over of the Site by the Employer. The Contractor shall provide relevant justification for the identified utilities (Charted & Uncharted) which require removal/diversion for proceeding with the works.

10.46.7 The Engineer will accord approval within 21 days to the Contractor for initiating required action for the utilities warranting removal/relocation/modification.

10.46.8 The Contactor shall be responsible for taking prompt necessary action for such identified utilities (Charted & Uncharted) including the following but not limited to:

i. Identification of the extent of the utility to be relocated

ii. Coordinate and get permissions from utility owner & all relevant authorities.

iii. Preparation and submission of relevant documentation to the authorities.

iv. Mitigate the situation and re-arrange the work to minimise the effect on the timeline of the Works

v. Continue with other related works in as much as possible to maintain the timeline of the Works.

10.46.9 The relocation/removal/diversion of identified Uncharted Utilities shall be assigned to the Contractor to be carried out through the utility agencies, or their specified contractor or by the Contractor himself. The cost of relocation/removal/diversion of Uncharted Utility shall be paid by the Employer as mentioned below:

i. If Uncharted Utility relocation/removal/diversion is carried out by Utility agency or theirspecified contractor, the Contractor shall make the payment to such agency or specified contractor. The Employer shall reimburse such amount as Specified Provisional Sum based on invoices.

ii. If Uncharted Utility relocation/removal/diversion is carried out by Contractor himself, then he shall be paid under Specified Provisional Sum.

10.46.10 The Contractor shall not divert, remove or relocate any such identified Charted & Uncharted Utilities without having first received the Engineer's consent to such diversion, removal or relocation.

10.46.11 The Contractor shall liaise and co-ordinate with the relevant Utilities Companies to ensure that all the above-mentioned works of relocation/diversion, support and protection are executed satisfactorily. Contractor shall obtain necessary clearances from the Utility company/owner prior to the start of any relocation/removal/diversion works of the utilities. The same shall be submitted to the Engineer prior to start of the works.

10.46.12 Throughout the execution of the Contract, the Contractor shall reasonably comply, in all respects, with the requirements of all the utility owners and authorities regarding the handling, protection and maintenance of the utility facilities. The responsibility in respect of diversion/ modification/ relocation/ protection etc. of the Utilities (Charted or Uncharted) to facilitate safe construction lies with the Contractor. If required, the employer shall provide support to facilitate approvals/permits from utility owner/concerned department for the proposed diversion/relocation of utilities.

10.47 Prevention of Damage and Interference

10.47.1 Temporary supports and protection methods proposed by the Contractor and agreed by the utility owner shall be provided to the utilities. The permanent supports and protection shall be provided wherever required for the safety and security of the utility service.

10.47.2 The Contractor shall not interfere in any manner with the Utility lines and services without prior approval of the Utility owner and Engineer. Whenever the interfering necessity arises, the Contractor shall submit a proposal to the Engineer for his approval. Any unintentional interference caused shall be immediately corrected without causing danger and trouble to any

on-going operations or the existing utility lines or services. The Contractor shall immediately inform the Engineer and the utility agencies of:

i. damage to utilities;

ii. leakage of utilities;

iii. discovery of utilities not previously identified; and

iv. Any hazardous material found during the excavation.

a) location of utility

b) date on which the utilities were encountered;

c) nature and sizes of the utilities;

d) condition of utility;

e) temporary or permanent supports provided; and

f) diversions made –temporary or permanent

The Contractor shall include the details (plan, location, ownership, size and material) of all such utilities in the As-built Drawings.

10.48 Drainage Systems

10.48.1 All existing drainage systems that are affected by the Temporary and the Permanent Works shall be protected, relocated and/or diverted as required for the Works, by the Contractor.

10.48.2 Such protection, relocation or diversion works shall be carried out by the Contractor, and his designs shall be approved by the utility owners / relevant authorities and the Engineer.

10.48.3 Upon completion of the works, all the diverted or temporarily diverted drains/box culverts and canals shall be fully reconstructed to their original size or to a revised size as required by the utility owners /relevant authorities. However, if the utility owner or relevant authority requires to keep the Utility at the original location, the same shall be reconstructed at the original location.

10.49 Building Service Connections

10.49.1 Building service connections shall be maintained and protected or if required to be shifted, shall be informed to the Engineer during the execution of the works. The Contractor shall take necessary steps to ensure these services with the approval of utility owner and the Engineer.

10.49.2 Building service connections shall include the branch pipes from the main water pipe, water meter chambers/bulk meter, sewer and drainage discharge pipes, grease traps, etc.

10.49.3 Building service connections shall be identified by trial trenches or other methods approved by the relevant Utility Companies. Where these service connections interfere with the works, the Contractor shall follow the methodology as approved by the relevant Utility Companies and the Engineer.

10.50 Deleted

10.51 TRAFFIC MANAGEMENT PLANS

10.51.1 General

a) The Contractor shall thoroughly acquaint itself with existing traffic conditions and understand the importance of maintaining traffic safety and the avoidance of excessive traffic delay. The Contractor shall co-operate with the relevant agencies regarding traffic control and all details shall be subject to the Engineer's approval.

b) The requirements concerning temporary road works shall include, but not be limited to, construction of detours, temporary bridge approach roads, traffic control devices and services for the control and protection of traffic through areas of construction.

c) The Contractor shall be responsible for investigating and establishing the requirements for traffic control and ensuring safety at each site and shall submit such details in the form of a Temporary Traffic Control Plan for the Engineer’s review and consent, wherever required.

d) All temporary roadworks and traffic management shall be as specified in this appendix, unless specified otherwise elsewhere in the Contract or local Indian regulations and standards, and the more onerous provision shall apply.

10.52 Deleted

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10.56 Deleted

10.57 Construction Requirements

10.57.1 The Contractor shall keep the length of construction areas to manageable lengths such that traffic will be accommodated safely. Traffic control devices and services shall be provided and maintained both inside and outside the limits of work as required to facilitate traffic guidance, should this be necessary. The provision of traffic control devices and services shall comply with the provisions of the Works Requirements and the Conditions of Contract and local Indian regulations and standards.

10.57.2 Prior to the start of construction operations, the Contractor shall erect such signs, barricades, and other traffic control devices as may be required by the Works Requirements and the Conditions of Contract or as directed by the Engineer. Traffic control devices shall be operated only when required and only those devices that apply to conditions actually in existence shall be operable.

10.57.3 Wherever required or directed by the Engineer, temporary fences shall be placed to provide a visual barrier between the work area and adjacent traffic or buildings.

10.57.4 Any devices provided under this clause that are lost, stolen, destroyed, or deemed unacceptable while in use on the Works shall be replaced by the Contractor at the Contractor's risk and cost.

10.57.5 During non-working hours and following completion of a particular construction operation, all warning signs, except those necessary for the safety of the public, shall be removed or entirely covered with either metal or plywood sheeting so that the sign panel will not be visible.

10.57.6 Retro-reflective sheeting on signs, barricades, and other devices shall be kept clean. Stretches, rips, and tears in the sheeting shall be promptly corrected by the Contractor. Retro-reflective sheeting shall have a maintained retro-reflection.

10.57.7 Nighttime operations shall be illuminated by a lighting system which has received the Engineer' s consent. The lighting system shall be positioned and operated to avoid glare to road users. The heat produced by any lighting system shall be considered and allowed for. The use of lights with flames (such as gas-powered lighting) will not be permitted.

10.57.8 The Contractor shall ensure that no Contractor's Equipment leaves the work sites with mud, debris or rock that may drop or be deposited on a public highway or private right-of-way, and the roads in the vicinity of the Site shall be kept clean. Suitable vehicle washing facilities shall be provided by the Contractor.

10.58 PACKAGING STORAGE SHIPPING AND DELIVERY

10.58.1General

a) Unless otherwise required by the Special Conditions, Plant and the Materials shall be delivered to the Site at the most suitable time(s) in accordance with the Works Programme and Procurement Work Segment Programme, so as to avoid undue damage and/or deterioration due to a storage period of excessive duration.

b) All Plant and the Materials, if manufactured or assembled off-Site, shall be properly and securely packed at the point of origin, in order to prevent damage during transport to the Site and due to storage in the weather conditions to be encountered at the Site.

c) The Contractor shall securely crate or box all consignments for ocean shipment in a manner suitable to protect them from damage in transit and shall be responsible for and rectify any and all damage due to any improper packing. Crates shall have external markings identifying the Contract reference number, origin, destination, contents and consignee.

d) The Contractor may be required to furnish the Employer, by courier or other approved means with advance copies of shipping documents, invoices and other pertinent papers showing the date and origin of shipment, a description of the Goods, the shipping weight of each item, destination, name of the vessel and other pertinent information.

e) The Contractor shall also be responsible for the trans-shipment up till the delivery to the installation sites.

f) The Contractor shall ensure, prior to delivery of Plant or Material, that adequate storage facilities and/or areas are available on Site to properly store and protect the Plant or the Material so as to prevent any damage or deterioration. Air-conditioned or other controlled-environment storage shall be provided for Plant items sensitive to high humidity and/or temperature.

g) Materials of an inflammable, explosive, toxic or similarly hazardous nature shall be securely stored separately at approved locations. The Contractor shall provide adequate security and safety control at such locations throughout the storage period. Before delivery of such Materials to Site, all necessary permits and licenses shall have been obtained from the authorities having jurisdiction, all in accordance with the applicable Laws.

h) When Plant or Materials arrive on Site it shall as soon as practicable be inspected by the Contractor in the presence of the Engineer, for damage or deterioration. The Contractor shall be responsible for unpacking and re-packing in an appropriate manner and for provision of all necessary equipment, tools, materials and labour at his own expense. If damage or deterioration has occurred as determined by the Engineer, payment for shall not be made for such damaged or deteriorated Plant or Materials, and such shall be removed from the Site and repaired or replaced according to the instructions of the Engineer, at the Contractor's risk and cost.

i) For the Plant or the material which is subject to deterioration after opening the packing, appropriate alternative inspection measures shall be determined on Site between the Engineer and the Contractor. No payment shall become due to the Contractor for those uninspected Plant or Material, unless otherwise determined by the Employer.

j) Packing materials shall remain the property of the Contractor and shall be removed from the Site immediately when no longer required on the Site, as determined by the Engineer.

k) The Contractor shall be responsible for the safe and secure storage and handling of Plant and Materials on Site until the issuance of the Taking-Over Certificate for the relevant part of the Works, regardless of any transfer of ownership thereof to the Employer.

l) Any action taken by the Engineer in inspecting Plant or Materials upon arrival on Site or any determination subsequently made by the Engineer shall not relieve the Contractor of any of his responsibilities under the Contract.

10.59 Storage of Plant and Materials

10.59.1 The Contractor shall provide and maintain storage facilities at acceptable locations in consultation with the Engineer, for the equipment and materials of all kinds intended for use in carrying out the Permanent Works or for incorporation into the Permanent Works.

10.59.2 The Contractor shall prepare, protect, provide security and store in an agreed manner for all Works, Contractor's Equipment, equipment and materials until the Project completion so as to safeguard them against any loss, damage and any other hazards arising during shipment, storage on/off the Site or climatic influences.

10.60 Crating

The Contractor shall provide all packing, crates and markings. In doing so, it shall comply with the following requirements:

a) Each case, crate or package shall be waterproof, rot, insect and rodent proof. It shall be of robust construction and fit for its intended purpose. The Contractor shall, in determining the packaging materials to be used, take into consideration the climatic conditions likely to occur during the period of transport, shipment and storage.

b) Each case, crate or package shall be legibly and indelibly marked in large letters with the Site address, Contract number, "right way up", opening points and other markings

as necessary to permit materials to be readily identified and handled during transit and when received at the Site.

c) Each case, crate or package shall contain a comprehensive packing list showing the number, mark, size, weight and contents, together with any relevant drawings. A second copy of the packing list shall be enclosed in a watertight enclosure on the outside of each case, crate or package. Distribution of additional copies of each packing list shall be in accordance with the Engineer's instructions.

d) All items heavier than 100 kg shall be marked on the outside of the case, crate or package, indicating the gross and net weights, the points for slinging, and where the weight is bearing.

e) Care shall be taken to prevent movement of items within cases, crates or packages by the provision of bracing, straps and securing bolts as necessary. Bags of loose items shall be packed in cases and shall be clearly identified by well-secured metal labels on which the quantity and name of the parts and their index or catalogue number have been stamped.

f) All packing shall be free from sharp edges to prevent injury to persons or other objects.

g) Each bulky/heavy case, crate or package shall include wedge(s) for easy loading and unloading by mechanical handling equipment such as forklift truck.

h) Electronic circuit boards, integrated circuits and the like shall be well protected by using appropriate packing, e.g. anti-static bubble wrap or similar.

i) Rubber products and the like shall be suitably packed to avoid damage including but not limited to hardening, deformation and peel-off.

10.61 General Precautions

10.61.1 Spare parts shall be tropicalized in their packing for prolonged storage in accordance with appropriate international/ Indian standards and shall be suitably and individually labelled to indicate:

a) Name of parts;

b) Shelf life and date of manufacture;

c) Type or condition(s) of storage and special handling information;

d) Description of item and relevant part number;

e) Serial number, if applicable;

f) Inspection/test certificate number and batch number; and g) Contract number, order number and item number.

10.61.2 Tubes, cable, conductor and other similar openings shall be properly sealed and blanked off to prevent ingress of dirt or moisture.

10.61.3 Spare ball and roller bearings and similarly protected items shall not be removed from the manufacturer’s wrappings or packing.

10.61.4 Fragile materials shall be packed in such a way that they shall not be damaged during transit and when they are properly unpacked for quality inspection. Glass items shall be capable of

being easily re-packed without removing the original wrappings or packing for long- term storage within the same packing case.

10.61.5 Appropriate precautions in accordance with the Contractor's safety regulations, the regulations of the Employer, Appendix 13 [Environmental, Social, Health and Safety Manual] and statutory regulations in respect of all hazardous, toxic, inflammable, etc. materials.

10.62 Packaging Procedures

10.62.1 All required inspection/test certificates shall be supplied and packed together with individual materials. All packaging materials and procedures shall be subject to review by the Engineer.

10.62.2 All empty cases, crates or packages, whether or not returnable, shall be removed from the Site by the Contractor or stored by the Contractor in such a way that they do not interfere with the progress of the Works.

10.63 Shipping

10.63.1 The Contractor shall notify the Engineer at least fifteen (15) days in advance of any expected shipment date and give further notification of the actual shipment date and routing when such information is subsequently established. This shall complement the inspection requirements prior to delivery as specified herein.

10.63.2 Two (2) copies of packing lists and quality certificates shall be attached with each case or package to be shipped. One copy shall be placed inside the package and the second copy shall be enclosed in a watertight enclosure on the outside of each case or package. A copy of packing lists and quality certificates shall be sent to the Engineer after each package of the Works, the equipment, spare parts and other items have been shipped.

10.63.3 Without prejudice to any other provisions of the Contract, the Contractor shall be responsible for all legal requirements, insurance, customs, duties, dues, taxes and other such requirements and expenditures required for the plant, equipment, spare parts and other items to be supplied under the Contract.

10.64 Delivery

10.64.1 The Contractor shall deliver Plant and Materials required for the Works and all items to be supplied under the Contract to the Site.

10.64.2 The Contractor shall unload all items to be supplied under the Contract at the designated delivery point and place them in position or store them.

10.64.3 Any part of the Works or any item to be supplied under the Contract that is damaged in transit shall not be considered as delivered until repairs or replacements have been made and all necessary spare parts or items have been delivered to the Site.

10.64.4 All documents, manuals, drawings and other deliverables shall be delivered to an address to be designated by the Engineer in writing.

10.64.5 The Contractor shall store and secure Plant and Materials until the same have been inspected by the Engineer and are considered delivered at the designated point.

10.64.6 The Contractor shall remove temporary fittings required for shipment and re-assembly of Plant and Materials and shall complete this prior to the inspection of same and before they are considered delivered.

10.64.7 An item shall be considered delivered when all damage has been repaired and all documentation and post-delivery preparation has been completed.

APPENDIX 11

WORKS QUALITY MANAGEMENT PLAN

11.1. General

The Contractor shall implement a Project Quality Management Plan in accordance with ISO-9001 "Quality System - Model for Quality Assurance in Design/Development, Production, Installation and Servicing" to ensure that all materials, workmanship, plant and equipment supplied and work done under the contract meets the requirements of the contract. This plan shall apply to all activities related to the quality of items, including designing, purchasing, inspecting, handling, assembling, testing, storing, and shipping of materials and equipment and different elements of construction work and installations of system components.

The Quality Plan to be prepared by the Contractor and submitted to the Engineer shall follow the requirements of ISO 9000 and address each element therein.

Registration of the Contractor's organisation, or subcontractors or subconsultants is not required for this Project but the Project Quality Management Plan as submitted shall meet the intent of the ISO 9000 requirement in that there is a comprehensive and documented approach to achieving the project quality requirements.

11.2. Works Quality Management Plan

The Works Quality Management Plan (WQMP) shall as a minimum address the quality system elements as required by ISO 9001, generally noting the applicability to the Contractor's Works Programme for the Project. Procedures or Quality Plans to be prepared by others (Suppliers, Subcontractors, Subconsultants) and their incorporation in the overall WQMP shall be identified.

The Contractor shall provide and maintain a Quality Assurance Plan (QA) to regulate methods, procedures, and processes to ensure compliance with the Contract requirements. The QA Plan, including QA written procedures, shall be submitted to the Engineer for his review.

Adequate records shall be maintained in a readily retrievable manner to provide documented evidence of quality monitoring and accountability. These records shall be available to Employer at all times during the term of the Contract and during the Defects Liability Period and for a five-year period thereafter.

The Plan shall identify:

- Design Process: that control, check and verify the accuracy, completeness and integration of the design shall be performed by certified personnel and in accordance with documented procedure that have the written consent of the Engineer.
- Special Processes: that control or verify quality shall be performed by certified personnel and in accordance with documented procedures that have the written consent of the Engineer;
- Inspection and Test: Inspection and testing instructions shall provide for reporting nonconformances or questionable conditions to the Engineer; Inspection shall occur at appropriate points in the installation sequence to ensure compliance with drawings, test specifications, process specifications, and quality standards. The Engineer shall designate, if necessary, inspection hold points into installation or inspection planning procedures;
- Receiving Inspection: These procedures shall be used to preclude the use of nonconforming materials and to ensure that only correct and accepted items are used and installed;

- Identification and Inspection Status: a system for identifying the progressive inspection status of equipment, materials, components, subassemblies, and assemblies as to their acceptance, rejection, or non-inspection shall be maintained;
- Identification and Control of Items: an item identification and traceability control shall be provided;
- Handling, Storage, and Delivery: provide for adequate work, surveillance and inspection instructions.

The Plan shall ensure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, and defects in materials and equipment shall be promptly identified and corrected.

The Plan shall provide for establishing, and maintaining an effective and positive system for controlling non-conforming material including procedures for the identification, segregation, and disposal of all non-conforming material. Dispositions for the use or repair of non-conforming materials shall require the Engineers consent.

11.3. Plan Implementation and Verification

The Plan shall clearly define the QA Organisation. Management responsibility for the QA shall be set forth on the Contractor's policy and organisation chart. The Plan shall define the requirements for QA personnel, their skills and training. Records of personnel certifications shall be maintained and monitored by the QA personnel. These records shall be made available to the Engineer for review, upon request.

The QA operations shall be subject to the Engineers, Employer or Employer's authorised representative's verification at any time, including: surveillance of the operations to determine that practices, methods and procedures of the plan are being properly applied; inspection to measure quality of items to be offered for acceptance; and audits to ensure compliance with the Contract documents.

Monthly Quality Report (MQR): The contractor shall submit the Monthly Quality Report to the Engineer. MQR will contain, apart from the Material Testing Reports, the following major items:

a) Status of Approval of Method Statements: The Contractor shall submit Method Statements including check lists & ITP (Inspection & Test Plan) for execution of each and every item of work including temporary works at least four weeks before their execution, conforming to the Outline Construction Specifications (OCS) -Civil given in the contract document for review and approval by the Engineer. (copies of sample Method Statements are available with the Engineer).

b) Quality Walk: Quality Walk of the project site shall be held once in a week by the employer/Employer’s authorized representative.

c) Weekly Quality Report (WQR): The contractor shall submit the Weekly Quality Report for review of the quality by the Engineer in weekly progress review meeting. The WQR will be based on the lines of MQR.

d) Internal Quality Audit (IQA): The contractor shall conduct an internal audit of the quality of the project by the quality team of their HQ every month and shall submit the report to the Engineer.

e) External Quality Audit (EQA): The contractor shall get conducted the External Quality Audit quarterly by the reputed agency approved by the Engineer and shall submit the report to the Engineer.

f) Calibration of Batching Plant: The contractor shall be done the calibration of batching plant, immediately after installation of the batching plant and at an interval of six months

thereafter, by a reputed external agency approved by the Engineer. However, the contractor shall check the calibration in presence of Engineer's authorized representative on regular basis at least once in a month.

g) Laboratory at Site: The contractor shall get calibrated the Laboratory equipment and their dial gauges from the reputed agency/laboratory accredited by NABL and approved by the Engineer. The calibration certificate including their validity shall be displayed near each and every equipment of the Lab.

h) External Laboratory for Conducting Tests: The contractor shall get conducted the tests of materials and elements of the work for which testing facility is not available in the field Lab, from the external laboratories having valid accreditation of NABL approved by the Engineer. In addition to this, the contractor shall get conducted 5% of the tests, for which testing facility is available in field Lab also, in the external Lab, to facilitate independent review.

i) Water: The contractor shall get the water tested, from the reputed external laboratory approved by the Engineer, at the start of the work and at an interval of three months thereafter. The contractor shall also conduct the testing of the water at least once in a month in the field laboratory.

j) Status of deployment of Machinery and other T&P (Tools & Plants): The contractor shall deploy machinery and other T&P as per the provisions of the contract. Method statements approved by the Engineer and as per the requirement of the site. The contractor shall indicate the schedule of deployment of the machinery and other T&P in the Monthly Quality Report. The fitness of the machinery and other T&P shall be regularly got checked by the contractor by external inspection/Audit Team.

k) NCNs (Non-Conformity Notice) of quality issued by Engineer/Employer & NCR's (Non-Conformity Report) of quality raised by the Contractor: The status of NCNs and NCRs of quality shall be included by the contractor in the Monthly Quality Report.

The Contractor shall provide all necessary access, assistance and facilities to enable the Engineer to carry out on-site and off-site surveillance of Quality Assurance Audits to verify that the quality system which has the consent of the Engineer is being implemented fully and properly.

APPENDIX 12

CONTRACTOR'S SITE LABORATORY

12. SITE LABORATORY

12.1 The Site Laboratory shall be approximately 100 m^2 in area. It shall consist of the following accommodation:

1 concrete laboratory	60 m^2 floor area
1 office	15 m^2 floor area
1 storeroom	10 m^2 floor area
Male & female toilets, changing room & shower	sufficient for 6 persons

12.2 The remainder of the 100 m^2 shall consist of storage area for concrete cube curing tanks. The laboratory, office etc. shall be in one building; the curing tank storage building may be in a separate building, but if so, it shall be adjacent to the laboratory building & connected to it by a level, weatherproof passageway. In addition, an area of covered hard standing of 50m^2 for motor vehicles shall be provided adjacent to the laboratory.

12.3 STANDARD OF CONSTRUCTION

12.3.1 The laboratory shall be constructed to the best Engineering practice and as approved by the Engineer. Two independent telephone lines with two extensions each shall be provided for the laboratory. Telephones shall be in areas as agreed with the Engineer.

12.3.2 A water tank with minimum capacity of 2000 litres shall be installed, as a source of constant water pressure (15 kPa minimum) for each laboratory.

12.3.3 In the case of sinks used for washing samples, adequate trapping and/or separating devices shall be provided to ensure the proper functioning of the facility.

12.4 FURNISHINGS AND FIXTURES

The contractor’s site laboratory shall be provided with required furnishings and fixtures.

12.5 LABORATORY EQUIPMENT

12.5.1 The laboratory equipment, as listed below, shall be approved by the Engineer. The Contractor shall submit for the Engineer's approval within 2 weeks of the order to commence work the name of the supplier it intends to use for each piece of apparatus together with the relevant catalogue number. All the equipment shall be ISI marked. Equipment for concreting shall conform to specification given in relevant IS codes.

12.5.2 The layout of the equipment in the testing laboratory shall be instructed by the Engineer. The equipment shall be maintained to an accuracy appropriate to the required testing methods with routine calibration by an accredited organization as recommended by the appropriate Authority. Equipment shall also be calibrated after maintenance or relocation.

12.5.3 The Contractor's site laboratory shall be equipped with the following material testing equipment as a minimum. The nature and quantity of equipment required for testing may be varied by the Engineer depending on the detail of the Contractor's Design and Construction methods or for any other reason which he deems to be valid and necessary for the proper control of quality:

S. No	Description	Unit
Sieve Analysis		
1.	Electric Sieve shaker (portable)	1 unit
2.	Coarse sieves in Sizes from 100mm to 10mm (As per IS 383 table no. 2) Fine Sieves 10mm, 4.75mm, 2.63mm, 1.18mm, .600mm, .300mm, .150mm) Pans & Covers Specific Gravity and Absorption of Coarse Aggregate Wire basket, 200mm dia.	1 Set each
3.	Heavy duty suspension balance, 20 kg x 1 gm. with accessory for weight in water.	1 Set.
4.	Suitable water container	1 Nos.
5.	Unit Weight of Aggregate Balance, 100 kg. capacity with 10 gm precision	1 No.
6.	Tamping rod 16mm diameter x 600mm long	2 Nos.
7.	Measuring containers (3,10,15,30 liters)	1 each
8.	Flakiness and Elongation Flakiness gauge, elongation index	2 Set.
9.	Soundness Test	
10.	Sodium sulphate	5 Kg.
11.	Soaking tank	1 Nos.
12.	Balance, Capacity 3 kg., Sensitivity 0.1 gm.	1 Set.
Concrete		
13.	Buckets for concrete sampling	4 Nos.
14.	Slump cone	4 Nos.
15.	Tamping rod	4 Nos.
16.	Base plate	4 Nos.
17.	Mixing pan for concrete	2 Nos.
18.	Scoop for general purpose	2 Nos.
19.	Concrete thermometer	2 Nos.
20.	Concrete cylinder mould, 150 mm * 300 mm;	4 each
21.	150 mm * 200 mm	4 each
22.	Concrete cube mould, 100 mm cube & 150 mm cube	2+20 each
23.	Adjustable spanners for dismantling cube moulds	2 Nos.
24.	Capping set	2 Nos.
25.	Capping Compound	As per requirement
26.	Riffle	1 No.
27.	Concrete curing tank with capacity for 270 cubes, temperature controlled, with circulation system drain and lockable cover	2 Nos.
28.	Schmidt test hammer	1 No.
29.	Compression testing machine (Fully automated)	1 No.
30.	Mould oil	As per requirement
31.	Temperature chart recorder	1 No.
Miscellaneous		
32.	Vernier calipers to measure up to 200mm, with elongated jaws	2 Nos.
33.	Steel rule, 300 mm long graduated	2 Nos.

S. No	Description	Unit
34.	Rubber gloves	10 pr.
35.	Cotton working gloves	20 pr.
36.	First aid kit	1 Set.
37.	Wire brush	6 Nos.
38.	Steel tape, 3m, 5m, 30m	3 each.
39.	Ball peen hammer, 1 kg	2 Nos.
40.	Paint scraper. Approx. 100mm wide	2 Nos.
41.	Float, steel Approx.280 x 120 mm	2 Nos.
42.	Sack barrow	1 No.
43.	Shovel: Square Mouthed	2 Nos.
44.	Round Mouthed	2 Nos.
45.	24- wheel trolley, heavy duty, approx. 0.7m x 1.0m long pneumatic tyred type	2 Nos.
46.	Wheelbarrow, rubber tyred	1 Nos.
47.	Comprehensive tool kit. To include screwdrivers, pliers, claw hammer, multi-grips, spanners (adjustable)	1 No.
48.	Type NR Schmidt Hammer and tester with recording device	1 No.
49.	Testing Anvil for Schmidt Hammer test (SHT)	1 No.
50.	Chart recording paper for SHT	10 pkts.
51.	Cover meter for detecting metal objects to depth of 100mm below the surface of non-magnetic objects	3 Nos.
52.	RCPT Testing Machine with mould	1 No.
53.	Loss angeles abrasion machine	1 Set.
54.	Mortar cube casting machine	1 Set.
55.	Cement testing kit as per Is-4031	1 Set.
56.	Core cutter with dolly and hammer (as per appendix D od RDSO-004)	4 Set.

S. No.	Consumable Item
1	Sieve brush Wire brush
2	Sodium carbonate
3	Sodium hexa meta phosphate.
4	Kerosene Mercury

Note: All machines and equipment should have a Calibration Certificate.

Appendix 13

Environment, Social, Health and Safety Management Manual

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1.0 ESHS FRAMEWORK

1.1 General

1.1.1. The Contractor shall be responsible for the Environment, Social, Health and Safety (ESHS) on the Site and any other areas being used by him for the purposes of the Contract. Each Contractor shall develop his own contract specific ESHS Management Plan, which will represent his approach to the management of ESHS activities on his work sites under the Contract with the Employer. The ESHS Management Plan should contain all the measures as given in the project Environmental and Social Management Plan (ESMP) which is part of the project ESIA.

1.1.2. The Contractor shall ensure that all appropriate ESHS measures are implemented throughout the execution of the Works.

1.2 Scope

1.1.3. The ESHS Manual defines the principal requirement of the Employer and forms an essential part of the overall Environment, Social, Health and Safety Management System proposed to be employed by the Employer for the construction of the Project.

1.3 Application of This Document

1.1.4. This document applies to all aspects of the Contractor's Scope of Work including Sub-contractors and all other agencies. There shall be no activity associated to the Contract, which is exempted from the purview of this document.

1.4 Purpose of This Document

1.1.5. The objective of these guidelines is to ensure that adequate precautions are taken for incident/occupational illness free safe work execution as well as to avoid harmful effects on the environment and social during construction.

1.1.6. This document:

a) Describes the Environment, Social, Health and Safety interfaces between the Engineer and the Contractor.

b) Details the processes by which the Contractor shall manage Environment, Social, Health and Safety issues while carrying out the work under the contract.

1.4.1 These requirements shall be read together with, ISO 45001: 2018 Occupational Health and Safety Management System and ISO 14001: 2015 Environmental Management Systems.

1.4.2 The Contractor shall be responsible for obeying all Laws, Rules & Regulations in force at any point of time regarding the Environment, Social, Health & Safety of workers.

2.0 ESHS MANAGEMENT

2.1 General

2.1.1 This document defines the principal requirements to be practiced at the Site at all times.

2.2 ESHS Targets and Goals

2.2.1 Following ESHS targets and goals shall be set and achieved by the Contractor/Sub-contractor based on time bound work plan:

a) Zero total recordable injuries;

b) Zero non-conformances in respect of statutory laws related to Environment, Health, Social and Welfare measures, living conditions and Safety regulations;

c) Total compliance of recording and reporting of all types of incidents;

d) 100% compliance on Safety Induction of all personnel;

e) Total compliance of conducting inspections and audits as per approved ESHS Management Plan;

f) 100% incident recording and reporting;

g) 100% adherence to usage of appropriate PPEs at work;

h) Executing construction work with least disturbance to the environment, adjoining road users and traffic;

i) Minimize waste generated at sites and maximize reuse of materials;

j) Maintaining environment conditions of site as per statutory requirement of HPCB, NGT etc. to avoid penalty;

k) To achieve construction site as zero discharge site as far as possible.

2.3 Contractor's Obligation to Abide by Mandatory Legislations and Standards

2.3.1 The construction works shall be undertaken in accordance with the Employer's ESHS Management Policy and Management Systems as amended from time to time.

2.3.2 The construction works shall be undertaken in accordance with all updated applicable legislation listed below, but not limiting to:

a) Indian Electricity Act 2003 and Electricity Rules, 2005;

b) National Building Code, 2016;

c) Haryana National Building Code,2016;

d) The Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Act, 1996;

e) The Building and other Construction Workers' (Regulation of Employment and Conditions of Service) Rule,1998;

f) Factories Act, 1948 and state respective factory Rules;

g) Motor Vehicles Act as amended in 1994 and The Central Motor Vehicles Rules,1989;

h) Indian Road Congress Code IRC: SP: 55-2014 'Guidelines on Safety in Road Construction Zones';

i) The Petroleum Act, 1934 and Rules, 1976;

j) Gas Cylinder Rules, 2003;

k) Indian Explosives Act, 1884, along with the Explosives Substance Act, 1908 and the

Explosives Rules, 1983;

l) Environmental and Social Legislations as listed in Clause 6.0 of this document.

2.4 Contractor's Environmental, Social, Health and Safety Management Policy and Plan

2.4.1 The Contractor as per Rule 39 of the BOCW Central Rules shall formulate an Environment, Social, Health & Safety policy and display it at conspicuous places at work sites in English and Hindi so that the policy shall be understood by majority of the construction workers.

2.4.2 The Contractor shall revise the policy whenever any modification having implication on the Environment, Social, Health and Safety of the workers is made or any new construction work, substances, or technique are introduced which have implication on environment, health and safety of workers.

2.4.3 The contractor shall submit the ESHS Management plan for review by the engineer within 56 days after the commencement date and submit the Final ESHS Management Plan within 90 days after incorporating all comments suggested by the Engineer.

2.4.4 The Contractor shall revise and submit the ESHS Management Plan if at any time the ESHS Management Plan is insufficient in the Engineer's opinion. The Contractor, within 14 days of such intimation shall submit the revised ESHS Management Plan to the Engineer for review.

2.4.5 Any omissions, inconsistencies, and errors in the ESHS Management Plan or the Engineer's acceptance or rejection of the ESHS Management Plan and/or supplements thereto shall be without prejudice to the Contractor's obligations with respect to site ESHS and shall not be excused for any failure by the Contractor to adopt proper and recognized ESHS practices throughout the execution of the Works. The Contractor shall adhere to the ESHS Management Plan and shall ensure, as far as practically possible, that all supervisors and sub-contractors of all tiers have a copy of the ESHS Management Plan on the Site and comply with its provisions.

2.4.6 The details of contents to be covered in the ESHS Management Plans are given in Clause 8.0, Attachment -1[Contents of ESHS Management Plan] of this document.

2.5 Designer's Role

2.5.1 The Designer's primary role includes to minimize the risk to Environment, Social, Health and Safety of those who are going to construct, maintain, clean, repair, dismantle or demolish the structures and anyone else like adjoining road users/public, who might be affected by the work.

2.5.2 Every temporary structure like scaffold, temporary deck, earth retaining structures etc. shall be properly designed.

2.6 Site ESHS Organization

2.6.1 The Contractor shall appoint the required ESHS Management Personnel as prescribed in the Contract.

2.6.2 **Conduct and Competency**

The Contractor shall ensure that all personnel are competent to perform the job assigned to them. In the event that the Contractor is unable to demonstrate the competency of any person whose activities can directly impact the Works' ESHS performance, the Engineer shall remove that person from the Site without any procedural formalities.

2.6.3 **Approval from The Engineer**

The name, address, educational qualification, work experience of each ESHS personnel deployed shall be submitted to the Engineer for approval well before the start of the Works or before deployment whichever is earlier. These personnel are authorized to work only after the approval of the Engineer. In case any ESHS personnel leaves the Contractor, the same shall be intimated to the Engineer within a week. The Contractor shall recruit new personnel and fill up the vacancy withing 30 days of leaving of approved ESHS Expert.

2.7 Responsibility of ESHS Personnel

2.7.1 The Contractor ESHS Management Personnel shall report to Contractor's ESHS Expert who shall always report directly to the Contractor's Project Manager. Their primary role is to oversee Environment, Social, Health and Safety aspects at work Site. The Engineer shall always monitor adherence to this procedure.

2.7.2 No Contractor shall engage ESHS manpower from any outsourcing agencies as in that case the effectiveness would be lost. All ESHS manpower shall be on the payroll of the main contractor only and not on the payroll of any sub-contractor or outsourcing manpower agencies etc.

2.8 ESHS Committee

2.8.1 The Contractor shall form Site ESHS Committee within 90 days of award of the Contract and notification regarding the same shall be communicated to the members.

2.8.2 The Terms of Reference for the Site ESHS Committees shall be as follows:

a) To oversee implementation of the Contractor's Environment, Social, Health and Safety policies and practices;

b) To monitor the adequacy of the Contractor's ESHS Management Plan and ensure its implementation;

c) To review ESHS training;

d) To review the Contractor's ESHS monthly reports;

e) To identify probable causes of accident and unsafe practices in construction work and to suggest remedial measures;

f) To stimulate interest of the Workers in ESHS by organizing environment/safety week, safety competition, talks and film-shows on environment/safety, preparing posters or taking similar other measures as and when required or as necessary;

g) To go around the Site with a view to check unsafe practices and detect unsafe conditions and to recommend remedial measures for their rectifications including first-aid medical and welfare facilities;

h) Committee team members should perform a site inspection before every committee meeting and to monitor ESHS inspection reports;

i) To bring to the Notice of the Engineer hazards associated with use, handling and maintenance of the equipment used during the course of construction work;

j) To suggest measures for improving environment, social, health and safety in construction work at the Site;

k) To investigate the health hazards associated with handling different types of explosives, chemicals, and other construction materials and to suggest remedial measures including personal protective equipment; and

l) To review the last ESHS committee meeting minutes and the remedial measures taken for Non-Compliance.

m) Following shall be the composition of the Site ESHS Committee:

2.8.3 Site ESHS Committee meeting shall be conducted once in a calendar month and participation of following members shall be ensured.

Chairman	Project Manager
Secretary	ESHS Expert (Will be nominated by Project Manager)

Members	i) Contractor's ESHS staff. ii) Labour Welfare Officer; iii) In -charge of Plant and Machinery & Site Electricals; iv) In-charge of Special Work Operations (e.g. bridge, viaduct, and tunnel, etc.); v) In-charge of Stores; vi) Subcontractor's representative; and vii) Workers' representatives;
Engineer's Representatives	To be nominated by the Engineer

2.8.4 **Minimum time between two monthly ESHS Committee meetings**

A minimum period of 21 days shall be maintained between any two ESHS monthly committee meetings.

2.8.5 Agenda

The Secretary shall circulate the agenda of the meeting at least seven working days in advance of the scheduled date of the meeting to all members as well as to the Employer.

2.8.6 The agenda should broadly cover the following:

a) Chairman's overview of ESHS Management Performance;
b) Confirmation of minutes of last meeting;
c) Previous month ESHS statistics;
d) Incident and accident investigation/Dangerous occurrence/Near miss report;
e) Site ESHS inspection and compliance report;
f) The Contractors' ESHS issues;
g) Report from the Employer and Engineer;
h) Non-compliances raised by Engineer/Statutory Authorities;
i) Report and compliance of GRC; and
j) Any other concern.

2.8.7 In case of station and other contiguous areas where more than one main Contractor is working together, the Engineer shall instruct the other Contractors/ Sub-contractors to join for the monthly ESHS committee meeting of the main civil Contractor, to discuss and decide about the common provision of safety, security, lighting, toilet, drinking water etc. and sharing the maintenance cost of the same etc.

2.8.8 The Minutes of the Meeting shall be prepared as per the format provided and sent to all members within 2 working days by mail. Minutes of the ESHS Committee Meeting shall also be displayed on the notice board for wider publicity to all concerned.

2.9 ESHS Induction Training and ID Card

2.9.1 The Contractor shall ensure that all personnel working at the Site receive an ESHS induction training immediately on the first day of joining explaining the nature of the work, the hazards that may be encountered during the site work. Personnel shall only be deployed at site once

he/she has completed ESHS induction training. The training shall cover the contents as given in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/001].

2.9.2 All personnel shall be issued a photo identity card as per the format given in Clause 8.0, Attachment-4[General Instruction: ESHS/GI/002].

2.9.3 The Contractor shall also issue a Personnel pocket ESHS Booklet in a Hindi to the Workers, which provides information on ESHS and emergency procedures.

2.10 Other ESHS Training

2.10.1 The Contractor shall organize the ESHS trainings to managers, supervisors and other personnel in behavioral change and improve ESHS performance.

2.10.2 The Contractor shall provide a training/workshop on ESHS to all its workers/staff/employees/subcontractors of at least 2 days. It shall be completed in various modules and each employee/worker shall have a record of completing all modules.

2.10.3 On-the spot practical skill development training on height safety including scaffold safety, crane safety, welding safety, electrical safety, and traffic safety for marshals shall also be conducted.

2.10.4 Every employee including workman shall take a ESHS oath followed by toolbox talk every day.

2.10.5 All vehicles and machine drivers including heavy work vehicle and machine operators shall be trained on defensive driving by the external agency with necessary certificate or license.

2.10.6 The Contractor shall ensure only certified/authorized scaffolder by the external agency to be deployed at work site for erection/dismantling of scaffolding work.

2.11 ESHS Inspections

2.11.1 The Contractor shall evolve and administer a system of conducting ESHS inspection and other risk management analysis on a periodical basis.

2.11.2 The purpose of ESHS inspection is to identify any deviation in construction activities and operations, machinery, plant and equipment and processes against the ESHS Management Plan and its supplementary procedures and programs.

2.11.3 The Contractor shall initiate a monthly joint site ESHS Management inspection with the Engineer and report shall be generated with the corrective action.

2.11.4 The Contractor project manager & ESHS expert with site team shall be participating in the ESHS inspection.

2.11.5 The Contractor shall submit follow up compliance report of the ESHS inspection report within 15 days of the date of Inspection in a coloured soft copy.

2.11.6 The Compliance of the joint inspection “Non-Compliance” shall be witnessed/accepted by the Engineer.

2.11.7 Following ESHS inspections program shall be adopted:

a) Planned general inspection;

b) Routine inspection;

c) Specific inspection; and

d) Other inspection.

2.11.8 **Planned general inspections** are performed at predetermined intervals. Inspections that will be classified under this inspection program are:

a) Monthly Contractor and sub-contractor’s Site ESHS committee inspection;

b) Weekly ESHS inspection by construction supervisors (the Contractor and the Subcontractor);

and

c) Daily ESHS inspection by the Contractor Site ESHS team.

2.11.9 Routine inspections are often referring to the inspection of the Site, equipment and temporary structures performed by the Site and equipment operators and temporary structure erectors.

Inspections that will be classified under this inspection program are:

a) Daily inspection of plant and equipment by operators;

b) Weekly inspection of scaffold by scaffolding supervisors;

c) Monthly Inspection of electrical hand tools by competent electrical supervisors;

d) Quarterly inspection of temporary electrical systems by competent electrical supervisors; and

e) Half-yearly inspection of lifting machinery, lifting appliances, equipment and gears by Govt. approved competent persons.

f) Quarterly colour coding of lifting gears, tools & tackles. The recommended colour coding for the 4 quarters of the years shall be as under

i) January – March: GREEN

ii) April – June: YELLOW

iii) July – September: BLUE

iv) October – December: WHITE

2.11.10 The list mentioned above is not exhaustive. The Contractor may add additional categories. The ESHS Expert shall ensure that a system of routine inspections is carried out periodically to all plants, equipment, powered tools and any other temporary structures that will pose a hazard to operators and workmen.

2.11.11 **Specific Inspection**

Specific inspections are performed on activities without a predetermined date. Competent supervisors usually perform inspections for ensuring an activity whether it is executed in accordance to a general set of rules; Method Statement submitted or developed procedures.

The following are examples that will be commonly performed as required on the Site:

a) Inspection performed before a heavy lifting operation;

b) Inspection performed before and after the entry of person into a confined space;

c) Inspection performed before and after a welding and gas cutting operation;

d) Inspection of formwork before concreting by formwork erector.

2.11.12 The list mentioned above is not exhaustive. The Contractor shall ensure that a competent supervisor inspects all high-risk processes and activities.

2.11.13 Other inspections include the following:

a) Mandatory inspections by Labour Department of Government of Haryana; and

b) HRIDC/Engineer site ESHS management team.

c) Inspections by Central Pollution Control Board, Haryana Pollution Control Board, Ministry of Environment and Forest and Climate Change, National Green Tribunal etc.

2.11.14 The Contractor shall prepare all required ESHS inspection checklists for all activity operations and equipment. Checklists will be prepared based on the Indian Safety Standards, Rules and Regulations and the Works requirements.

2.11.15 All inspection records and reports will be properly kept and filed for audit purpose. Inspection

reports of planned general inspection and routine inspection will be used for discussion during safety committee meetings.

2.12 ESHS Audit

2.12.1 The purpose and scope of ESHS Audit is to assess potential risk, liabilities and the degree of compliance of the ESHS Management Plan and its supplementary procedures and programs against applicable and current ESHS legislation regulations and the Works requirements.

2.12.2 The Contactor's project manager shall hold the ultimate responsibility in ensuring implementation of ESHS audit program during the construction work.

2.12.3 Monthly Audit Rating Score (MARS)

2.12.4 Monthly Audit Rating Score (MARS) will be performed once in a month. A team consisting of the Contractor's project manager, ESHS experts and the Engineer's representative based on the pre-designed score-rating format will conduct it.

2.12.5 This Monthly ESHS Audit Rating Score (MARS) report will enable the Engineer to evaluate the general compliance by the Contractor with the Conditions of Contract, and the ESHS Management Plan. A Minimum Compliance level to achieve 75% overall Audit Rating is essentially required. Failing this, the Engineer will take punitive action which includes non-processing of running account bills.

2.12.6 Timing

The Monthly Audit Rating Score (MARS) should be conducted at least 7 days prior to the scheduled date of monthly ESHS Committee Meeting.

2.12.7 Evaluation

The numerical scoring has been weighed on a 1-10 scale. The audit team will use their observations noted in evaluating the points to be awarded against each of the elements of the audited section. Wherever some topics and sub-topics are not applicable the score rating need not be given. The overall audit ratings shall be achieved by:

$$\text{Overall Audit rating} = \frac{\text{Actual Score Achieved}}{\text{Maximum Possible Score}} \times 100$$

The criticality of the required actions for the respective sections of the Audit will be classified as:

S.No.	Score	Description	Action
1	< 60%	Immediate	Require the Contractor to rectify within 24 hours
2	< 75%	Improvement Necessary	The Contractor rectification within 7 days and confirmed in writing to the Engineer
3	< 90%	Improvement Desirable	The Contractor rectification within 1 month and confirmed in writing to the Engineer

2.12.8 **Report**

A copy of each Audit Report will be sent to the Engineer and to all subcontractors, with whom it will then be discussed in detail at the monthly ESHS Committee Meeting to ensure that any corrective actions are agreed upon.

2.12.9 **Internal ESHS Audit**

Internal ESHS Audit will be conducted by the Contractor Project Manager and ESHS Expert

once in a month and report will be shared with the Engineer within two days of Internal Audit Conducted.

2.12.10 **Reporting**

Compliance of Internal Audit report will be submitted to the Engineer by the Contractor within 15 days of Audit Conducted.

2.13 ESHS Communication

2.13.1 The Contractor shall make every effort to communicate the ESHS Management measures through posters **campaigns**/billboards/banners/glow signs being displayed around the Site as part of the effort to raise ESHS awareness amongst the work force. Posters should be in Hindi, English and other suitable language deemed appropriate. Posters/billboards/ banners/glow signs should be changed at least once in a month to maintain the impact.

2.13.2 The Contractor shall also observe important days as listed in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/003] and printing and displaying ESHS signage and posters as listed in Clause 8.0, Attachment-4 [General Instruction: ESHS/GI/004].

2.14 ESHS Submittals

2.14.1 The **Contractor's** ESHS Management shall send the following reports to the Engineer periodically in soft copy:

a) Daily reporting of total number of workmen;

b) Monthly ESHS Report;

c) Minutes of ESHS Committee meeting;

d) ESHS inspection and compliance reports; and

e) ESHS audits reports;

- Monthly Audit Rating Score (MARS) reports;
- Internal ESHS audits;

2.14.2 The **Contractor** shall prepare a Monthly ESHS Report consisting of the following within 7th of next month to the Engineer:

a) Monthly man-hour details as specified in the ESHS Management Plan;

b) Monthly accident/incident details as specified in the ESHS Management Plan;

c) ESHS committee details;

d) ESHS inspection and compliance report;

e) ESHS internal audit & MARS Audit details;

f) ESHS communication activities undertaken in the month indicating the number of posters displayed and balance availability in stock;

g) Details of ESHS training imparted.

h) Toolbox talks details

i) PPE details: Quantity purchased, issued to the workmen and stock available.

j) Details on IP 44 panel boards, lighting poles, welding and cutting equipment, Inspection of Ladders, Hoists, lifting appliances Tools & Tackles.

k) Monthly Site illumination monitoring results including emergency power backup.

l) Housekeeping details

m) Barricade details with lighting and maintenance details;

n) No of critical excavations with mitigation measures;

o) Health and welfare activities;

p) Monthly Environment (including air, noise, water and soil testing results) and Social Report;

q) Graphical representation of monitored results over past four reporting periods;

r) Details of Clearance/ Permission//Permit obtained;

s) Compliance status for conditions of all relevant clearances /permissions / consents/permits for the Work, including quarries, etc.;

t) Tree felling, transplanting and compensatory planation details;

u) Details of consumption of construction material, energy and water;

v) Details of different types of waste and scrap generated during the month and sold to authorized recyclers;

w) Summary of complaints, results of investigations and follow-up actions;

x) Gender: Number of female workers, percentage of female workforce, gender issue raised and dealt with;

y) HIV/AIDS: Provider of health services, information& training;

z) GBV/SEA: Details of training conducted;

aa) Grievances: List of grievances received in the reporting period and unresolved past grievances by date received, complaint how received, to whom referred to for action, resolution and date (if completed), date of resolution of community grievances if any.

bb) ESHS activities planned for next month.

2.15 Accident Reporting and Investigation

2.15.1 All accidents and dangerous occurrences shall immediately be informed through message to the **Engineer**. This will enable the Engineer to reach the scene of accident/dangerous occurrences to monitor/assist any rescue work and/or start conducting the investigation process so that the evidences are not lost.

2.15.2 **Reports** of all accidents (fatal/injury) and dangerous occurrences shall also be sent to the Engineer within 24 hours by the Contractor.

2.15.3 In addition to the above verbal and written reporting to the Engineer, as per Rule 276 of HBOCWR, notice of any accident to a worker at the Site that:

a) Causes loss of life; or;

b) Disables a worker from working for a period of 48 hours or more immediately following the accident; shall forthwith be sent by telegram, telephone, fax, or similar other means including special messenger within 4 hours in case of fatal accidents and 72 hours in case of other accidents, to:

i) The Assistant Director, Industrial Safety and Health having jurisdiction in the area in which the establishment in which such accident or dangerous occurrence took place is located. The Assistant Director, Industrial Safety and Health shall be the authority appointed under section 39 of the Act;

ii) Board with which the building worker involved in accident was registered as a beneficiary;

iii) Chief inspector; and

iv) The next of kin or other relative of the Worker involved in the accident.

2.15.4 Further, notice of any accident shall be sent in respect of an accident which:

a) Causes loss of life; or;

b) Disables the injured worker from work (for a period of more than 10 days) to;

i) The Officer-in-charge of the nearest police station;

ii) The District Magistrate or, if the District Magistrate by order so desires to;

iii) The Sub-Divisional Magistrate.

2.15.5 In case of an accident-causing minor injury, first-aid shall be administered, and the injured worker shall be immediately transferred to a hospital or other place for medical treatment.

2.15.6 Where any accident-causing disablement that subsequently results in death, notice in writing of such death, shall be sent to the authorities within 72 hours of such death.

2.15.7 The following items are defined as dangerous occurrences and shall be reported to the inspector having jurisdiction, whether any disablement or death caused to the Worker, namely:

a) Collapse or failure of lifting appliances, or hoist, or conveyors, or similar equipment for handling of building or construction material or breakage orfailure of rope, chain or loose gears; or overturning of cranes used in construction work;

b) Falling of heavy objects from height;

c) Collapse or subsidence of soil, tunnel, pipelines, any wall, floor, roof or any other part of any structure, launching girder, platform, staging, scaffolding or means of access including formwork;

d) Fire and explosion causing damage to any place on the site where the Workers are employed;

2.15.8 In case of failure of lifting appliance, loose gear, hoist machinery and transport equipment at the Site, such appliances, gear, hoist, machinery or equipment and the Site of such occurrence shall, as far as practicable, be kept undisturbed until inspected by the Inspector having jurisdiction.

2.15.9 Every notice given for fatal accidents or dangerous occurrences shall be followed by a written report to the concerned Authorities under Section 39 of BOCWA and the Chief Inspector of Government of Haryana in the specified Form **XLVI** of the **HBOCWR.**

2.15.10 Actions to be taken post incident/accident:

a) In case any incident/accident happens at Site leading to injury to the worker,the worker/s is/are required to be taken to the nearest hospital immediately;

b) Project Manager/ESHS Expert /Labour Welfare Officer of the Contractor needs to report the incident to the Engineer immediately without fail for all the death cases including natural deaths;

c) In case of fatal accident, doctor from the nominated hospital is the only authorized person to declare the death of the worker. It is not to be decided suo-moto by any other person. FIR should be registered for all the fatal cases which happen at the Site/labour camp;

d) Post Mortem of the dead body is mandatory in all the death cases i.e. whether it is natural or due to any incident / accident;

e) Family members of the injured / deceased worker are to be informed immediately;

f) In case of fatal accident, the dead body is to be handed over to the family members.

Arrangement of sending the dead body to the native place shall be made by the Contractor including cash payment for meeting out last rites expenses as per Rules;

g) Fatal accident report is to be sent to State Labour Authority in Form EE (as per workmen's compensations Act) within seven days and to the Licensing Authority in Form XLVI within 24 hours of the incident/accident;

h) Copy of all the documents deposited with any labour authority, FIR, Post Mortem, Medical Reports etc. shall be submitted to the Engineer in duly approved Labour Welfare Fund (LWF) Form;

i) The Contractor shall be liable for getting disbursement of Provident Fund benefits, compensation under Employee compensation Act, benefits of ESI Act to the workman/dependents of the deceased workman. The Contractor shall also provide accommodation and transportation to dependents of the deceased workman or to the disabled workman who come for settlement ofterminal claims.

2.15.11 **Accident Investigation:**

a) Investigations shall be conducted in an open and positive atmosphere that encourages the witnesses to talk freely. The primary objective is to ascertain the facts with a view to prevent future and possibly more serious occurrences;

b) Accidents and dangerous occurrences which result in death, serious injury or serious damage must be investigated by the Contractor immediately to find out the cause of the accident/occurrence so that measures can be formulated to prevent any recurrence; and

c) Near misses and minor accidents should also be investigated by the Contractor as soon as possible as they are signals that there are inadequacies in the ESHS Management System.

2.15.12 Procedure of Incident Investigation

It is important after any accident or dangerous occurrence that information relating to the incident is gathered in an organized way. The following steps shall be followed:

a) Take photographs and make sketches;

b) Examine involved equipment, work piece or material and the environmentalconditions;

c) Interview the injured, eye-witnesses and other involved parties;

d) Consult expert opinion where necessary; and

e) Identify the specific Contractor or subcontractor involved.

2.15.13 Having gathered information, it is then necessary to make an analysis of incident:

a) Establish the chain of events leading to the accident or incident;

b) Find out at what stage the accident took place;

c) Considering all possible causes and the interaction of different factors that led up to the accident and identify the most probable cause, the cause of an accident should never be classified as carelessness; and

d) The specific act or omission that caused the accident must be identified.

2.15.14 The next stage is to proceed with the follow-up action:

a) Report on the findings and conclusions;
b) Formulate preventive measures to avoid recurrence; and
c) Publicize the findings and the remedial actions taken.

2.15.15 The Engineer's Independent Incident Investigation

In case of fatal/dangerous occurrence, the Engineer shall also conduct independent investigation. The

Contractor and his staff shall extend necessary co-operation and testify about the accident.

2.15.16 The Contractor shall take every effort to preserve the scene of accident till the Engineer completes the investigation.

2.15.17 All persons summoned by the Engineer in connection to witness recording shall obey the instructions without delay. Any wilful suppression of information by any person shall be removed from the site immediately and/or punished.

2.16 Emergency Preparedness Plan

2.16.1 The Contractor shall prepare, as required under BOCWR, an Emergency Response Plan for the Site as a part of the Contractor ESHS Management Plan. The plan shall integrate the emergency response plans of the Contractor and all other Subcontractors. The Emergency Response Plan shall detail the Contractor's procedures, including detailed communication arrangements, for dealing with all emergencies that could affect the Site. The plan shall address items such as injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.

2.16.2 The Contractor shall ensure that the Emergency Response Plan is prepared to deal with emergencies arising out of, but not limited to:

a) Fire and explosion;
b) Collapse of lifting appliances and transport equipment.
c) Collapse of building, sheds or structure etc.
d) Landslides getting workers buried, floods, earthquake, storms and other natural calamities etc.

The above list is not exhaustive and other emergencies can also be included.

2.16.3 Arrangement shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the Contractor with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

2.16.4 The Contractor shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.

2.16.5 The Contractor shall conduct an onsite emergency mock drill once in every quarter for all his workers and his sub-Contractor's workers.

2.16.6 It shall be the responsibility of the Contractor to keep the Local Law and other Authorities informed and seek urgent help to mitigate the consequences of an emergency. Prompt communication to the Employer and Engineer, through telephonically initially and followed by a written report, shall be made by the Contractor.

2.17 Experts/Agencies for Environment, Social, Health & Safety Services

2.17.1 The Contractors may utilize the services of experts/agencies empaneled for the purpose of training, audit and any other ESHS services with prior approval of the Engineer. This approval can be withdrawn by the Engineer at any time if the quality of output of the agency is found not satisfactory.

3.0 LABOUR PROTECTION

3.1 General

3.1.1 The Contractor shall comply in full of the project Workplace Policy as described in Attachment-2 [Work Place Policy on HIV/AIDS, Prevention & Control] and Attachment -3 [Covid 19 policy].

3.2 Engagement of Staff and Labour

3.2.1 The Contractor shall ensure that the employees deployed by him in the premises of the Employer are physically and mentally fit and do not have any criminal record.

3.3 Payment of Minimum Wages

3.3.1 The Contractor shall ensure payment of at least the minimum wages as prescribed and applicable from time to time under the Minimum Wages Act, 1948 in the presence of an authorised representative of the Engineer and shall maintain proper records of their timely disbursement. These records shall be preserved for a period of at least 3 years and made available even after the Contract is over for any verification by the statutory authorities.

3.4 Conditions of Labour

3.4.1 The Contractor shall observe conditions of labour that are no less favourable than those established for the relevant trade or industry.

3.4.2 During the work, the Contractor shall afford all employees all basic rights enumerated in the conventions of the International Labour Organisation, including freedom of association, right to freedom from forced labour, and right to freedom from discrimination based on race, colour, sex, religion, political opinion and social origin.

3.4.3 The Contractor shall ensure coverage of his employees under the Employees Provident Fund and Miscellaneous Provisions Act, 1952 and the Employees State Insurance Act, 1948 via independent code numbers allotted to them by the Central Provident Fund Organisation and Employees State Insurance Corporation respectively.

3.4.4 The Contractor shall insure all his employees under Group Personal Accident Insurance scheme through a recognised and registered insurance company.

3.5 Labour Laws

3.5.1 The Contractor shall ensure that all his employees and the Subcontractors obey applicable following laws and regulations, including those concerning safety at work.

a) Minimum Wages Act, 1948;
b) Payment of Wages Act, 1936;
c) Equal Remuneration Act, 1976;
d) Employees Provident Fund and Miscellaneous Provisions Act, 1952;
e) Employees State Insurance Act, 1948;
f) Maternity Benefit Act, 1951;
g) Child Labour (Prohibition and Regulation) Act, 1986;
h) Building and Other Construction Workers (Regulation of Employment of Service) Act, 1996;
i) Haryana Building and Other Construction Workers (Regulation of Employment and

Conditions of Service) Rules, 2005;

j) Building and Other Construction Workers Welfare Cess Act, 1996;

k) Building and Other Construction Workers Welfare Cess Rules, 1998;

l) Haryana Major Accident, Hazard Control Rules, 2009; and

m) Workmen's Compensation Act. 1923;

3.5.2 The Contractor shall comply with all other statutory requirements, rules, regulations and notifications in relation to employment of his staff and workers that may be issued from time to time by the concerned government authorities.

3.6 Working Hours

3.6.1 No work shall be carried out beyond the statutory limit given under BOCWA, 1996.

3.6.2 No work shall be carried out outside the normal working hours stated in the Contract unless otherwise:

a) The Engineer gives his consent in writing for additional work; and

b) The work is unavoidable or necessary for the protection of life or property or forthe safety of the Works, in which case the Contractor shall immediately inform the Engineer.

4.0 SAFETY GENERAL

4.1 General

4.1.1 The following standards whichever is more stringent shall be applicable:

a) The BOCW Acts 1996, The BOCW Rules 1998 and the Haryana BOCW Rules 2005 framed there under;
b) Other relevant National Legislations & IS Codes.

4.2 Housekeeping

4.2.1 Housekeeping is the Act of keeping the working environment clear of all unnecessary waste, thereby providing a first-line of defense against accident and injuries.

4.2.2 General Housekeeping shall be carried out by the Contractor and ensured always at the Site, Construction Site/Depot, Batching Plant, Labour Camp, Stores, Offices and Toilets/Urinals.

4.2.3 The Contractor shall be responsible for providing segregated containers for disposal of debris at required places and regular cleaning of the same.

4.2.4 Full height fence, barriers, barricades etc. shall be erected around the Site in order to prevent the surrounding areas from excavated soil, rubbish etc., which may cause inconvenience to and endanger the public. The barricade, especially those exposed to public shall be aesthetically maintained by regular cleaning and painting as directed by the Engineer. These shall be maintained in one line and level. Measures shall be adopted to ensure that seepage from site shall not go on the road/pubic area.

4.2.5 All stairways, passageways and gangways shall be maintained without any blockage or obstructions. All emergency exists passageways, exits fire doors, break-glass alarm points, firefighting equipment, first aid stations, and other emergency stations shall be kept clean, unobstructed and in good working order.

4.2.6 Lumber with protruding nails shall be bent/removed and properly stacked.

4.2.7 All surplus earth and debris are removed/disposed off from the working areas to officially designated dumpsites. Trucks carrying sand, earth and any pulverized materials etc. to avoid dust or odour impact shall be covered while moving. The tyres of the trucks leaving the site shall be cleaned with water, wherever the possibility of spillage on carriageways meant for regular road traffic exists.

4.2.8 No parking of trucks/trolleys, cranes and trailers etc. shall be allowed on roads, which may obstruct the traffic movement.

4.2.9 Roads shall be kept clear and materials like pipes, steel, sand, boulders, concrete, chips and brick etc. shall not be allowed on the roads to obstruct free movement of road traffic

4.2.10 Proper and safe stacking of materials are of paramount importance at yards, stores and such locations where material would be unloaded for future use. The storage area shall be well laid out with easy access and material stored/stacked in an orderly and safe manner.

4.2.11 Flammable chemicals/compressed gas cylinders shall be safely stored.

4.2.12 Unused/surplus cables, steel item and steel scrap lying scattered at different places within the working areas shall be removed and identified locations (s).

4.2.13 Empty cement bags and other packaging materials shall be properly stacked and removed.

4.2.14 Debris shall be handled and disposed off in such a manner that it does not create any hazards to the Site personnel. Debris shall not be accumulated to form a hazard and should be kept sufficiently moist to bring down the dust level within permissible limit.

4.2.15 Debris or other material shall not be thrown inside or outside the Site premises from any height. The debris or waste material shall be disposed off at regular intervals as soon as the work has been completed.

4.2.16 Material shall be stacked or stored or placed so close to any edges of a floor or platform which may endanger the safety of the person working in the close vicinity of it.

4.2.17 Drip pans of suitable size shall be used to collect oil leakages and spills while plants/equipment/machinery maintenance.

4.2.18 The Contractor shall make available Material Supply Data sheet (MSDS) for material/chemicals/substances used at Site. Such material/chemicals/substances used shall be treated, handled, stored, transported and disposed off, by the Contractor, in a manner specified in the MSDS

4.3 Working at Height

4.3.1 Organization and planning

The contractor shall ensure that work at height is

i) properly planned for any emergencies and rescue

ii) appropriately supervised; and

iii) carried out in a manner, which is reasonably practicable safe.

4.3.2 The contractor shall ensure that work at height is carried out only when the weather conditions do not jeopardize the health or safety of persons involved in the work.

4.3.3 Competence**:**

The contractor shall ensure that no person engages in any activity, including organization, planning and supervision, in relation to work at height or work equipment for use in such work unless he is competent to do so or, if being trained, is being supervised by a competent person. Issuance of Height pass in addition to normal ID card for worker deployed at height is mandatory. They shall be issued with a different colour high visibility jacket for ease of identification.

4.3.4 **Selection of 'work equipment' for work at height**

1) The contractor, in selecting work equipment for use in work at height, shall

a) Give collective protection measures priority over personal protection measures; and

b) take account of

i) The working conditions and the risks to the safety of persons at the place where the work equipment is to be used;

ii) In the case of work equipment for access and egress, the distance to be negotiated;

iii) The distance and consequences of a potential fall;

iv) The duration and frequency of use;

v) The need for easy and timely evacuation and rescue in an emergency; and

vi) Any additional risk posed by the use, installation or removal of that work equipment or by evacuation and rescue from it;

(2) The contractor shall select work equipment for work at height which:

a) Has characteristics including dimensions which:

(i) Are appropriate to the nature of the work to be performed and the foreseeable loadings; and

(ii) Allow passage without risk.

4.3.5 Fragile surfaces

4.3.6 The Contractor shall ensure that no person at work passes across or near, or working on, from or near, a fragile surface where it is reasonably practicable to carry out work safely and under appropriate ergonomic conditions without his doing so.

4.3.6.1 Where it is not reasonably practicable to carry out work safely and under appropriate ergonomic conditions without passing across or near, or working on, from or near, a fragile surface, every contractor shall,

(a) Ensure, so far as is reasonably practicable, that suitable and sufficient platforms, coverings, guard rails or similar means of support or protection are provided and used so that any foreseeable loading is supported by such supports or borne by such protection;

(b) Where a risk of a person at work falling remains despite the measures taken under the preceding provisions of this regulation, take suitable and sufficient measures to minimise the distances and consequences of his fall.

4.3.6.2 Where any person at work may pass across or near, or work on, from or near, a fragile surface, every contractor shall ensure that

(a) Prominent warning notices are so far as is reasonably practicable affixed at the approach to the place where the fragile surface is situated; or

(b) Where that is not reasonably practicable, such persons are made aware of it by other means.

4.3.6.3 The Contractor shall ensure that following areas are clearly indicated:

a) where a workplace contains an area in which, owing to the nature of the work, there is a risk of any person at work;

b) Falling a distance; or

4.3.6.4 Being struck by a falling object

4.3.6.5 The Contractor shall take suitable and sufficient steps to prevent any person being struck by any falling material or object which is liable to cause personal injury.

4.3.6.6 The Contractor shall ensure that no material or object is thrown or tipped from height in circumstances where it is liable to cause injury to any person.

4.3.6.7 The Contractor shall ensure that materials and objects are stored in such a way as to prevent risk to any person arising from the collapse, overturning or unintended movement of such materials or objects.

4.3.6.8 Requirements for existing places of work and means of access or egress at height. Every existing place of work or means of access or egress at height shall;

a) Be stable and of sufficient strength and rigidity for the purpose for which it is intended to

be or is being use;

b) Where applicable, rest on a stable, sufficiently strong surface;

c) Be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work to be carried out there

d) Possess suitable and sufficient means for preventing a fall

e) Possess a surface which has no gap

i) Through which a person could fall;
ii) Through which any material or object could fall and injure a person; or
iii) Giving rise to other risk of injury to any person, unless measures have
iv) been taken to protect persons against such risk;

f) Be so constructed and used, and maintained in such condition, as to prevent, so far as is reasonably practicable -

i) The risk of slipping or tripping; or
ii) Any person being caught between it and any adjacent structure;

g) Where it has moving parts, be prevented by appropriate devices from moving inadvertently during work at height.

4.3.6.9 Requirements for guardrails, toe-boards, barriers and similar collective means of protection;

i) Unless the context otherwise requires, any reference in this section to means of protection is to a guardrail, toe-board, barrier or similar collective means of protection.
ii) Means of Protection shall;

a) Be of sufficient dimensions, of sufficient strength and rigidity for the purposes for which they are being used, and otherwise suitable;

b) Be so placed as prevent, so far as is practicable, the fall of any person, or of any material or object, from any place of work.

iii) In relation to work at height involved in construction work

a) The top guard-rail or other similar means of protection shall be at least 1100mm above the edge from which any person is liable to fall;

b) toe-boards shall be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work; and

c) any intermediate guardrail or similar means of protection shall be positioned so that any gap between it and other means of protection does not exceed 550 mm.

iv) The Contractor shall ensure that handrail for protection of wall opening/egress shall be made up to study material and fabricated by pipes 40 mm or rebars of 32mm dia only. The handrail shall be of sufficient strength to withstand the impact fall load. The handrail shall be made in two layers i.e., mid rail and top rail along with provision of toe guard/board of minimum 150 mm in height from the level from where handrail is erected.
v) Any structure or part of a structure which supports means of protection or to which means of protection are attached shall be of sufficient strength and suitable for the purpose of such support or attachment.

4.3.7 Requirements for all Working Platforms:

a) Every working platform requires a firm & stable supporting structure for holding it;

b) Any surface upon which any supporting structure rests shall be stable, of sufficient strength and of suitable composition safely to support the supporting structure, the working platform and any loading intended to be placed on the working platform.

c) Stability of supporting structures, any supporting structure shall;

i) Be suitable and of sufficient strength and rigidity for the purpose for which it is being used;

ii) In the case of a wheeled structure, be prevented by appropriate devices from moving inadvertently during work at height.

iii) in other cases, be prevented from slipping by secure attachment to the bearing surface or to another structure, provision of an effective antislip device or by other means of equivalent effectiveness.

iv) be stable while being erected, used and dismantled; and

v) when altered or modified, be so altered or modified as to ensure that it remains stable.

vi) Have suitable base plates and properly footed thereby.

d) Stability of working platforms A working platform shall

i) be suitable and of sufficient strength and rigidity for the purpose or purposes for which it is intended to be used or is being used.

ii) be so erected and used as to ensure that its components do not become accidentally displaced so as to endanger any person;

iii) when altered or modified, be so altered or modified as to ensure that it remains stable; and

iv) be dismantled in such a way as to prevent accidental displacement.

e) A working platform shall be of sufficient dimension to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;

f) possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap

i) through which a person could fall;

ii) through which any material or object could fall and injure a person; or

iii) giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk; and

g) be so erected and used, and maintained in such condition, as to prevent, so far as is reasonably practicable

i) the risk of slipping or tripping; or

ii) any person being caught between the working platform and any adjacent structure.

h) be fully decked to avoid any fall of material or person.

i) be of min. 900 mm in width. Use of single challies/grating as working platform is prohibited. Specific size working Challis/Grating of Drop In type design is recommended. Oversize use as well as tying with binding wire is strictly prohibited.

j) The platform shall be tied up properly with the structure in such a way

k) that it cannot be displaced in any circumstances by its own.

l) Collective fall protection in the form of two level of handrail of adequate strength to withstand the impact load shall be ensured.

m) Proper and safe means of access/egress shall be ensured to these working platforms.

i) Loading

A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation, which could affect its safe use. Concrete, debris or other material shall be not allowed to accumulate at any platform on a scaffold.

ii) Additional requirements for scaffolding

Strength and stability calculations for scaffolding shall be carried out unless

A. A note of the calculations, covering the structural arrangements contemplated, is available; or

B. It is assembled in conformity with a generally recognized standard configuration.

iii) Depending on the complexity of the scaffolding selected, a competent person shall draw up an assembly, use and dismantling plan. This may be in the form of a standard plan, supplemented by items relating to specific details of the scaffolding in question

iv) A copy of the plan, including any instructions it may contain, shall be kept available for the use of persons concerned in the assembly, use, dismantling or alteration of scaffolding until it has been dismantled.

v) The dimensions, form and layout of scaffolding decks shall be appropriate tothe nature of the work to be performed and suitable for the loads to be carried and permit work and passage in safety.

vi) While a scaffold is not available for use, including during its assembly, dismantling or alteration, it shall be marked with general warning signs in accordance with and be suitably delineated by physical means preventing access to the danger zone.

vii) Scaffolding may be assembled, dismantled or significantly altered only under the supervision of a competent person and by persons who have received appropriate and specific training in the operations envisaged which addresses specific risks which the operations may entail and precautions to be taken, and more particularly in

A. understanding of the plan for the assembly, dismantling or alteration of the scaffolding concerned;

B. safety during the assembly, dismantling or alteration of the scaffolding concerned;

C. measures like provision of safety nets, safety harness etc. to prevent the risk of persons, materials or objects falling;

D. safety measures in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned;

E. Measures to ensures its stability like provision of diagonal/cross bracings, provision of base plate, sole plate, anchoring with wall with maximum gap of 3 meter between two anchoring point in any direction.

F. ensuring no defects in the scaffold material like bending, damaged etc.

G. prohibiting use of Re-bars instead of standard locking pins, pins shall be provided at both ends (top & bottom) of the standards while coupling/joining two standards with each other;

H. ensuring stability of partially dismantled scaffold. The same shall be permitted only after safety of the remaining portion has been ensured;

I. permitting openings in any working platform especially for allowing access only.

J. in case of high height tower scaffolds, the height of tower scaffold is not more than four times of least base dimension of such scaffold. Such scaffold shall be lashed/anchored to a building or a fixed structure before being used;

K. construction of Mobile tower scaffold with regard to stability. These

L. shall be used on plain & even surface, and have casters provided with positive locking devices;

M. prohibiting presence of worker on board scaffold, tools, material when such is being shifted from one place to other;

N. The underneath area of the erection/ dismantling shall be barricaded or guarded to prevent any unauthorized entry

O. any other risks which the assembly, dismantling or alteration of the scaffolding may entail

viii) Suspension scaffold shall be provided at each of its suspension point with secondary safety wire rope with automatic locking or similar safety device mounted on each of such rope so that secondary safety rope supports the platform in the event of failure of primary suspension wire ropes;

4.3.8 Temporary works

a) All Temporary work shall be so designed, constructed and maintained that such arrangement support the load that may get imposed on them and it is so erected that working platform, means of access, bracing, means of handling and stabilizing could easily be fixed. Approved design of temporary works by designer.

b) Work of erection, dismantling of structures or Temporary work or shoring or any other work shall be carried out by trained worker under competent supervision.

c) The completed/erected temporary work shall be inspected by the competent engineer/supervisor for its strength, stability, rigidity and safe for use before taken into use. As built checking and certification by temporary works coordinator along with tagging to be obtained. Once it is erected and certified “safe to use” no modification and alteration to be allowed without designer written approval.

d) A site specific checklist to be developed including all the above mentioned items to ensure effective compliance. Checklist to be signed by competent scaffold supervisor, construction site in charge and site ESHS expert. All inspected temporary works, staging, scaffolding etc. shall be appropriately tagged for their safe worthiness or otherwise.

4.3.9 Requirements for collective safeguards for arresting falls

a) Collective safeguard are safety net, airbag or other collective safeguard for arresting falls

b) A safeguard shall always be used if

i) A risk assessment has demonstrated that the work activity can so far as is reasonably practicable be performed safely while using it and without affecting its effectiveness;

ii) A sufficient number of available persons have received adequate training specific to the safeguard, including rescue procedures.

c) A safeguard shall be suitable and of sufficient strength to arrest safely the fall of any person who is liable to fall. To ensure this, thorough inspection of the arrangement installed shall be carried out by competent site personnel along with ESHS representative

d) A safeguard shall

i) In the case of a safeguard which is designed to be attached, be securely attached to all the required anchors, and the anchors and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of safely supporting the foreseeable loading in arresting any fall and during any subsequent rescue;

ii) in the case of an airbag, landing mat or similar safeguard, be stable; and

iii) in the case of a safeguard, which distorts in arresting a fall, afford sufficient clearance.

e) Suitable and sufficient steps shall be taken to ensure, so far as practicable, that in the event of a fall by any person the safeguard does not itself cause injury to that person.

4.3.10 Requirements for personal fall protection systems

a) A personal fall protection system shall be used only if a risk assessment has demonstrated that

i) The work can so far as is reasonably practicable be performed safely while using that system; and

ii) The use of other safer work equipment is not reasonably practicable; and

b) The user and a sufficient number of available persons have received adequate training specific to the operations envisaged, including rescue procedures.

c) A personal fall protection system shall

i) Be suitable and of sufficient strength for the purposes for which it is being used having regard to the work being carried out and any foreseeable loading;

ii) Where necessary, fit the user;

iii) Be correctly fitted;

iv) Be designed to minimize injury to the user and, where necessary, be adjusted to prevent the user falling or slipping from it, should a fall occur; and

v) be so designed, installed and used as to prevent unplanned or uncontrolled movement of the user.

d) A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of supporting any foreseeable loading.

e) Suitable and sufficient steps shall be taken to prevent any person falling or slipping by provisioning of personal fall protection system. In case due to site constraint, workers are

exposed to working near open edges, a retractable fall arrestor device shall be mandatorily used at the work location. All workers to be provided with personalized safety harnesses and trained and supervised to ensure it's anchoring with the fall arrestor system at all time during working.

4.3.11 Requirements for Ladders

a) Every contractor shall ensure that a ladder is used for work at height only if a risk assessment has demonstrated that the use of more suitable work equipment is not justified because of the low risk and

   i) The short duration of use; or

   ii) Existing features on site, which he cannot alter.

b) In no case ladder shall be permitted beyond 6m height for any work or access. Access above 6m height in the form of proper Dog Legged staircase needs to be provided.

c) Only metal/aluminum ladders with handrail shall be allowed for lesser height and on temporary basis. Bamboo/wooden/rope ladders and improvised ladder assembled from staging/scaffolding material are strictly prohibited.

d) Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it.

e) A ladder shall be so positioned as to ensure its stability during use. Base to height ratio of 1:4 to be maintained.

f) A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it cannot be displaced and swinging is prevented.

g) A portable ladder shall be prevented from slipping during use by -

   i) Securing the stiles at or near their upper or lower ends;

   ii) An effective anti-slip or other effective stability device; or

   iii) Any other arrangement of equivalent effectiveness.

h) A ladder used for access shall be long enough to protrude sufficiently above the place of landing to which it provides access, unless other measures have been taken to ensure a firm handhold.

i) No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use.

j) A mobile ladder shall not be move while workers are climbed on it.

k) Where a ladder or run of ladders raises a vertical distance of 6 meters or more above its base, there shall, where reasonably practicable, be provided at suitable intervals sufficient safe landing areas or rest platforms.

l) Every ladder shall be used in such a way that

   i) A secure handhold and secure support are always available to the user; and

   ii) The user can maintain a safe handhold when carrying a load unless, in the case of a step ladder, the maintenance of a handhold is not practicable when a load is carried, and a risk assessment has demonstrated that the use of a stepladder is justified because of the low risk; and the short duration of use.

m) Ladders rungs made of rebars or round pipes are prohibited. Handrails used in ladders shall be

of sufficient strength to withstand the side impact load.

n) Ladder which is fabricated locally shall have rungs at equal intervals as ergonomically suitable for use and comply to the relevant standards.

o) In case of working during interface all ladders shall have marked of companies to which they belong.

4.3.12 **Mobile Elevated Working Platforms (MEWP)**

4.3.12.1 The Contractor shall ensure that Mobile Elevated Working Platform (MEWPs) which includes provision of Sky Lifts/Scissor Lifts shall be used as means of access/egress wherein there is impossible to use safe & sturdy means of access/working platform in the form of stair tower/scaffold. One MEWP for each one km of active worksite and two no's of MEWP for each tandem lift operations.

4.3.12.2 Truck Mounted Mobile Elevated Working Platforms (MEWP) are prohibited to be used on undulated construction sites, but can be used on levelled surface. Rough Terrain types Mobile Elevated Working Platforms (MEWP) are to be used on undulated construction sites, but not suitable for long marching on levelled surface.

4.3.12.3 The use of Mobile Elevated Working Platforms shall only be conducted in the presence of competent supervision.

4.3.12.4 All Safety measures as advised by OEM shall be strictly followed while use of such MEWP's.

4.4 Overhead Protection

4.4.1 The Contractors shall provide overhead protections as per BOCW Act & Haryana BOCW Rules.

4.5 Slipping, Tripping, Cutting, and Falling Hazards

a) The Contractor shall follow guideline of Slipping, Tripping, Cutting and falling hazards as Per Rule 98 of HBOCWR.

b) All places like passageways, working platforms and other places of construction should be free from accumulation of dust, debris or other materials and from obstructions that may lead to slip/trip.

c) Sharp projections or any protruding nails or similar objects shall be suitably guarded or shall even be avoided to make the place safe to work and All places should be free from dust, debris or similar materials;

d) Suitable safety net shall be provided at places of material / man falling is possible in accordance with national standards.

e) When workers are exposed to hazards of falling from height, they shall be provided with adequate equipment or means like double lanyard with shock absorber, retractable type full body safety harness shall be provided where worker's movement is within defined distance. Lifeline of adequate strength for saving them from such hazards. Lifeline of steel wire rope only to be used for lifeline purposes. Such equipment's shall be in accordance with national/international standards.

f) All the floor openings shall close and secure against any movement. In addition to the covers used, it shall also be barricaded after de-shuttering.

g) Handrail, mid rail & toe board shall provide edge protection of building floor.

h) All lift shafts shall provide with a temporary gate. Which shall be locked.

i) Fabricated edge protection shall be ensured as per the requirement.

j) Reinforcement of pier/columns/walls/abutments shall be secured from the risk of tilting through provisioning of minimum four guy wires ropes/ steel bracing anchored to any concrete block/counterweight of sufficient capacity.

k) The Collapse of formwork in the construction industry has the potential for severe injury and death. The four stages of the use of formwork (erection, adjustment, concrete placement and dismantling) all need to be managed in a risk assessment framework. Implementing suitable control measures can eliminate or reduce the potential for events such as the collapse of formwork. Suitable control measures include:

i) Keeping the documentation for the formwork at the workplace;

ii) Follow the schematic drawing for erection of formwork;

iii) Erecting the formwork on foundations which will support the loads to be imposed on the formwork;

iv) Not erecting formwork near excavation;

v) Ensuring materials used in the erection of formwork are not defective;

vi) Securing loose material which may be dislodged as a result of inclement weather;

vii) Inspecting the formwork assembly before and during the placement of concrete;

viii) Not attaching equipment to the formwork assembly unless specifically designed for this purpose; and not using a stripping process which may cause damage to the permanent structure.

4.6 Lifting Appliances including Cranes

4.6.1 Lifting appliances means a crane, hoist hydra, derrick, winch, gin pole, sheer legs, jack, hoist drum, slewing machinery, slewing bearing fasteners, lifting machinery sheaves, pulley blocks, hooks or other equipment used for lifting materials, objects or the Workers and lifting gears means ropes, chain slings, shackles, hooks, lifting lugs, wire ropes, lifting eyebolts and eye nuts and other accessories of a lifting appliance.

4.6.2 Each of the lifting appliances and lifting gear including all parts thereof, whether fixed or moveable shall be thoroughly tested and examined by a competent person once at least in every 6 months or after it has undergone any alterations or repairs liable to affect its strength or stability. Within the validity, if the lifting appliances are shifted to a new site, re-examination by the competent person for ensuring its safety shall also be done.

4.6.3 The Contractors shall utilize the services of any competent person as defined in Factories Act, 1948 with the permission of the Engineer.

4.6.4 No machine shall be selected to do any lifting on a specific job until its size and characteristics are considered adequate:

a) The weights, dimensions and lift radii of the heaviest and largest loads;

b) The maximum lift height, the maximum lift radius and the weight of the loads that must be handled at each;

c) The number and frequency of lifts to be made;

d) How long the crane will be required on site;

e) The type of lifting to be done (for example, is precision placement of loads important;

f) The type of carrier required (this depends on ground conditions and machine capacity In its operating quadrants: capacity is normally greatest over the rear, less over the side, and non-existent over the front;

g) Whether loads will have to be walked or carried;

h) Whether loads will have to be suspended for lengthy periods;

i) The site conditions, including the ground where the machine will be set up, access roads and

ramps it must travel, space for erection and any obstacles that might impede access or operation.

4.6.5 The Contractor shall ensure that a valid certificate of fitness issued is available for all lifting appliances including synchronized mobile jacks, pre-stressing hydraulic jacks, jacks fitted with launching girders etc. and the Engineer approval is obtained before inducting to the site. Only after obtaining the approval from the Engineer any lifting appliances and gear shall be used.

4.6.6 The laminated photocopies of fitness certificate issued by competent person, the Engineers approval letter, the operators photo, manufactures load chart and competency certificate shall always be either kept in the operator cabin or pasted on the visible surface of the lifting appliances.

4.6.7 All lifting appliances and loose gears shall be clearly marked for its safe working load and identification by stamping or other suitable means.

4.6.8 The Contractor shall also maintain a register containing a system of identification of all tools and tackles, its date of purchase, safe working load, competent person date of examination etc.

4.6.9 Sufficient lighting arrangement shall be ensured at all lifting operations.

4.6.10 **Qualification of operator of lifting appliances etc.:** The Contractor shall not employ any person to drive or operate a lifting machine-like crane, hydra etc. whether driven by mechanical power or otherwise or to give signals to work as an operator of a rigger or derricks unless he:

a) Is above 21 years of age and possesses a valid heavy transport vehicle driving license as per Motor Vehicle Act and Rules;

b) Is competent and reliable;

c) Possesses the knowledge of the inherent risks involved in the operation of lifting appliances by undergoing a formal training at any institution of national importance acceptable to the Engineer; and

d) Is medically examined periodically as specified in schedule VII of BOCW Rules.

4.6.11 All hydraulic piping and fittings shall be maintained leak proof.

4.6.12 Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting.

4.6.13 Hand spliced slings up to 32mm diameter shall not be used at site for any lifting purpose. The slings used shall confirm to IS 2762: 2009 Wire rope slings and sling leg specification.

4.6.14 No load shall be slewed over public areas without stopping the road traffic first.

4.6.15 Automatic safe load indicator (ASLI) to be provided in crane with audible and visible warning system and made functional and calibrated by the manufacturer or its authorized representative every 6 months or after repair of the lifting equipment.

4.6.16 **Automatic safe load indicators and data logger in lifting appliances**

As stipulated in Rule 123 of HBOCW Rules, every lifting appliances and gears like cranes, hydras etc., if so constructed that the safe working load may be varied by raising or lowering of the jib or otherwise, shall be attached with an automatic indicator of safe working loads approved by Bureau of Indian standards/International certifying bodies which gives a warning to the operator whenever the load being handled exceeds the safe working limit.

a) Provision of functional data logger with alert facility through SMS and web in all cranes shall be mandatory;

b) Cut-out shall be provided which automatically arrests the movements of thelifting parts of every crane if the load exceeds the safe working limit.

4.6.17 The crane should have a substantial/durable safe working load chart which has clearly legible

characters in English and Hindi and figures displayed inside the crane and is easily visible to the crane operator.

4.6.18 General Requirements

The sweep area (work area) of the construction machinery shall be always free from obstructions. All hydraulic piping and fittings shall be maintained leak proof. The operator cab shall posses good and safe:

a) Structure, windows and windshield wipers;

b) Drivers chair and footrest;

c) Control handles;

d) Cab instrumentation;

e) Telecommunication;

f) Cab outfitting;

g) Wind indicator with an adjustable set point shall be in a position representative for the wind on the crane. The indicator shall give continuous information regarding constant speeds and gusts.

4.6.19 Mandatory Rigging requirement

a) Rigging shall be done under experienced and qualified rigger only. All Load shall be adequately and safely rigged to prevent any danger;

b) The primary requirement in rigging shall be to assess the weight of load before attempting any lift;

c) All hooks shall be fitted with Master Rings having certificate of fitness from the competent person, so that the hooks are subjected to balanced vertical loading only;

d) Only four legged slings shall be allowed which includes master link (ring), intermediate master link (ring) if necessary, chain / wire rope sling, sling hook or other terminal fitting;

e) Requirements of outriggers

   i) All outriggers shall be fully extended and at all tyres are clear of the ground;

   ii) Heavy duty blocking having large bearing area shall be necessary to prevent sinking of floats;

   iii) Provision of heavy steel plates/ high density interconnected wooden logs of required dimension shall be used to uniformly distribute the load;

   iv) The crane shall be setup on fully compacted ground;

4.6.20 Pick & carry operation

Prohibition on Use of "Tractor transmission type Pick and Carry Hydra Crane": Tractor transmission type Pick and Carry-1st Generation model is prohibited at HORC Project works. Contractor shall mobilize "Truck transmission type" Pick and Carry (Hydra)Crane– minimum 2nd Generation model only or higher model.

4.6.21 Winches

Every contractor shall ensure that:

   i) winches are not used if control levers operate with excessive friction or play.

   ii) adequate protection is provided to winch operator against abnormal weather.

   iii) control levers are secured in the neutral position and winches shall be

iv) power shut-off whenever winches are left unattended.

v) No worker is authorized to transfer, alter or adjust electric control circuits except an electrician along with winch operator.

vi) apart from mechanical brakes, winches shall also have the provision of OEM fitted Electrically operated braking system.

vii) Anchoring and stability of the winches shall be ensured and certified by P&M team.

viii) Standard counterweight as per OEM recommendation shall be used.

4.6.22 Operation of lifting appliances

Every Contractor shall ensure that:

a) The complete lifting operation shall be governed by signals as per established standards;

b) Adequate measures to be taken to ensure that no workers is allowed to stand, pass, rides or sit under the suspended load;

c) No lifting appliances shall be left by the operator while power is on or load is suspended;

d) After completion of the lifting operation, all doors of the appliances shall be closed by the operator and ignition/operation key should be handed over to competent reliever operator or site In-charge;

e) All loads are provided with minimum two tag lines to ensure that the load can be controlled at all times;

f) No close working to any live over head power line is permitted without system of a 'Permit to Work' and prior permission of the engineer shall be obtained before performing such operation;

g) Danger zone shall be identified and cordoned off for all lifting appliances during their operation;

h) All lifting gears & slings shall be stamped or appropriate tags for their identification no & SWL;

i) Knotting/wrapping of chains & slings shall not be allowed at site;

j) Lifting appliances shall not be used for any dragging or pulling purposes. Contract shall refer to 75% capacity load chart for ascertaining the suitability of crane for safe lifting of load;

k) During tandem lift, available capacity of crane in respect of SWL shall be considered after reduction of 15% for 75% (DIN) load chart respectively. In addition, additional de rating as advised by third party testing and certified agency shall also apply;

l) During hoisting of long material, use of suitable lifting beam is recommended;

m) Only original equipment manufacturer (OEM) supplied/provided load chart shall be used during lifting operation;

n) Before performing any lifting operation, all electronic devices, control levers, hydraulic oil, wind pressure etc. shall be checked and necessary spare parts to be kept in stock to handle any breakdown during time bound lifting operation;

o) Lifting point shall be considered on the I-Girders/U Girder/C Girder/Steel girder/parapet etc. during the casting of the same. Design load calculation for the same should be conducted;

p) All lifting activities shall be stopped in case of high speed wind and similar adverse whether condition or as prescribed by the crane manufacturer; and

q) All cranes shall be provided with fail safe devices to avoid any hoist free fall in case of brake failure.

4.7 Construction Machinery

4.7.1 Construction machineries may include dumpers and dump trucks, lift trucks and telescopic handlers, piling rigs, vibration hammers, rail welding equipment, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.

4.7.2 Every construction equipment shall be in sound mechanical working condition and certified by either competent person under Factories Act or manufacturers' warranty in case of brand new equipment or authorized persons/firms approved by the Engineer before induction to any site.

4.7.3 Fitness of the machine shall be carried out on regular basis or after every maintenance work excluding any minor service/oil or filter change and be documented properly. The certificate shall be available in operator/driver cabin.

4.7.4 All vehicles shall be fitted with audible reverse alarms and maintained in good working condition. Reversing shall be done only when there is adequate rear-view visibility or under the directions of a banksman.

4.7.5 Air compressor shall be fitted with a pressure relief valve and shall have the safe working pressure clearly marked upon them. Every Air Compressor/Air receiver shall be subject to examination/tested by the Competent person as per manufacturer's instructions. The test certificate shall be available at the work location.

4.7.6 The air compressor hose shall be connected with whiplash arrestor / chains at the joints of hose.

4.7.7 **General operating procedures:** Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.

a) No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturer's recommendations;

b) Working on gradients beyond any equipment's capability shall not be allowed.

c) Prevention of dumper and dump truck accidents should be managed by providing for adequate lateral clearances, wheel stops at a sufficient distance from the edgesof excavations, spoil heaps, pits, markers, etc.;

d) No construction material, other than soil shall be carried in excavator buckets;

e) When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them;

f) Every contractor shall ensure that Competency certificate for driver/operatorsshall be issued by their Plant and Machinery In-charge. The certificate shall be pasted on the machine body in such a way that drivers/operator vision is nothindered;

g) Checklist shall be prepared for all construction machinery and be filled on daily basis by the operator and be counter signed by plant & machinery person;

h) Provision of helper is mandatory for each construction appliances and vehicles during their movement inside and outside of site; and

i) All wood working machines shall be fitted with suitable guards and devices such astop guard, riving knife, push stick, guards for drive belts and chains, and emergency stop switch easily accessible by the operator.

4.8 Machine Guarding

4.8.1 The Contractor shall ensure at the site all motors, cog wheels, chains and friction gearing, fly

wheels, shafting, dangerous and moving parts of machinery are securely fenced or legged.

4.8.2 Fencing of dangerous parts of machinery shall not be removed while the machinery is in use or in motion and when removed, it shall be replaced as soon as practicable and in any case before the machinery is again brought into use.

4.9 Site Electricity

4.9.1 The Contractor shall refer to the applicable guideline "Indian Electricity Rules, 1956" and any amendment thereafter. ESHS requirements are:

a) Graduate Electrical Engineer having Electrical Supervisory Competency Certificate.

b) Diploma Electrical Engineer having Electrical Supervisory Competency Certificate;

c) ITI Certificate Holder Electrician with Wiremen Permit; and

d) Assessment of Electrical Load and properly designed power distribution system;

4.9.2 The Indian Electricity Rules 1956 and Indian Electricity Act 2003 as amended up to date shall be followed. The detailed instructions on safety procedures given in Indian Standards, Indian Electricity Rules and respective State Electricity Authorities' Regulation with up to date amendment shall be applicable.

4.9.3 **Assessment of Power**

a) The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.

b) The contractor shall elaborate as to how the total supply is to be obtained/generated. The details of the source of electricity, earthing requirement, substation/panel boards, distribution system shall be prepared and necessary approval from the Engineer obtained before proceeding of the execution of the job.

c) The main contractor shall take consideration, the requirements of the Subcontractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators. All the norms on installation and maintenance have to be adhered.

d) As small capacity generators create more noise and safety hazards, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.

e) Usage of Transformers inside the tunnel is strictly prohibited.

4.9.4 **Work on Site**

a) The contractor shall also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Engineer for necessary approval.

b) The LT/HT distribution diagrams of sub stations shall be prominently displayed. The substation premises, main switch rooms and D.B enclosure shall be kept clean whenever works are carried out either inside or outside.

c) No flammable material shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of Indian Explosives Act.

d) Protective and Safety equipment such as rubber gauntlets or gloves, earthing rods, linemen's belt, portable artificial respiration apparatus, safety goggles etc., shall be provided as per the requirements of the work.

e) Necessary number of caution boards such as "Man working on line, Don't switch on" shall be readily available in the vicinity of electrical installation.

f) Charts displaying methods of giving artificial respiration to a recipient of electrical shock

(one in English and another one in the regional language) shall be prominently displayed at appropriate places.

g) No work shall be undertaken on live installations or on installation, which could be energized unless another person is present to immediately isolate the electrical supply in case of any accident and to render first aid, if necessary.

h) No work on live L.T bus bar or pedestal switch board in the sub stations should be handled by a person below the rank of a licensed wireman and such a work should preferably be done in the presence of a qualified engineer.

i) When working on or near live installations, suitable insulated tool should be used and special care should be taken to see that those tools accidentally do not drop on live terminals causing shock or dead short.

j) The electrical switch controls in distribution boards shall be clearly marked to indicate the areas being controlled by them.

k) Before starting any work on the existing installation, it shall be ensured that the electric supply to that portion is cut off. Precautions, like displaying "Men at Work" caution boards on the controlling switches, removing fuse carrier from these switches shall be taken against accidental operation. Caution boards shall be kept with the person working on the installation.

l) All equipment/ sub systems shall conform to relevant IEC standard on Electromagnetic Compatibility (EMC)

m) The Contractor shall provide adequate stand by equipment to ensure the safety of personnel, the works and the public.

4.9.5 No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

4.9.6 **Adverse or Hazardous Environments:**

Electrical equipment which may reasonably foreseeably be exposed to-

a) Mechanical damage.

b) The effects of the weather, natural hazards, temperature or pressure;

c) The effect of wet, dirty, dusty, or corrosive conditions; or

d) Any flammable or explosive substance, including dust, vapors, or gases, shall be of such construction or a necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.

e) In all the above situations, only appropriate IP-rated electrical panels, plugs, sockets etc. shall be used.

4.9.7 **Distribution System:**

a) The contractor shall provide a distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances.

i) Fixed plant – 400 V 3 phase

ii) Movable plant fed via trailing cable over 3.75 kW – 400 3 phases.

iii) Installation in Site buildings – 230V single phase.

iv) Fixed flood lighting – 230 V single phase

v) Portable and hand tools- 115V single phase

vi) Site lighting – 115V single phage

vii) Portable hand lamps – 115V single phase

4.9.8 **Electrical Protection circuits**

a) Appropriate electrical protection shall be provided for all circuits, against overload, short circuit and earth fault current.

b) The Contractor shall provide sufficient ELCBs (maintain sensitivity 30 mA)/ Residual Current Circuit Breakers (RCCBs) for all the equipment (including Potable equipment), electrical switchboards, distribution panels etc. to prevent electrical shocks to the Workers.

c) All protection devices shall be capable of interrupting the circuit without damage to any equipment's and circuits in case of any fault may occur. No single insulation cable shall be used.

d) Rating of fuses and circuit breakers used for the protection of circuits should be coordinated with equipment power ratings.

e) Protection against lighting shall be ensured through lightening arrester for equipment's kept in open at Sites.

f) The contractor shall ensure that all generators and welding sets in use on Site are adequately and effectively always earthed during operation.

g) The contractor shall ensure that provision of rubber mat near each and electrical panel.

4.9.9 **Cables:**

a) Cables shall be selected after full consideration of the condition to which they shall be exposed and the duties for which they are required. Supply cable up to 3.3kV shall be in accordance with BS 6346:1997;

b) For supplies to mobile or transportable equipment where operating of the equipment subjects the cable to flexing, the cable shall conform to any of these codes BS 6007/BS 6500/BS 7375.

c) Flexible cords with a conductor cross section area smaller than 1.5 mm2 shall not be used and insulated flexible cable shall conform to BS 6500 and BS 7375.

d) Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables BS 6346 and BS 6708.

e) Cables buried directly in the ground shall be of a type incorporating armour or metal sheath or both. Such cables shall be marked by cable covers or suitable marking tape and be buried at a sufficient depth to avoid their being damaged by any disturbance of the ground. Cable routes shall be marked on the plans kept in the Site electrical register.

f) Cable passing under the walkway and across way for transport and mobile equipment shall be laid in ducts at a minimum depth of 0.6 meters.

g) Cables that need to cross open areas, or where span of 3m or more are involved, a catenary wire on poles or other supports shall be provide for convenient means of suspension. The minimum height shall be 6m above ground.

h) Cables carrying a voltage to earth in excess of 65V other than supply for welding process shall have metal armour or sheath, which has been effectively earthed and monitored by the contractor. In the case of flexible and trailing cables such earthed metal sheath and/or armour should be in addition to the earth core in the cable and should not be used as the protective conductor.

i) Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame-retardant compound shall be used whenever there is a risk of mechanical damage occurring.

j) Electrical cable of five cores shall be used in all three-phase equipment.

4.9.10 **Plugs, socket-outlets, and couplers:**

a) The contractor shall ensure plugs, socket-outlets, and couplers are available in the construction Site as splash proof type. The minimum degree of ingress protection should be of IP44 and IP65 (in Tunnels and in continuous exposures water areas) in accordance with BS EN 60529.

b) Only plugs and fittings of the weatherproof type shall be used, and they should be colour coded in accordance with the Internationally recognized standards for example as detailed as follows:

i) 110 volts: Yellow.

ii) 240 volts: Blue.

iii) 415 volts: Red.

4.9.11 **Connections:**

a) Every joint and connection in a system shall be mechanically and electrically suitable for use to prevent danger. Proper cable connectors as per national/international standards shall only be used to connect cables.

b) No loose connections or tapped joints shall be allowed anywhere in the Sites.

4.9.12 **Potable and hand-held equipment:**

a) The contractor shall ensure the use of double-insulated or all-insulated portable electrical hand equipment.

4.9.13 **Other equipment:**

a) All equipment shall have a provision for major switch/cut-off switch in the equipment itself.

b) All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable.

c) Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorized access.

d) Approved perimeter marking shall be used to isolate restricted areas from designated work areas and entryways and shall be erected before work begins and maintained for the entire duration of work. Approved perimeter marking shall be installed with either red barrier tape printed with the words “DANGER-HIGH VOLTAGE” or a barrier of yellow or orange synthetic rope, approximately 1 to 1.5 meter above the floor or work surface.

e) All temporary metal structures like barricade boards, temporary metal containers/shed etc. shall be adequately earthed through suitable means.

f) All earth pits shall be properly numbered along with display of resistance value and inspection records of the same shall be maintained.

4.9.14 **Work on or near live conductors**

No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless-

a) It is unreasonable in all the circumstances for it to be dead; and

b) It is reasonable in all the circumstances for him to be at work on or near it while it is live; and

c) Suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

4.9.15 Whenever pilling work is undertaken manually through tripod in the influence zone of live OHE, method statement shall be prepared, submitted, and got approved before start of work.

4.9.16 **Inspection and Maintenance**

a) All electrical equipment should be permanently numbered, and a record kept of the date of issue, date of last inspection and recommended inspection period.

b) Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.

c) All Electrical panels/DG panels/Distribution boxes etc. shall be provided with rubbers mats.

4.9.17 **General Safety Precautions while working in OHE Area**

The precautions laid down below must be followed under all circumstances in sections equipped for 25 kv as single phase, 50 Hz traction.

a) No work close to the live OHE shall be carried out without power block unless the work area is properly screened, barricaded, earthed and supervised by a competent Engineer subject to specific approval from Engineer/Employer.

b) No work shall be done above or within a distance of 2 m from the live OHE without a "permit-to-work."

c) No part of a tree shall be nearer than 4 m from the nearest live conductor. Any tree or branches likely to fall on live conductor should be cut or trimmed periodically to maintain this clearance. Cutting or trimming should be done by the OHE staff themselves or through an agency managed and supervised by them.

d) Work for trimming of trees should also be done in the presence of authorized OHE staff or supervisor to maintain the safe clearance of 4 m any dispute regarding cutting of trees may be done on contract basis or departmentally of the terms & conditions of concerning dept.

e) No fallen wire or wires shall be touched unless power is switched off and the wire or wires suitably earthed. In case the wires drop at a level crossing, the Gatekeeper shall immediately make arrangements to stop all road traffic and keep the public away.

f) As far as possible closed wagons shall be used for material trains. In case open or hopper wagons are used, loading and unloading or such wagons in electrified tracks shall be done under the supervision of an Engineering official, who shall personally ensure that no tool or any part of the body of the worker comes within the 'danger zone' i.e., within 2 m of the OHE.

g) Permanent way staff should keep clear of the tracks and avoid contact with the rails either when approaching or reaching the work-spot when an electrically hauled train is within 250m.

h) When unloading rails alongside the tracks, it should be ensured that rails do not touch each other to form a continuous metallic mass of length greater than 300m.

4.9.18 **Hand Tools and Power Tools**

i) The contractor is wholly responsible for the safe condition of tools and equipment used by his employees and that of his subcontractors.

j) Use of short/damaged hand tools shall be avoided, and the contractor shall ensure all his hand tools used at his work Site are safe to work with or stored and shall also train his employees (including his sub-contractors) for proper use thereby.

k) All hand tools and power tools shall be duly inspected before use for safe operation.

l) All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

4.9.19 **Hand tools:** Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes, screw drivers, crow bars, nail pullers.

4.9.20 The contractor shall ensure that;

a) For crosscutting of hardwood, saws with larger teeth points (no. of points per inch) shall be preferred to avoid the saw jumping out of the job.

b) Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.

c) Unless hatchet has a striking face, it shall be used as a hammer.

d) Only knives of retractable blades shall be used in the worksite.

e) No screwdrivers shall be used for scraping, chiseling of punching holes.

f) A pilot hole shall always be driven before driving a screw.

g) Wherever necessary, usage of proper PPEs shall be used by his employees.

4.9.21 **Power tools**

Power tools include drills, planes, routers, saws, jackhammers, rinders, sprayers, chipping hammers, air nozzels and drills.

4.9.22 The contractor shall ensure that

a) Electric tools are properly grounded or/and double insulated.

b) Ground fault Circuit interrupters (GFCIs)/ Residual Circuit Breakers (RCCBs) shall be used with all portable electric tools operated especially outdoors or in wet condition.

c) When operating in confined spaces or for prolonged periods, hearing protection shall be required.

d) The tool is held firmly, and the material is properly secured before turning on the tool.

e) All drills shall have suitable attachments respective of the operations and powerful for ease of operation.

f) When any work/operation needs to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same applicable to detachable tool bit also.

g) Size of the drill shall be determined by the maximum opening of the chuck in case of drill bit.

h) Attachments such as speed-reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers.

i) Stock should be clamped or otherwise secured firmly to prevent it from moving.

j) Workers shall never stand on the top of the ladder to drill holes in walls/ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended.

k) Electric planes shall not be operated with loose clothing or long scarf or open jacket.

l) Safety guards used on right angle head or vertical portable grinders must cover a minimum of 180^0 of the wheel and the spindle/wheel specifications shall be checked.

m) All power tools/hand tools shall have guards at their nip points.

n) Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid ‘kickback’.

o) Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback.

p) Push sticks shall be provided and properly used to hold the job down on the table while the

heels move the stock forward and thus prevent kickbacks.

q) Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off.

r) Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use.

s) No worker shall point any power operated/hand tool to any other person especially during loading/unloading.

4.10 Illumination

4.10.1 The Contractor shall provide sufficient site lighting, of the right type and at the right place for it to be properly effective as per the relevant national standards & guidelines.

4.11 Welding and Cutting

4.11.1 Gas cylinders in use shall be kept upright on a custom-built stand or trolley fitted with a bracket to accommodate the hoses and equipment or otherwise secured. The metal cap shall be kept in place to protect the valve when the cylinder is not connected for use.

4.11.2 Test Certificate for cylinders and Vendor license shall be obtained. Gas Cylinder Act & Rules shall always be followed at workplace.

4.11.3 All gas cylinders shall be fixed with pressure regulator and dial gauges. clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.

4.11.4 Non-return valve and flashback arrester shall be fixed at both end of cylinder and torch.

4.11.5 Domestic LPG cylinders shall not be used for gas welding and cutting purpose.

4.11.6 Dry Chemical Pressure (DCP) or CO2 type Fire Extinguisher not less than 5 kg shall be fixed at or near to welding process zone in an easily accessible location. Fire extinguisher should confirm to IS 2190:1992.

4.11.7 Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 m (20 feet) apart or separated by a fireproof, 1.5 m (5 feet) high partition. Flammable substances shall not be stored within 15m of cylinder storage areas.

4.11.8 Welding grounds and returns should be securely attached to the work by cable lugs, by clamps in the case of stranded conductors, or by bolts for strip conductors. The ground cable will not be attached to equipment or existing installations or apparatus.

4.11.9 All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.

4.11.10 Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).

4.11.11 Transformer used for electrical arc welding shall be fixed with ammeter and voltmeter and fixed with separate main power switch.

4.11.12 Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.

4.11.13 The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

4.12 Excavation General

4.12.1 References:

a) The Haryana Building and other construction workers (Regulation of Employment of conditions of Service) Rules, 2005;

b) IS: 3764 -1992 (Re-affirmed 1996): Code of Safety for Excavation Work;

c) IS: 4756 -1978 (Reaffirmed 1996): Safety Code for Tunnelling Work;

d) IS 4081:2013 Blasting and related drilling operations-code of safety.

4.12.2 The Contractor shall ensure:

a) Where any construction & building worker engaged in excavation is exposed to hazard of falling or sliding material or article from any bank or side of such excavation which is more than 1.5 m above his footing, such worker shall be protected by adequate piling and bracing against such bank or side;

b) Undercutting during excavation shall be avoided. Whenever it is inescapable and banks of an excavation are undercut, adequate shoring is provided to support the material or article overhanging such bank;

c) Excavated material is not stored at least 0.65 m from the edge of an open excavation or trench and banks of such excavation or trench are stripped of loose rocks and the banks of such excavation or trench are stripped of loose rocks and other materials which may slide, roll or fall upon a construction building worker working below such bank;

d) Hard barricading shall be provided to prevent a person or livestock from falling into the excavated area and shall always be maintained in place;

e) Hard barricading ,Full height fence, barriers etc. will be installed at the site in order to preserve the surrounding area from excavated soil, rubbish etc. which may cause inconvenience to public.

f) Metal ladders and staircases or ramps are provided, as the case may be, for safe access to and egress from excavation where, the depth of such excavation exceeds 1.5 m and such ladders, staircases or ramps comply with the IS 3696 Part 1&2 and other relevant national standards;

g) Trench and excavation is protected "against falling on a person by suitable measures if the depth of such trench or excavation exceeds 1.5m and such protection is an improved protection in accordance with the design and drawing ofa professional engineer, where such depth exceeds 4.0m;

h) For preventing vehicles from falling in the excavated portion, the vehicle shall not be permitted to be driven near the lip of the excavation. Adequate and well anchored stop blocks shall be provided on the edge of excavated area to prevent vehicles from operating near the edge of excavated surface.

4.12.3 Warning Signs and Notices:

The Contractor shall ensure that suitable warning signs or notices, required for the safety of workers carrying out the work of an excavation, shall be displayed or erected at conspicuous places in Hindi and in a language understood by most of such workers at such excavation work.

4.13 Material Transportation

4.13.1 The Contractor shall develop the method statement for heavy/big material/machinery transportation such as Rolling Stock, Transformer, and Bridge Main Girder, etc.

4.13.2 The Contractor shall ensure that the person in charge should inspects the safety implementation like properly fixing of wire with vehicle slab bed, condition of vehicle breaks etc. before starting the job.

4.13.3 The Contractor shall ensure that every vehicle/moving machinery should have a signal man who has a whistle, a flag or a signal light (in the night) with striking clothes and stands at a safe visible place from a machine operator by means of the proper signal and way determined.

4.13.4 Training related to moving and parking safely should be given to driver/operator like parking construction vehicles at a specified place with a parking brake and making sure to put a drag.

4.14 Foundation Works

The Contractor is required to evaluate the risk in each activity and suggest a control measures of piling works:

a) Covering of bore holes with adequate warning signs;

b) Cage to be lowered by using crane;

c) The auxiliary hook of the rig shall not be used to pull or lower the cage in bore hole;

d) The tremie pipe lowering and lifting after concreting shall be done by using crane;

e) Control measure to arrest polymer spillage from the Site to avoid contaminating the surface drains;

f) An entry restraining fence shall be provided around the pier excavation completion;

g) No man suffering from any chronic disease, alcoholic excess, ear or heart troubles or having a sluggish blood circulation or who has excess of fat should be employed as a diver;

4.15 Batching Plant and Casting Yard (if Stablished)

The Contractor is required to evaluate the risk in each activity and suggest Control Measures:

a) Adequate space between the casting bed, segment storage area and the adjoining road shall be maintained so that a steel railing could be installed to segregate the gantry crane movement area from the road;

b) All safety precautions stated in Sub-Clause 4.8 [Construction Machinery], Automatic Safe Load Indicator (ASLI) for crane and gantry shall be complied during erection of gantry crane and other equipment;

c) The aggregate/sand storage area shall be kept under the full coverage of effective water sprinkler to avoid dust generation;

d) The entire batching plant/aggregate storage Area shall be adequately walled of sufficient height, above which the Contractor is required to erect green dust protective net. This is a mandatory requirement to avoid dust in surrounding environment;

e) The batching plant and casting yard required to obtain ‘’Consent to Establish’’ and ‘’Consent to Operate’’ certificate from State Pollution Control Board;

f) LOTO (Lock Out Tag Out) system shall be installed.

g) The batching plant/casting yard shall be barricaded and made as a compulsory Personal Protective Equipment (PPE) zone;

h) Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation;

i) Drainage shall be effectively provided, and waste water shall be disposed after proper treatment; and

j) Manual handling of cement shall be avoided. Whenever it is necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.

4.16 Form Works

a) Ensure the inspection of formwork assembly before and during the placement of concrete; and

b) Ensure no attaching equipment to the formwork assembly unless specifically designed for this purpose; and not using a stripping process which may cause damage to the permanent structure.

4.17 Concrete Works

a) Concrete pumping equipment, trucks etc. are not to be washed down on site and any waste-water, concrete slurry or other contaminants are to be contained, ball catcher should be used during washing of the concrete; and

b) These contaminants are not to be discharged into or onto roadways, footpaths, gutters, drainage systems, watercourses or any other surface area that will result in damage to the environment or contravenes environmental legislation.

4.18 Pier Casting Works

a) Using crane to hold the pier reinforcement during the time gap between de-staging and placement of shutter; and

b) Location and pier height specific securing arrangement and specific Method Statement for pier more than 9.0 m shall be submitted and approved by the Engineer.

4.19 Building and Roof Erection Works

4.19.1 The Contractor shall prepare plan, erection sequence and work procedures properly under competent and experienced personnel to ensure the safety of workers and prevent structure failure during erection:

a) Contractor shall develop and confirm with the Engineer his method statement with details;

b) The stability of structural members is to be ensured by means of ties, braces, anchor/fixing bolts, or other suitable means before releasing lifting gear, slings, chains etc;

c) Tag lines must be attached to the ends of components/loads to maintain control during crane lifting operations;

d) Structure stability is to be ensured always. Unattended and incomplete buildings/structures are NOT to be left in an unsafe and hazardous condition, to pose a risk to the safety and health of site personnel or the public;

e) The Workers placing and securing roof battens are to be protected and are to work from an enclosed environment (e.g. scaffolding, deck guardrail or equivalent) and work up from the bottom of the truss/rafter towards and finish at the ridge /peak of the roof framing; and

f) When the spacing of trusses and roof battens exceed 600mm the appropriate procedures are to be considered and applied after conducting a risk assessment to provide the optimum fall protection.

4.20 Fire Protection

4.20.1 The contractor shall ensure that the construction site is provided with—

a) Fire extinguishing equipment sufficient to extinguish any probable fire at such construction site;

b) An adequate water supply at ample pressure as per national standards;

c) Number of trained persons required to operate the fire extinguishing equipment provided; and

d) Is properly maintained and inspected at regular intervals of not less than once in a year by the responsible person and a record of such inspections is maintained.

4.20.2 The extinguishers shall be chosen as per type of fire load and surrounding location.

4.20.3 All construction machinery including crane shall carry a portable fire extinguisher in operator's cabin.

4.20.4 The Contractor shall prepare an emergency plan and Fire Evacuation plan and same shall be a part

of Site ESHS Management Plan. Mock drills should be held on a quarterly basis to ensure the effectiveness of the arrangements and as a part of the programme, the telephone number of the local fire brigade should be prominently displayed near each telephone on site.

4.20.5 Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards.

4.20.6 All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and firefighting equipment.

4.21 Demolition

4.21.1 All demolition works shall be carried out in a controlled manner under the management of experienced and competent supervision.

4.21.2 The concerned department of the Government or local authority should be informed, and permission obtained wherever required.

4.21.3 All glass or similar materials or articles in exterior openings should be removed before commencing any demolition work and all water, steam, electric; gas and other similar supply lines must be disconnected.

4.21.4 No demolition work should be performed if the adjacent structure seems to be unsafe unless and until remedial measures life sheet piling, shoring, bracing or similar means to be ensured for safety and stability for adjacent structure from collapsing.

4.21.5 Debris/bricks and other materials or articles should be removed by means of chute, bucket or other safe method.

4.21.6 No person other than the Workers or other persons essential to the operation of demolition work shall be permitted to enter a zone of demolition and the area be provided with substantial barricades.

4.22 Permit to Work

4.22.1 The Contractor shall develop work permit system, which is formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken.

4.22.2 Work Permits form an essential part of safe systems of work for many construction activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

4.22.3 A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work.

4.22.4 Examples of high-risk activities include but are not limited to:

a) Entry into confined spaces;

b) Hot work;

c) To dig where underground services may be located;

d) Work with heavy moving machinery;

e) Heavy lifting operations and lifting operations closer to live electric power line;

f) Work with using track motor vehicles etc.; and

g) Work under electric facility and overhead electric (OHE) line energized.

4.22.5 The Contractor shall prepare operation manuals above mention and implement training course at any time based on such manuals to the Workers given completion of certificates before the commencement of works.

4.22.6 The permit-to-work system should be fully documented, laying down:

a) How the system works;

b) The jobs it is to be used for;

c) The responsibilities and training of those involved; and

d) How to check its operation.

4.22.7 A work permit authorization form shall be completed with the maximum duration period not exceeding 12 hours or end of shift, which is earlier.

4.22.8 A copy of each permit to work shall be displayed at work place. during its validity, in a conspicuous location in close proximity to the actual works location to which it applies.

4.23 Traffic Management and Site Barricading

4.23.1 The basic objective of the following guiding principles is to lay down procedures to be adopted by the Contractor to ensure the safe and efficient movement of traffic and also to ensure the safety of workmen in the all work areas.

4.23.2 The guiding principles to be adopted for safety in construction zone are to:

a) Warn the road user clearly and sufficiently in advance;

b) Provide safe and clearly marked lanes for guiding road users;

c) Provide adequate traffic marshals to regulate the movement of traffic;

d) Provide safe and clearly marked buffer and work zones; and

e) Provide adequate measures that control driver behaviour through construction zones.

4.23.3 In all cases, the Contractor shall take proper precautions. Wherever operations undertaken are likely to interfere with public traffic, Specific Traffic Management Plans shall be drawn up and implemented by the Contractor in consultation with the approval of Local Police Authorities and/or the concerned politburo/Civil Authorities and followed to the IRC: SP;55- 2014 (Guidelines on Traffic Management in work zones) & IRC: 67 (Code of Practice for Road Signs).

4.23.4 Full height fence, barriers, barricades etc. shall be erected around the site in order to prevent the working area from the risk of accidents due to speedy vehicular movement. Same the way barricades protect the road users from danger due to construction equipment and other temporary structures.

4.23.5 All barricades shall be conspicuously seen in the dark/nighttime by the road users so that no vehicle hits the barricade. Conspicuity shall be ensured by affixing retro reflective stripes of required size and shape at appropriate angles at the bottom and middle portion of the barricade at a minimum gap of 1000mm. In addition minimum one red light blinker or rope light should be placed at the top of each barricade.

4.24 Working near Railway

4.24.1 The details of Safe work procedure for work near Railway Track are given in Clause 8.0, Attachment -5 of this document.

4.25 Other Works to be Scrutinized

4.25.1 Other works including, but not be limited to, the works in the Site (the ROW), the works in the Borrow Pit, the works in the Quarry and Works on road shall be included to be scrutinized with respect to the accident prevention.

4.25.2 If blasting is anticipated in excavation in rock, preventive measures against accidents and protective measures against environmental/social impacts shall be of paramount importance.

4.25.3 The Contractor shall include all those items as well as work elements to formulate the preventive

and protective measures considering envisaged conditions, situations, and activities of the works which may induce accidents or hazard to environment and/or society.

4.26 Personal Protective Equipment

4.26.1 The Contractor shall provide required PPEs to workmen to protect against safety and/or health hazards and ensured all workers wear mandatory PPEs during working. Primarily PPEs are required for the following protection:

a) Head protection (Safety helmet with a chin strap);

b) Foot protection (Safety footwear, Gumboot, etc.);

c) Body protection (High visibility clothing (Waistcoat/Jacket), Apron, etc.);

d) Personal fall protection (Full body harness, Rope-grip fall arrester, etc.);

e) Eye protection (Goggles, Welders Glasses, etc.);

f) Hand protection (Gloves, Finger coat, etc.);

g) Respiratory protection. (Nose mask, Self-contained breathing apparatus, etc.); and

h) Hearing protection (Ear plugs, Ear muffs, etc.).

4.26.2 The PPEs and safety appliances provided by the Contractor shall be of the standard as prescribed by Bureau of Indian Standards (BIS). If materials conforming to BIS standards are not available,.

4.26.3 The Contractor shall provide the PPEs which the Contractor deems necessary including; but not be limited to, safety helmets, safety shoes and Hi-Viz to all the Contractor's Employees including workmen (including those of its sub-contractors). High visibility clothing as per the following requirement.

a) Hi-visibility jacket covering upper body and meeting the following requirements as per BS EN 471:1994;

b) Background in fluorescent orange-red in colour;

c) Jackets with full-length sleeves with two bands of retro reflective material, which shall be placed at the same height on the garment as those of the torso. The upper band shall encircle the upper part of the sleeves between the elbow and the shoulder; the bottom of the lower band shall not be less than 5cm from the bottom of the sleeve;

d) Two vertical green strips of 5cm wide on front side, covering the torso at least 500 cm2;

e) Two diagonal strips of 5 cm wide on back in an 'X' pattern covering at least 570cm2;

f) Horizontal strips not less than 5cm wide running around the bottom of the vertical strip in front and 'X' pattern at back;

g) The bottom strip shall be at a distance of 5cm from the bottom of the vest; and

h) Strips shall be retro reflective and fluorescent.

Safety Helmet Colour Code (Every Helmet should have the LOGO*affixed/painted)	**Person to use**
Hard hat with company Logo (Employees)	Hard hat with reflective tape (Marshals)
White	Employer/Engineer
Grey	All designers, Architect, Consultants, etc.
Violet	Main Contractors (Engineers/Supervisors)

Blue	All subcontractors (Engineers/Supervisors)
Red	Electricians (Both Contractor and Subcontractor)
Green	Safety professionals (Both Contractor and Subcontractor)
Orange	Security guards/Traffic marshals
Yellow	All workmen
White (with "VISITOR" sticker)	Visitors
Safety Shoes (Anyone at the Site including Marshals)	
All employees of the contractor including workmen	Traffic marshals

Note: LOGO·

a) Logo shall have its outer dimension 2"X2" and shall be conspicuous
ii) Logo shall be either painted or affixed
iii) No words shall come either on Top / Bottom of Logo

Logo of the corresponding main contracting company for their employees and sub-contracting company for their employees shall only be used.

4.26.4 In addition to the above any other PPEs required for any specific jobs like, welding and cutting, working at height, tunnelling etc. shall also be provided to all workmen and also ensure that all workmen use the PPEs properly while on the job.

4.26.5 The Contactor shall not pay any cash amount in lieu of PPEs to the workers/sub- contractors and expect them to buy and use during work.

4.26.6 The Contactor shall at all-time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Engineer during the inspections.

4.26.7 It is always the duty of the Contactor to provide the required PPEs for all visitors. Towards this required quantity of PPEs shall be kept always at the security post.

4.27 Visitor at Site

4.27.1 No visitor can enter the Site without permission. All authorized visitors should report at the Site office. The Contractor shall provide visitor's helmet (White helmet with visitor sticker) and other PPEs like Safety Shoe, reflective jacket, respiratory protection etc. as per requirement of the Site.

4.27.2 The Contractor shall be fully responsible for safety and health of all visitors within the Site.

4.28 Site Security

4.28.1 The Contractor shall be wholly responsible for security on the Site and any other areas being used by him or the Subcontractor's for the purposes of the Contract.

4.28.2 The Contractor shall assign on the Site a security officer (adequately trained person,) and his alternate(s), who shall be primarily responsible for the Contractor's security services and fully cooperate with the Engineer's security organization throughout the Time for Completion.

4.28.3 Where necessary, the Contractor shall install, modify, maintain the temporary security fences, gates, posts, security lightings and other facilities required for proper security control, in addition to those to be constructed as part of the Works. The Contractor shall operate these facilities to properly control ingress to and egress from the areas under his control throughout the Time for Completion. This control shall apply to every person including the Employer's Personnel.

5.0 OCCUPATIONAL HEALTH AND WELFARE

5.1 Physical Fitness of Workmen

5.1.1 The Contractor shall ensure that his employees/workers subject themselves to such medical examination as required under the law or under the contract provision and keep a record of the same.

5.1.2 The Contractor shall not permit any employee/workers to enter the work area under the influence of alcohol or any drugs.

5.1.3 The Contractor shall maintain the confidential records of medical examination, or the physician authorized by the Engineer.

5.1.4 No worker is charged for the medical examination and the cost of such examination is borne by the Contactor employing such worker.

5.2 Medical Facilities

5.2.1 Occupational Health Centre (First Aid Station)

The Contractor shall ensure at the construction Site an occupational health center, mobile or static is provided and maintained in good order. Services and facilities as per the scale lay down in Schedule IV of HBOCWR. A construction medical officer appointed in an occupational health center, possess the qualification as laid down in Schedule V Rule no 113 of HBOCWR:

5.2.2 The Contractor shall appoint appropriate full-time staff including one nurse, one dresser- cum-compounder, one sweeper-cum-ward boy with each construction medical officer.

5.2.3 The Contractor shall communicate the complete details including name, qualification and experience of the construction medical officer, to the inspector having jurisdiction under HBOCWR.

5.2.4 Ambulance Room, Ambulance Van and Stretchers:

The Contractor shall ensure at a construction site of a building or other construction work that an ambulance van and room are provided at such construction Site, or an arrangement is made with a nearby hospital for providing such ambulance van for transportation of serious cases of accident or sickness of workers to hospital promptly and such ambulance van and room are maintained in good repair and is equipped with standard facilities specified in Schedule VI of Rule 114 & Schedule VII of Rule 115 of HBOCWR.

5.2.5 The Contractor shall provide enough stretchers at each site for use in an emergency.

5.2.6 First Aid Boxes and Emergency Care:

The Contractor shall ensure at construction site one First-aid box for 100 workers for providing first-aid to the workers. Every First-Aid box is distinctly marked “First-Aid” and is equipped with the articles specified in Schedule IX of Rule 119 of HBOCWR. Adequate no. of trained first aid persons shall be available at each work site in each shift.

5.2.7 HIV/AIDS Prevention and Control:

a) The Contractor shall adopt the Employer’s “Workplace Policy on HIV/AIDS Prevention and Control for Workers Engaged by Contractors” and implement it. A copy of the policy is given in Clause 8.0, Attachment-2 [Workplace Policy on HIV/AIDS Prevention & Control];

b) The Contractor shall prepare and submit the plan for HIV/AIDS Prevention and Control for his workers in terms of the aforesaid Employer’s Policy within 56 days of the date of notification of the Contract.

c) The Contractor shall organize awareness program for labourers on the risks of AIDS and STDs in coordination with Haryana State AIDS Control society.

5.2.8 COVID -19 Prevention and Control

The Contractor shall ensure that the latest guidelines issued by Ministry of Health and Family Welfare (MoHFW), local government and the district administration are strictly followed at the construction works site. The Workplace Policy on COVID-19 Prevention and Control is given in Clause 8.0, Attachment-3 [Workplace Policy on COVID-19 Response]. The Contractor shall undertake a COVID-19 risk assessment of project area and prepare and submit COVID-19 Response and Management Plan.

5.2.9 Prevention of Mosquito Breeding

Measures shall be taken to prevent mosquito breeding on the Site. The measures to be taken shall include:

a) Empty cans, oil drums, packing and other receptacles, which may retain water, shall be deposited at a central collection point and shall be removed from the site regularly;

b) Stagnant water shall be treated at least once every week with oil to prevent mosquito breeding;

c) The Contractor's equipment and other items on the site, which may retain water, shall be stored, covered, or treated in such a manner that water could not be retained; and

d) Water storage tanks shall be provided.

5.2.10 Posters in local language, Hindi and English, which draw attention to the dangers of permitting mosquito breeding, shall be displayed prominently on the Site.

5.2.11 The Contactor at periodic interval shall arrange to prevent mosquito breeding by fumigation/spraying of insecticides, and the ideal larvicide etc.

5.2.12 Alcohol, Smoking and Drugs

a) The Contactor shall always ensure that no employee is working under the influence of alcohol/drugs which are punishable under BOCWR;

b) Smoking at public places by any employee is also prohibited as per Government Regulations. The Contractor shall comply with the legal provisions in this regard, such as; Prohibition of Smoking in Public Places Rules, 2008. He shall be solely responsible for any penalty or punitive action by the government authorities because violations of the provisions contained in these rules by him or his representatives or his employees or his Subcontractors. Requisite notice boards, posters, etc., shall be put by him, as per the Rules.

5.3 Welfare Measures for Workers

5.3.1 Latrine and Urinal Accommodation:

a) Latrine and urinals shall be provided as per Chapter VI, Part – II of Rule 80 of Haryana BOCWR and shall also comply with the requirements of public health authorities; and

b) When women are employed, separate latrine and urinals accommodation shall be provided.

5.3.2 Moving Sites:

a) In case of works like track laying, the zone of work is constantly moving. In such cases, mobile toilets with proper facility to drain the sludge shall be provided at reasonably accessible distance; and

5.3.3 **Canteen**

In every workplace wherein not less than 250 workers are employed, the Contractor shall provide an adequate canteen conforming to Chapter VI, Part – II of Rule 81 of Haryana BOCWR

5.3.4 **Drinking Water.**

As per Section 32 of BOCWA, the Contractor shall make in every site, effective arrangements to provide sufficient supply of wholesome drinking water. Quality of the drinking water shall conform to the requirements of national standards on Public Health Laws. While locating these drinking

water facilities due care shall be taken so that these are easily accessible from the place of work for all workers at all location of the Site. All such points shall be legible marked "Drinking Water" in a language understood by most of the workmen employed.

5.3.5 **Crèche**

In every workplace where in more than 50 female workers are ordinarily employed, there shall be provided and maintained a suitable room for use of children under age of 6 years, conforming to the provisions of Section 35 of BOCWA.

5.3.6 Labour Accommodation Camps

The Contractor shall prepare Labour camp management plan as part of site ESHS plan. Where workers are based some distance from their normal place of residence, the Contractor shall provide them with suitable and safe accommodation free of charge and shall take all necessary precautions to protect their health and welfare. The accommodation shall conform to the requirements of Section 34 of BOCWA and include but not be limited to the further measures specified hereunder.

5.3.7 All accommodation camps shall be provided always with a sufficient supply of clean drinking water (of potable quality according to national legal standards), in suitable and easily accessible locations:

5.3.8 The quality of drinking water shall be tested once a fortnight as prescribed in IS 10500:2012and immediate remedial action shall be taken if quality falls below the standard. Test results shall be provided to the Engineer at least monthly.

5.3.9 The Contractor shall provide all accommodation camps with clean and properly equipped and staffed kitchen and canteen facilities to supply meals for workers.

5.3.10 The Contractor shall provide sufficient toilet and bathroom facilities for the numbers of workers accommodated in each camp. Separate accommodation and toilet/bathroom facilities shall be provided for men and women and all facilities shall be kept in full working order always and cleaned and re-equipped daily.

5.3.11 The Contractor shall provide a laundry facility at the Labour Accommodation Camps.

6.0 ENVIRONMENT AND SOCIAL MANAGEMENT

6.1 General Conduct of the Works

6.1.1 The purpose and objective of these guidelines is to outline how the project will avoid, minimise or mitigate effects on the environment and surrounding area. These guidelines detail the implementation of measures in accordance with environmental and social commitments of HRIDC. These guidelines will be 'live' guidelines that will be reviewed and updated at regular intervals throughout the project life cycle. These guidelines will ensure that the development is compliant with current Environmental and Social legislations and will guide and assist the Contractor in exploring all reasonable and feasible means for reducing construction related Environmental and Social impacts.

6.1.2 The Contractor shall comply with the Environment and Social Management Plan (ESMP) given in the Environmental and Social Impact Assessment (ESIA) report available on HRIDC portal for information disclosure and will note and implement any requirements therein, in addition to those found in this specification.

6.1.3 The Contractor is required to build good public relations before the commencement of the Works particularly with the local level representatives such as the Gram Panchayat, by informing the expected impacts by the Works and their schedule and dispute resolution mechanism known as GRM set by the Employer.

6.2 Environmental Legislation

6.2.1 The Contractor shall always comply with all relevant National and State legislations regarding environmental protection, pollution prevention and control, waste management and other relevant environmental matters, including but not necessarily limited to, the following with their latest amendments:

a) The Environment (Protection) Act, 1986 and Rules 1986

b) The Indian Wildlife (Protection) Act, 1972;

c) The Forest (Conservation) Act, 1980 &Rules;

d) Punjab Land Preservation Act, 1900;

e) The Noise Pollution (Regulation and Control) Rules, 2000;

f) Notification on Control of Noise from Diesel Generator (DG) sets, 2002;

g) The Air (Prevention and Control of Pollution) Act, 1981and Rules 1981;

h) The Water (Prevention and Control of Pollution) Act, 1974 and Rules 1974;

i) Guidelines to control and regulate ground water extraction in India, 24th September2020, Central Ground Water Authority;

j) The Solid Management Rules, 2016;

k) The Construction and Demolition Waste Management Rules, 2016;

l) The Hazardous and Other Wastes (Management and Transboundary Movement)Rules, 2016;

m) The Bio-medical Waste Management Rules, 2016;

n) Plastic Waste Management Rules, 2016;

o) E-Waste (Management) Rules 2016;

p) The Batteries (Management and Handling) Rules, 2001;

q) Manufacture, Storage, and Import of Hazardous Chemical (Amendment) Rules,1989;

r) Ancient Monuments and Archaeological Sites and Remains (Amendment andValidation) Act 2010;

s) Fly ash utilization notification, Sept 1999;

t) Applicable NGT Guidelines issued time to time; and

u) Provisions of Graded Response Action Plan notified by the MoEF&CC.

6.2.2 The Contractor shall comply the Environmental and Social Framework (ESF) of Asian Infrastructure Investment Bank (AIIB) February 2016.

6.2.3 If the requirements stated in this document are in conflict or inconsistent with the requirements of applicable laws, the more stringent requirements shall apply.

6.2.4 It is also the Contractor's responsibility to obtain all environmental clearances, official approvals, consents, or other authorizations as may be necessary to comply with the relevant statutes, and to pay all related fees and other costs. The Contractor shall obtain all authorizations in a timely manner and submit to the Engineer as the evidence for the regulatory obligations before commencement of any related construction activity. The indicative clearances/permission/permit are presented in Table below and Contractor is required to take any other clearance as required for its construction activities.

Clearance/ Permission/Permit	**Relevant Acts/Rules**	**Concerned Agency**
Consent to Establish and Consent to Operate of Ready mix Concrete batching plant if established	• The Water (Prevention and Control of Pollution) Act, 1974, and its amendments; • The Air (Prevention and Control of Pollution) Act 1981 and its amendments	Haryana Pollution Control Board
Authorization for generation, handling, storage, and transportation of hazardous waste	Hazardous and other Wastes (Management & Transboundary Movement) Rules, 2016	Haryana Pollution Control Board
Permission for extraction of ground water if bore well is established	Central Ground Water Authority guidelines to regulate and control ground water extraction in India, 24th September, 2020	Haryana Water Resources (Conservation, Regulation and Management) Authority
Pollution Under Control Certificate	Central Motor and Vehicle Act 1998 Vehicular Exhaust Norms, CPCB 2007	Department of Transport, Government of Haryana
Construction and Demolition Waste Management Plan	Construction & Demolition Waste Management Rules, 2016	Local Authority (Municipal Corporation)

6.3 Environmentally Friendly Construction Practices

6.3.1 Containment of Air Pollution

a) All construction equipment's should be cleaned of visible dirt/mud before exiting the construction sites and streets shall be promptly cleaned by manual sweeping, or by deploying electro – mechanical devices if such material has been dropped;

b) The Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from work sites such as construction depots and batching plants. This facility will be provided with efficient drainage, water re-circulation apparatus and silt traps to prevent any excessive buildup of water. Where wheel-washing facility is not possible, the Contractor shall ensure manual cleaning of wheels by wire brushes or similar suitable means;

c) The Contractor shall ensure that vehicles carrying dust generating material shall be covered with tarpaulin, shall have properly fitted side and tailboards and dust potential material shall not be loaded to a level higher than the side and tail boards;

d) Materials should not be dropped from more than 1.5 m to limit fugitive dust generation;

e) Necessary water sprinkling to be carried out for dust control. For water sprinkling, emphasis should be given on use STP treated water or RO reject water;

f) Stockpiles of sand and aggregate greater than 20m3 for use in concrete manufacture shall be enclosed on three sides, with walls extending above the stockpile and two (2) meters beyond the front of the stockpile;

g) Areas within the Site such as construction depots and batching plants, where there is a regular movement of vehicles shall have an approved hard surface that is kept clear of loose surface material;

h) Unless the Engineer has given notice otherwise, the Contractor shall restrict all motorised vehicles on the Site to a maximum speed of 15 kilometers per hour and confine haulage and delivery vehicles to the designated roadways inside the site;

i) The Contractor shall erect hoardings as specified in Engineer requirements securely around all construction work sites during the main construction activity, to contain dust within the site area and also to reduce air turbulence caused by passing traffic. The hoarding shall be safely secured to the ground to prevent from toppling with minimum gap between the base of hoarding and ground surface.

j) Water spray should be used to control dust during breaking of rock/concrete;

k) The contractor shall take all necessary actions to control air pollution as per guidelines issued by the Commission for Air Quality Management (CAQM) in National Capital Region time to time;

l) The contractor shall take necessary actions as per the provisions of Graded Response Action Plan (GRAP) issued from time to time.

6.3.2 Containment of Water Pollution and Efficient Use of Water

a) List of sources (surface/ground) to be provided for approval from Engineer;

b) A water meter shall be installed to quantify the consumption of water;

c) Prior to use of source, written permission to be obtained from authority to use the water in construction activity, and submit a copy to Engineer;

d) During construction only permitted quantity (permission taken) from approved sources to be used in construction activity;

e) A Drainage system should be constructed during the commencement of the works, drain off all surface water at the site into suitable drains;

f) At construction depots and batching plants temporary drainage works should be maintained, removed, and reinstated as necessary and all other necessary precautions should be taken for avoidance of damage by flooding and silt;

g) The Contractor shall provide a hard surface with suitable drainage system for Transit Mixture washing at Casting Yard and/or Batching plant. The slurry water from Transit Mixture washing area shall go to sedimentation tank of suitable capacity to treat the slurry water. The contractor shall ensure the facility remains functional till the end of the contract;

h) The Contractor shall take measures to prevent discharge of oil on land and in water bodies. Oil separator/interceptors shall be provided at Batching Plant and Construction Depot location for vehicle maintenance to prevent the release of oils and grease into the drainage system. These shall be cleaned on a regular basis;

i) Rainwater pumped out from trenches or foundation excavation should be discharged into storm water drains after obtaining notice of no objection from the Agency controlling the system;

j) The Contractor shall always ensure that all existing wells, stream courses and drains within, and adjacent to the site are kept safe and free from any debris and any excavated materials arising from the Works;

k) The Contractor shall discharge wastewater arising from site offices, canteens or toilet facilities constructed by him into sewers after obtaining prior notice of no objection of agency controlling the system;

l) The Contractor shall ensure that earth, bentonite, chemicals and concrete agitator washings etc. are not deposited/drained in the watercourses but are suitably treated and effluents and residue disposed off in a manner approved by local Regulatory Authorities;

m) Construction works should be programmed to minimize soil excavation works in rainy season. If carried out during rains, temporarily exposed slope surfaces should be covered by tarpaulin, and temporary access roads should be protected by crushed stone or gravel, as excavation proceeds.

n) Wastewater from Concrete Batching & Precast Concrete Casting and that generated from the washing down of mixer trucks and drum mixers and similar equipment should wherever practicable be recycled. The discharge of wastewater should be kept to a minimum;

o) The road between the vehicle washing bay and the public road should be paved to reduce vehicle tracking of soil and to prevent site run-off from entering public road drains;

6.3.3 **Containment of Noise and Vibration**

a) Contractor shall minimize the use of impact devices, such as jackhammers, and pavement breakers and instead use concrete crushers or pavement saws;

b) Equip noise producing equipment such as jackhammers and pavement breakers with acoustically attenuating shields or shrouds recommended by the manufacturers thereof, to meet relevant noise limitations;

c) Use hydraulic tools instead of pneumatic impact tools and electric instead of diesel-powered equipment. If pneumatic impact tools and equipment are used, they shall have intake and exhaust mufflers recommended by the manufacturers thereof, to meet relevant noise limitations;

d) Provide mufflers or shield panelling for other equipment, including internal combustion engines, recommended by manufacturers thereof;

e) Employ prefabricated structures instead of assembling on-site;

f) Provide enclosures for stationary equipment and barriers around noisy areas;

g) Locate and operate stationary equipment in such a way, so as to minimize noise and vibration impact on community, sensitive locations and nearby buildings.

h) Schedule truck loading, unloading, and hauling operations in such a way so as to minimize noise impact near noise sensitive locations and surrounding communities;

i) Plan noisier operations during times of highest ambient noise level, keep noise levels relatively uniform and avoid excessive and impulse noises;

j) Use only well-maintained, regular serviced plant/equipment, and not to be kept idling when not in use;

k) Maintain equipment such that parts of vehicles and loads are secure against vibrations and rattling;

l) Grading of surface irregularities on construction sites to prevent the generation of impact noise and ground vibrations by passing vehicles;

m) If back-up alarms are used on construction equipment, their noise emission level near noise sensitive receptors such as residences, schools, hospitals and similar areas where calmness is essential, should be regulated, especially at night time;

n) Avoid operating truck on streets that pass by schools during school hours;

o) Efforts to be made to bring down the noise levels due to the DG set, outside the premises, within the ambient noise requirements by proper setting and control measures;

p) The Contractor shall ensure that all necessary permissions/ approvals/consent is obtained from relevant authorities before installation and operation of Generator set;

q) A proper routine and preventive maintenance procedure for the DG set should be set and followed in consultation with the DG set manufacture;

r) At all times noise levels of DG sets shall comply the standards set out by CPCB/SPCB;

6.3.4 **Containment of Waste**

a) Construction activities are expected to generate a variety of waste such as:

   i) General refuse;

   ii) Construction and Demolition waste including waste from excavated material;

   iii) Chemical waste;

   iv) Hazardous waste; and

   v) Biomedical waste.

b) The Contractor is required to develop, institute and maintain a Waste Management Plan (WMP) during the construction of the project for his works. Such mechanism is intended to ensure that the designated area for the segregation and temporary storage of reusable and recyclable materials are incorporated in the WMP. The WMP shall be prepared and submitted to Engineer for approval.

General Refuse

c) General refuse like paper and food waste shall be stored in enclosed bins.

d) The refuse shall be stored and transported in accordance with good practice and disposed at licensed landfills;

e) An authorized waste collector shall be employed by the Contractor to remove general refuse from the site, on a daily basis to minimise odour, pest and litter impacts;

f) The Contractor shall not burn debris or vegetation on the site.

Construction and Demolition (C&D) Waste

g) C&D Waste would mainly arise from the project construction activities and from the demolition of existing structures where necessitated. It will include: material and equipment wrapping packaging material, unusable/surplus concrete/grouting mixes, damaged/contaminated/surplus construction materials, wood from formwork and false work, concrete rubble, plastics, metal, glass, asphalt, wood and refuse obtained from demolition of houses.

h) The Contractor shall be responsible for collection, segregation, storage and disposal of C&D waste as directed or notified by the concerned local authority in consonance with the Construction & Demolition Waste Management Rules, 2016;

i) The Contractor shall ensure that there is no littering, deposition and disposal of C&D waste along the natural drainage and in water body;

j) The C&D waste should be disposed off either when the quality of C&D waste is 15 Tons from entire contract or such C&D waste has been stored for 15 days (irrespective of quantity) whichever is earlier;

k) A proper arrangement for record keeping has to be maintained to ensure disposal of C&D waste to C&D waste recycling plant. Contractor shall submit the record of C&D waste disposal to recycling facility, in his Monthly Environment Report;

Hazardous Waste

l) Hazardous waste would mainly arise from the maintenance of equipment. These may include, but not be limited to: Used engine oils, hydraulic fluids, waste fuel, spent mineral oils/cleaning fluids from mechanical machinery, scrap batteries or spent acid/alkali, spent solvents/solutions. Hazardous waste shall be disposed off in a manner in compliance with the procedure given in "Hazardous Waste (management, handling and trans-boundary movement) rules, 2016" only to authorized recyclers under intimation to the Employer's Representative.

m) Chemicals classified as hazardous chemicals under "Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 of Environment (Protection) Act, 1986 shall be disposed off in a manner in compliance with the procedure given in the rules under the aforesaid act;

n) The hazardous waste shall be stored on an impermeable surface with containment bunding to retain leaks, spills and ruptures;

o) All waste collection containers shall be of appropriate size with a closed lid. Each container will be clearly labelled with a colour code system in local language and English. Original labels of empty containers should be completely covered and the contents of the type of waste stored in the used containers clearly indicated;

p) Drip pans of suitable size and numbers shall be used to collect oil leakage and spills. The area shall be cleaned after completion of maintenance/repair and generated waste disposed off in approved manner.

Bio medical waste

q) Collection, segregation, storage and disposal of Bio Medical waste shall be in accordance with The Bio-medical Waste Management Rules, 2016;

r) Storage time of waste shall be as less as possible so that waste storage, transportation and disposal is done within 48 hours;

s) The contactor shall ensure that Posters/ placards for bio-medical waste segregation are installed at the point of generation;

t) Disposal of biomedical waste shall be through a licensed waste collector, duly authorized by MoEF&CC or Haryana Pollution Control Board as the case may be. License of the waste

collector shall be shown to the Employer's Representative on demand. Staff handling the biomedical waste shall be provided with PPEs;

Colour coding of Waste storage bins

u) All waste shall be stored in different coloured bins as per table below:

Type of Waste	Colour
Wet/Organic/ Bio-Degradable Waste	Green Bins with lids
Dry/Recyclable waste (excluding Bio-medical waste/ hazardous waste)	Blue
Bio-Medical waste	Red with lids
E-Waste	Black
Hazardous Waste	Brown
COVID Waste	Yellow

6.3.5 **Landscape, Greenery and Aesthetics**

a) As far as is reasonably practicable, the Contractor shall maintain ecological balance by preventing deforestation and defacing of natural landscape. In respect of ecological balance, the Contractor shall observe the following instructions.

i) Prevent any avoidable destruction, scarring or defacing of natural surroundings in the vicinity of work;

ii) Any damage shall be repaired, replanted or otherwise corrected at Contractor's expense.

iii) Directional shielding for light used for illumination shall be used to prevent from striking adjacent areas, where feasible;

b) Tree Felling

i) All trees and shrubs, which are not specifically required to be cleared or removed for construction purposes, shall be preserved and protected from any damage by use of protective barriers or other methods approved by Engineer;

ii) The Contractor shall not fell, remove or dispose of any tree or forest produce in any land handed over to him for the construction of works and facilities related to project except with the previous permission obtained from the Forest Department;

iii) Trees shall not be used for anchorage.

6.3.6 **Energy Management**

a) The Contractor shall use energy efficient pumps and motors. The efficiency shall be measured during installation and also periodically;

b) The Contractor should rigorously follow the maintenance regime of his DG sets;

c) The Contractor shall maximize the use of energy efficient luminaries such as LED's, metal halide lamps and ensure optimum illumination levels to save energy;

d) The Contractor shall make provision of Earth Leakage Circuit Breakers (ELCBS) to prevent loss of excessive earth currents which are unsafe;

e) The Contractor shall plan in advance and select locations to receive and store material such that these are at the least distance from place of use;

f) The Contractor shall design site offices for maximum daylight and minimum heat gain.

6.3.7 **Archaeological And Historic Resources**

a) If any archeological and historic structure is likely to be affected, a resource protection plan shall be prepared by the Contractor in consultation with the Archaeological Survey of India (ASI) to identify and assess construction effects and seeks ways to avoid, minimize or mitigate adverse effects on such monuments;

b) The Contractor shall stop work immediately and notify the Engineer if, during construction, an archaeological or burial site is discovered. The work will not recommence until approval of the Engineer is obtained for the same.

6.3.8 **Fly Ash**

MoEF&CC fly ash notification dated September 1999 and its subsequent amendments makes it mandatory for use of fly ash-based products in construction activities located within 300Km from coal or lignite based thermal power plants. The Contractor shall use fly ash as a percentage substitution of cement, in concrete for certain structures and works as prescribed in the latest amendment. The Contractor shall provide details of usage of such products to Engineer and shall maintain a detailed record of usage of Fly Ash.

6.4 Environmental Monitoring

6.4.1 **Baseline Study:** Before commencement of actual construction work, all items and parameters as specified in ESHS manual shall be monitored once as the baseline of the environmental condition prior to the construction and compared with the monitored values during the construction period;

6.4.2 **Qualification of Monitoring Agency:** Monitoring shall be conducted by MoEF&CC approved or NABL accredited laboratory and approved by the Engineer;

6.4.3 **Enforcement of the Monitoring**: Monitoring plan shall be proposed in the Contractor's ESHS Management Plan and must be approved by the Engineer before commencement of the monitoring. If the monitoring results are more than baseline and standards, cause analyses and necessary counter measures shall beproposed to the Engineer in the monitoring reports;

6.4.4 **Parameters, Location and Frequency of the Monitoring:** Environmental Monitoring parameters, locations and frequency is given in following table.

Parameters, Standards, Location and Frequency of Monitoring

Parameters	Sampling Standards	Location	Frequency
Air (PM_{10}, $PM_{2.5}$)	CPCB (2011) Guidelines for the Measurement of Ambient Air Pollutants, Manual Sampling & Analyses	One representative location within each construction yard and batching plant	Monthly
		Closest residential or commercial area (one location) within 100m from each active construction site or representative locations approved by theEngineer.	Monthly
		$PM_{2.5}$ In Tunnel portion	Bi-weekly

Parameters	Sampling Standards	Location	Frequency
Noise **Day Time** (6 AM – 10PM) L_{max}, L_{min}, L_{eq}, L_{10}, L_{90}, L_{50} **Night Time** (10PM – 6AM) L_{max}, L_{min}, L_{eq}, L_{10}, L_{90},L_{50}	CPCB (2015) Protocol for Ambient Level Noise Monitoring	One representative location within each construction yard and batching plant	Weekly
		Closest residential or commercial area (one location) within 100m from each active construction site or representative locations approved by the Engineer.	Weekly
Vibration (in mm/s orVdB)	IS 14884 (2000)	During complaints or as directed by employer.	
Drinking/GW (pH, Total Alkalinity, Electrical Conductivity, Total Dissolved Solids, Fluoride, Arsenic, Nitrate, Iron, Lead, Cadmium, E-coli)	IS 3025 (2008) & IS 10500 (2012)	**Drinking water**: construction yard, batching plant andlabour camps	Quarterly (April, July, October, January)
		Groundwater: one representative tube/bore well in the adjacent residential area or within 100m from each active construction site	Quarterly (April, July, October, January)
Surface Water if any pH, Total Dissolved Solids, Fluoride, Arsenic, Iron, Lead, E-coli	IS 3025 (2008) & IS 2296 (1982) & CPCB (2012) Guide Manual Water and Wastewater Analysis	Upstream and downstream of the river/stream if any. Any natural water course (ex. Pond etc.) located or within 100 m of each a) construction yard, b) labour camp, and c) active construction site	Quarterly (April, July, October, January)

Parameters	Sampling Standards	Location	Frequency
Waste	Not available but fully complying with monitoring the quantities of wastes specified by the Solid Management Rules 2016 & the Construction and Demolition Waste Management Rules 2016	Each construction yard and construction site	Quarterly (April, July, October, January)
Hazardous waste	Not available but typed reporting (not handwriting) fully complying with monitoring the quantities of wastes specified by the Hazardous and Other Wastes (Managementand Transboundary Movement) Rules 2016,	Each construction yard and active construction site	Quarterly (April, July, October, January)
Complaints if any		All Works' related locations	Weekly

6.5 Complaint Response Process

6.5.1 Enquiries, complaints and requests for information can be expected from a wide range of individuals and organizations both private and government. Most complaints are likely to be received by HRIDC, although the site offices are also likely to be contacted;

6.5.2 The objective of the complaint process is to ensure that public and agency complaints are addressed and resolved consistently and expeditiously.

6.5.3 The Contractor's Project Manager will be notified immediately on receipt of complaint that may relate to environmental impacts. The Project Manager will immediately inform the Engineer;

6.5.4 Field investigation shall determine whether the complaint has merit, and if so, action shall be taken to address the complaint;

6.5.5 The outcome of the investigation and the action taken shall be documented on a complaint Performa prepared by the Contractor and submitted for notice by the Engineer in advance of the works;

6.5.6 Where possible, a formal response to each complaint received shall be prepared by the Contractor within seven days to notify the concerned person(s) that action has been taken.

6.6 Social Legal Requirement

6.6.1 The Contractor shall always comply with all relevant national and state legislations regarding social safeguard including but not necessarily limited to, the following with their latest amendments.

a) National Policy for the Empowerment of Women, 2001;

b) The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act,

2013;

c) The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Rules, 2013;

d) The Protection of Children from Sexual Offences Act, 2012;

e) The Human Immunodeficiency Virus and Acquired Immune Deficiency Syndrome (Prevention and Control) Act, 2017;

f) Child Labour (Prohibition & Regulation) Act 1986

Some of the key International instruments for the protection of women include the following:

a) United Nations General Assembly, Resolution 52/86 on Crime Prevention and Criminal Justice Measures to Eliminate Violence Against Women, 2 February1998;

b) United Nations Security Council Resolution 1325 on Women, Peace and Security, 31 October 2000;

c) Environmental and Social Framework (ESF) of Asian Infrastructure Investment Bank (AIIB) February 2016

6.7 Gender equality

6.7.1 The Contractor is responsible for providing equal opportunities to both genders and end gender related discrimination, if any. The ESHS Committee will proactively identify cases of gender discrimination with key focus on the following topics:

a) Gender based violence, including sexual harassment at the workplace;

b) Disparity in benefits provided;

c) Termination on account of pregnancy.

6.7.2 The Contractor shall enhance female workforce participation and maintain sex -disaggregated data for periodic reporting.

6.7.3 The Contractor shall ensure that women workers are paid at par with male workers

6.7.4 If women workers are deployed at site then day crèche facilities shall be provided to facilitate the women with infant working on site.

6.8 Labour Requirements

6.8.1 The contractor shall use unskilled labour drawn from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply etc.)

6.8.2 The recruitment of women and members of vulnerable groups shall be prioritized.

6.8.3 The Contractor shall provide training to build the skills of locally recruited labour.

6.8.4 All staff, skilled and unskilled labours employed on a site shall be required to sign Code of Conduct that shall ensure compliance with the ESHS provision (Refer 6.11).

6.9 Cultural and Religious Issues

6.9.1 Disturbance from construction works to the cultural and religious sites, and Contractors lack of knowledge on cultural issues cause social disturbances. The Contractor shall

a) Communicate to the public through community consultation, informing the peers and newspaper announcements regarding the scope and schedule of construction, as well as certain construction activities causing disruptions or access restriction;

b) Not block access to cultural and religious sites and sites of importance for livelihood activities, wherever possible;

c) Need to take mitigation measures while working near religious place/ educational institutions close to the construction sites;

d) Provide freedom to construction workers to observe their cultural and religious practices;

e) Monitor and be responsible for the behaviour of construction workers especially migrant workers towards the community. The workers must be debriefed well regarding local aspects and need to follow good behaviors, and informed regarding unexpected behaviors at the time of employing;

f) Provision of cultural sensitization training for migrant labours regarding engagement with local community;

g) Resolve cultural issues in consultation with local leaders and Project Manager;

h) Establish a mechanism that allows local people to raise grievances (directly and indirectly) arising from the construction process;

i) Inform the local authorities responsible for health, religious and security duly informed before commencement of civil works so as to maintain effective surveillance over public health, social and security matters.

6.10 Guidelines for Addressing GBV in Projects

6.10.1 The Contractor's ESHS Plan shall include implementation of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH) Prevention and Response Action Plan. This action plan shall describe Code of Conduct (CoC), mechanism to address such incidents, assess the project scenario and potential risks of GBV/SEA/SH, training plan for workers on GBV/SEA/SH and awareness programme amongst workers regarding socially, culturally appropriate behaviour that would ensure that the project community and women in particular are safe, secured, and not vulnerable to abuse. A sample GVB/SEA/SH action plan is given in Table below.

Table - GBV/SEA/SH Prevention Action Plan

Objective	Activity	Responsibility
Assess Potential Riskof GBV	Rapid assessment of worksite, project footprint (e.g. community structure, local self-governance, national regulations, history of incidence), type of workers (local or migrant) for possible GBV risk.	As part of the social impact assessment (to be updated at the time of construction).
Inclusive development	• Engage women in project planning and implementation • Incorporate women's feedback in project designand construction schedule • Organize systematic consultations with women to ensure continuous feedback on projects and identify any gender- sensitive adverse impacts	

Objective	Activity	Responsibility
Training – women	• Sensitization of women on GBV and women's rights to avoid/avert such incidents • Sensitization of women on actions to be taken in case of GBV	
Training – men	• Sensitization of male workers on GBV and women's rights to avoid/avert such incidents. • Sensitization of male workers on actions to be taken in case of GBV • Sensitization of male workers on appropriate socially and culturally acceptable behaviour towards women • Training of managers on methods of dealing with cases of GBV.	
Awareness generation	• Distribution of leaflets propagating gender-appropriate behaviour. • Signing of self-declaration format on commitment towards gender-sensitive behaviour. • Two orientations annually on GBV/SEA, Code of Conduct, Sexually Transmitted Infections (STIs) including HIV, and Human Trafficking for civil work employees. • Awareness raising programme to the local communities on GBV/SEA,HIV/AIDS,COVID-19 and Human Trafficking. • At least three IEC materials (zero tolerance to sexual harassment, Code of Conduct, Women hotline will be developed and disseminated at Construction Sites.	

6.10.2 The Contractor shall constitute an appropriate Grievance Redress Mechanism (GRM) for addressing grievances at worksite. Workers' Grievances of workers will be first brought to the attention of supervisor at Site. Grievances not redressed by the supervisor within 7 days will be brought to the Grievance Redress Committee (GRC). The composition of GRC will have representatives from workers, women representative, ESHS staff of the Contractor ESHS staff of GC. The main responsibilities of the GRC are to: (i) provide support to workers on problems arising at worksite, (ii) record workers grievances, categorize, prioritize grievances and resolve them, (iii) immediately inform the Engineer of serious cases; and (iv) report to workers on development regarding their grievances and decisions of GRC. The panel of the GRC will function without any prejudice or fear of retaliation. The well-being of the panel members will be protected by HRIDC. The GRC will redress the grievances within 14 days. The Contractor shall provide grievance box

at Project Site Office.

6.10.3 This project has zero tolerance of any form of:

a) **Gender-based violence (GBV)**, that is perpetrated against a person's will and that is based on socially ascribed gender-related differences between people.

b) **Sexual exploitation and abuse (SEA**) which is attempted abuse of a position of vulnerability, differential power, or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.

c) **Sexual harassment (SH**) which is unwelcome sexual advances, requests for sexualfavors, and other unwanted verbal or physical conduct of a sexual nature.

6.10.4 Any incidence of GBV, SEA or SH should be reported to the Grievance Redress Committee (GRC). The panel of the GRC should take appropriate gender-sensitive actions to verify authenticity of the incident with due consideration to the safety, security, and dignity of the offended person. The investigation should be concluded within three days of receiving the report or as reasonably possible. Depending on the severity of the incident, the panel may report the case to appropriate authorities.

Following the investigation, the GRC shall recommend appropriate actions to the company which may include but not limited to:

a) Informal warning

b) Formal warning

c) Additional training

d) Loss of up to one week's salary

e) Suspension of employment (without payment of salary), for a minimum period of one month up to a maximum of six months

f) Termination of employment

6.10.5 The affected person will be provided with appropriate support (e.g. psychological counselling, medical support and any other support as needed).

6.10.6 A self-declaration format for adherence to gender-sensitive behaviour should be signed by all contractors, subcontractors, employees, and senior managers, engaged by the Project to avoid GBV/SEA/SH at worksite. A self-declaration format is given in below:

6.10.7 **Commitment Statement for all Project Workers**

(to be translated into local language or explained in a manner that is appropriate for general understanding of the signee)

I, (name of person), acknowledge that preventing Gender-Based Violence (GBV), Sexual exploitation and abuse (SEA) and Sexual harassment (SH) is essential, and that preventing it is my responsibility. At [Company], GBV activities constitute acts of gross misconduct and are therefore grounds for sanctions, penalties or potential termination of employment. All forms of GBV are unacceptable, be it on the worksite, the worksite surroundings, at workers' camps, or in the community. Prosecution of those who commit GBV may be pursued if appropriate.

I agree that while working on the [Project], I will:

- Cooperate with any relevant investigations.
- Treat women, children (definition of "child" shall be as specified in Child Labour (Prohibition and Regulation) Act, 1986) and men with respect regardless of race; color; language; religion; political or other opinion; national, ethnic or social origin; sexual

orientation or gender identity; disability; birth or other status.

- Not use language or behaviour towards women, children or men that is inappropriate, harassing, abusive, sexually provocative, demeaning or culturally inappropriate.
- Not request or engage in sexual favors - for instance, making promises or favorable treatment dependent on sexual acts, in or outside the work site.
- Refrain from abusive and violent behaviour, in the workplace, labor camp or surrounding communities.
- Attend and actively partake in training courses related to HIV/AIDS, GBV, SEA and SH as requested by my employer.
- Report through the grievance redress mechanism or to my manager any suspected or actual GBV by a fellow worker, whether in my company or not, or any breaches of this Code of Conduct.

[Company] recognizes that false accusations of sexual harassment can have serious effects on innocent persons. If, after the investigation, it is found that the complainant has maliciously or recklessly made a false accusation, the complainant will be subject to appropriate sanctions. In such a case, the company will also take appropriate action to restore the reputation of the accused.

I understand that it is my responsibility to use common sense and avoid actions or behaviours

that could be construed as GBV or breach this Self-declaration format. I do hereby acknowledge that I have read the foregoing Self-declaration format, do agree to comply with the standards contained therein and understand my roles and responsibilities to prevent and respond to GBV. I understand that any action inconsistent with this Self-declaration format or failure to act, as mandated by this Self-declaration format may result in disciplinary action and may affect my ongoing employment.

I have familiarized myself with the contents of this Self-declaration format. By my signature below, I acknowledge, understand, accept and agree to comply with the information contained in the Self-declaration format provided to me.

I hereby confirm I have read and understand the Self-declaration format.
Name (Employee)

Signature
Date

6.11 Code of Conduct for Contractor's Workers

6.11.1 The Contractor shall have a Code of Conduct for the Contractor's Personnel. The Contractor shall ensure that each Contractor's Personnel is provided a copy of this Code of Conduct, written in a language comprehensible to that person, and shall seek to obtain that person's signature acknowledging receipt of the same. Reference code of conduct is place below:.

Code of Conduct for Contractor's Workers

We are the Contractor, [*enter name of Contractor*]. We have signed a contract with [*enter name of Employer*] for [*enter description of the Works*]. These Works will be carried out at [*enter the Site and other locations where the Works will be carried out*]. Our contract requires us to implement measures to address environmental and social risks related to the Works, including the risks of sexual exploitation and abuse and gender-based violence.

This Code of Conduct is part of the measures to deal with environmental and social risks involving the workers, related to the labor camps and the workplace. It applies to all our staff, laborers and other employees at the Works Site or other places where the Works are being carried out. It also applies to the personnel of each subcontractor and any other personnel assisting us in the execution of the Works. All such persons are referred to as "**Contractor's Personnel"** and are subject to this Code of Conduct.

This Code of Conduct identifies the conduct that is required from all Contractor's Personnel.

Our workplace is an environment where unsafe, offensive, abusive, or violent behavior will not be tolerated and where all persons should feel comfortable raising issues or concerns without fear of retaliation.

Contractor's Personnel shall:

1. Make earnest efforts to understand his/her responsibilities detailed in this Code of Conduct and any other documents and training, as directed by the Employer. Proactive seek clarifications to enable work to be undertaken in strict compliance with this Code of Conduct.
2. Carry out his/her duties competently and diligently.
3. Comply with this Code of Conduct and all applicable laws, regulations, and other requirements, including requirements to protect the health, safety and well-being of other Contractor's Workers and any other person.
4. Maintain a safe working environment including by:
    a. ensuring that workplaces, machinery, equipment, and processes under each person's control are safe and without risk to health.
    b. wearing required personal protective equipment.
    c. all works are conducted with safety clearance and under appropriate supervision.
    d. using appropriate measures relating to chemical, physical, and biological substances and agents.
    e. following applicable emergency operating procedures.
    f. providing separate, safe, and easily accessible working and accommodation facilities for women and men working on the site.
5. Report work situations that he/she believes are not safe or healthy and remove himself/herself from a work situation which he/she reasonably believes presents an imminent and serious danger to his/her life or health.
6. Treat other people with respect, and not discriminate against specific groups such as women, gays, people with disabilities, migrant workers, or children.
7. Not engage in sexual harassment which includes unwelcome sexual advances, requests for sexual favors, and other unwanted verbal or physical conduct of a sexual nature.
8. When engaging with the community and/or project affected persons, this should be done professionally and with utmost respect. Intimidation, threats, and coercive behavior will not be tolerated.
9. Not engage in sexual exploitation and abuse, which means any actual or attempted abuse of position of vulnerability, differential power or trust, for sexual purposes, including, but not limited to, profiting monetarily, socially or politically from the sexual exploitation of another.
10. Not engage in sexual assault, which means any form of non-consensual sexual contact.
11. Not engage in any form of sexual activity with individuals under the age of 18.

12. Not make any inappropriate and unwanted sexual advances to people in the adjoining communities or settlements.
13. Not work or be present in the worksite(s) under the influence of any intoxicating substances, such as alcohol or drugs.
14. Not possess alcohol or any other intoxicating substances while on duty or in the labor camps.
15. Return to the labor camp no later than 22:00, unless working on night shift.
16. Complete relevant training courses that will be provided related to the environmental and social aspects of the Contract, including on health and safety matters, Gender-based violence (GBV), Sexual Exploitation, Abuse and Harassment (SEAH).
17. Report violations of this Code of Conduct.
18. Not retaliate against any person who reports violations of this Code of Conduct, whether to AIIB or the Employer, or who makes use of the grievance mechanism for Contractor's Workers or the project's Grievance Redress Mechanism.

RAISING CONCERNS

If any person observes behavior that he/she believes may represent a violation of this Code of Conduct, or that otherwise concerns him/her, he/she should raise the issue promptly. This can be done in either of the following ways:

1. Contact [*enter name of the Contractor's Social Expert*] in writing at this address [X] or by telephone at [X] or in person at [X]; or
2. Call [X] to reach the Contractor's hotline *(if any)* and leave a message.

The person's identity will be kept confidential, unless reporting of allegations is mandated by the country law. Anonymous complaints or allegations may also be submitted and will be given all due and appropriate consideration. We take seriously all reports of possible misconduct and will investigate and take appropriate action. We will provide warm referrals to service providers that may help support the person who experienced the alleged incident, as appropriate.

There will be no retaliation against any person who raises a concern in good faith about any behavior prohibited by this Code of Conduct. Such retaliation would be a violation of this Code of Conduct.

CONSEQUENCES OF VIOLATING THE CODE OF CONDUCT

Any violation of this Code of Conduct by Contractor's Personnel may result in serious consequences, up to and including termination and possible referral to legal authorities.

FOR CONTRACTOR'S PERSONNEL:

I have received a copy of this Code of Conduct written in [X] language that I comprehend. I understand that if I have any questions about this Code of Conduct, I can contact [*enter name of Contractor's contact person with relevant experience in handling gender-based violence*] requesting an explanation.

Name of Contractor's Personnel: [insert name]

Signature: _____
Date: (day month year): _____

Countersignature of authorized representative of the Contractor: [insert name]
Signature: _____
Date: (day month year): _____

7.0 FINANCIAL DEDUCTION/WITHHOLDING

7.1 Financial deductions from Contractor on occurrences of an incident.

7.1.1 Table No. 1 below indicates ESHS incidents and the corresponding deductions to be made from the Contractor under Sub-Clauses 20.1 [Employer's Claims], Sub-Clauses 14.3 [Application for Interim Payment], Sub-Clauses 14.6 [Issue of Interim Payment Certificates] and Sub-Clauses 14.7 [Payment] of the General Conditions of Contract.

7.1.2 The affected part of the Works shall remain suspended until all necessary investigations are completed as prescribed in Clause 2. [ESHS Management], Sub-Clause 2.15 Accident Report and Investigation and as per the related local laws of the state.

7.1.3 Upon submission of the Contractor's Request for Inspection (RFI), a joint inspection of the affected part of the Works shall be carried out by the Engineer and the Contractor. On receipt of the Engineer's Consent (Notice of No Objection: NONO), the Contractor may resume the work.

7.1.4 The Contractor shall not be entitled to any extension of time or to the payment of any cost or profit due to any suspension in accordance with this Sub-Clause 8.5 [Extension of time for Completion]

7.1.5 The maximum amount of delay damages set out in Sub-Clause 8.8 [Delay Damages] of the General Conditions of Contract shall not be applicable where the cause of delay to completion is suspension of part of the Works due to the Contractor's non-compliance as described in this clause 7.1.

Table No. 1: Incidents

Sl. No.	Incident		Financial deductions from the Contractor in Indian Rupees
1.	Injury and Incidence reporting	i) Fatal accidents	i) Rs.10,00,000 for the first fatality and Rs.15,00,000 for every subsequent fatality.
		ii) Injury accident	ii) Rs.1,00,000 for first grievously injured person and Rs.75,000 for every subsequent grievously injured person (Grievous Injury as defined by Workmen's Compensation Act)

7.2 Withholding and deduction of payments from Contractor

7.2.1 The Engineer may issue a notice to the Contractor in accordance with Sub-Clause 3.5 [Engineer's Instruction] of the General Conditions of Contract to rectify any unsafe act or condition (including but not limited to error, default or omission) upon discovery of same on the Site by the Engineer, in a form of Nonconformity Report.

7.2.2 Table No. 2 below indicates Contractor's non-conformances from the ESHS requirements of the Contract and the corresponding amounts to be withheld and deducted by the Engineer from payment due to the Contractor under Sub-Clause 14.3 [Application for Interim Payment], Sub-Clause14.6 [Issue of Interim Payment Certificates (IPC)] and Sub-Clause 14.7 [Payment] of the General Conditions of Contract.

7.2.3 The Engineer shall have the right to withhold and deduct charges for any other unsafe act and/or condition depending upon the gravity of the situation on a case-to-case basis. The charge shall be comparable to that which is the closest to the unsafe act/condition, indicated in Table 2.

7.2.4 Except as may be required otherwise by the Laws of the Republic of India, upon receipt of the Engineer's notification concerning an unsafe act or condition as described in Table No. 2, the Contractor shall promptly comply with such notification, investigate the cause of the unsafe act or condition and as soon as possible (but no later than 14 days, or within such other period from receipt of the Engineer's notification as may be approved by the Engineer), submit to the Engineer for review full details of the proposed correction, prevention and any other measures (hereinafter referred to as the "measures") to be taken by the Contractor to rectify and close-out the matter and to prevent re-occurrence. Such measures shall be to the satisfaction of the Engineer.

7.2.5 The Engineer is entitled to withhold amounts from the Contractor's payment until the Engineer has verified the Contractor's measures, submitted to the Engineer for review as above, and accepted them after a joint inspection in response to the RFI for the same.

7.2.6 Should the Contractor default in implementing any measures within the time previously agreed between the Contractor and the Engineer or the Contractor makes subsequent violations as specified in Table No. 2, the Engineer shall be entitled to the deduction to be recovered from the Contractor under Sub-Clause 20.1 [Employer's Claims] of the General Conditions of Contract. Such deductions shall be made via the certification and payment process provided for in the Contract, including Sub-Clauses 14.3 [Application for Interim Payment], Sub-Clause 14.6 [Issue of Interim Payment Certificates] and Sub-Clause 14.7 [Payment] of the General Conditions of Contract without limiting to the unsafe acts and or conditions mentioned above in Table 2.

7.2.7 The release or deduction of amount shall happen in the next payment process.

7.3 Suspension of work

7.3.1 The Engineer may issue a notice to the Contractor in accordance with Sub-Clauses 3.5 [Engineer's Instruction] and Sub-Clause 8.9 [Suspension of Work] of the General Conditions of Contract to suspend the progress of part of the Works in a form of Nonconformity Report, if in the Engineer's opinion such work is non-compliant with the ESHS requirements of the Contract. Such notification shall include details of the cause of the suspension. During such suspension, the Contractor shall protect, store and secure such part of the Works against any deterioration, loss or damage.

7.3.2 The Contractor shall not proceed with the affected Works until its measures are accepted by the Engineer.

7.3.3 Suspension of part of the Works as described in Sub-Clause 7.3.1 above and withholding of the amount from the Contractor's payment Sub-Clause 7.2 above shall continue together or independently until the Engineer has verified the Contractor's correction and close-out of any such non-conformity.

7.3.4 The Contractor shall not be entitled to any extension of time or to the payment of any cost or profit due to any suspension in accordance with Sub-Clause 7.2.

7.3.5 The maximum amount of delay damages set out in Sub-Clause 8.8 [Delay Damages] of the Conditions of Contract shall not be applicable where the cause of delay to completion is suspension of part of the Works due to the Contractor's non-complianceas described in this Clause 7.

Table No. 2: Unsafe Acts/Conditions

Sl. No	Unsafe Act/Condition		Deductible amount from the Contractor in Indian Rupees
1.	Submission and approval of ESHS ManagementPolicy & Plan	i) Non- Submission of ESHS Plan within 56 days of Commencement Date as per Sub-Clause 2.4.3	i) Rs.50,000 per month
		ii) Non-approval of ESHS Management plan within 90 days as per Sub-Clause 2.4.3	ii) Rs.50,000 per month
2.	ESHS Organization	Not filling up the vacancies arises within one month during currency of the Contract as per Sub-Clause 2.6.3. a) Health and Safety Expert	Rs.50,000 per month for Health and Safety Expert
3.	ESHS Inspection	Non submission of the compliance report of Monthly Site Inspection Report as per Sub-Clause 2.11.5	Rs.50,000 per report
4.	ESHS Submittals	Non – Submission of Monthly ESHS Report as per Sub- Clause 2.14.2	Rs.50,000 per month
5.	Site Barricading	Not providing Hard barricading for pedestrian/road users as per Contract Agreement and Sub- Clause 4.27.4 of ESHS Manual	Rs.1,00,000 per location
6.	Labour Welfare Measures	i) Non – provision of Latrine & Urinal for Male & Female workers before occupied by labour as per Sub-Clause 5.3.1	i) Rs.1,00,000 per location
		ii) Non-provision of Bed & Separate Kitchen facility before occupied by labour as per Sub-Clause 5.3.9	ii) Rs.1,00,000 per location
7.	Non-Conformity	Non-compliance of Non – Conformity report within 14 days as per Sub-Clause 7.2.4	Rs. 50,000 per each NCR

8.0 ATTACHMENT

Attachment -1 Contents of ESHS Management Plan

1.0 General

1.1 The Contractor shall prepare an Environment, Social, Health and Safety (ESHS) Management Plan, which provides measures to protect the Environment, Health and Safety of workers and the public.

1.2 The Contractor's ESHS Management Plan shall be based on Environment, Social, Health and Safety considerations submitted with the Tender and shall have the content shown in the following section [Contents of ESHS Management Plan].

1.3 The Contractor shall submit his ESHS Management Plan for review by the Engineer within 56 days after the Commencement Date and shall amend the ESHS Management Plan to address any comments made by the Engineer and submit a Final ESHS Management Plan within 14 days of receipt of comments.

1.4 The Final ESHS Management Plan shall be binding on the Contractor for the duration of the Contract.

2.0 Content of ESHS Management Plan

2.1 The Contractor's ESHS Management Plan shall cover the following aspects:

Site ESHS Management Plan	
Contract No.	
Contractor Name	
Project Name	
1	Project Highlights i) Title of the content; ii) Contract number; iii) Brief scope of work; iv) Location map/key plan; v) Period of the project;
2	ESHS Management Policy
3	Site organization chart Chart indicating reporting of ESHS Management personnel, appointment, duties, and responsibilities
4	Roles &responsibility Individual responsibility of the i) The Contractor's representative ii) Health & Safety Expert/manager iii) Environment Expert/manger

	iv) Social expert v) Construction manager vi) ESHS Committee members vii) ESHS Engineer viii) Site Engineer ix) Bridge Engineer x) Construction Supervisors xi) Subcontractors
5	ESHS Site Committee i) Details - Chairman, secretary, members, and employer's representative ii) Procedures for effective conduct of meeting
6	ESHS Training
7	Subcontractor Evaluation, Selection, Control and ESHS Code of Conduct
8	ESHS Inspection and audit
10	Accident, Incident, Near miss, Dangerous occurrence, investigation reporting procedures
11	First Aid, Occupational Health and Emergencies measures
12	Staff and labour welfare measures
13	Hazards and Risks with Risk assessment and mitigation procedures
14	Safe Work Procedures e.g. i) Excavation ii) Structural steel erection iii) Form works iv) Concrete placement v) Work at height vi) Floor, wall openings and stairways vii) Welding, cutting and bracing viii) Lifting appliances ix) Electrical equipment x) Mechanical equipment xi) Fire prevention xii) Hazardous chemicals and solvent xiii) Lighting

	xiv) Plumbing work xv) Plastering & Painting xvi) Glass cladding
15	Work permit system
16	List of standard job specific PPEs to be used in the site
17	Maintenance of regime for construction equipment and machinery
18	Traffic management plan
19	Housekeeping
20	i) Environmental and Social Management ii) Applicable National and State legislation and regulations iii) Specific procedures for achieving environmental and social performance requirements as given in the Employer's requirements on Environment. iv) Details on air monitoring and noise monitoring control plan which details mitigation measures / corrective action / preventive action and monitoring schedule. v) The ESHS Management Plan must contain procedures on prevention and control of water pollution, storage, handling and disposal of waste, including municipal, C&D, plastic, bio-medical, chemical and hazardous wastes, reuse/recycle of waste, selling to authorised recyclers and records thereof, preservation of landscape disturbed due to construction, housekeeping/Environmental sanitation and traffic management as required under the contract. vi) Procedures for recording environmental complaints and response process. vii) Waste Management Plan viii) HIV Prevention and Control Plan ix) Gender Based Violence (GBV) and sexual Exploitation and Abuse (SEA) Prevention and Response Plan x) COVID-19 Response and Management Plan xi) Labour Camp Management Plan
21	Emergency Response plan
22	Visitors and security arrangement
23	Safety and Health promotion and awareness;
24	Safety and Health equipment and Safety and Health of the Contractor's construction and office equipment;

Note: -The Environment, Social, Health and Safety (ESHS) Management Plan shall be incorporated in the relevant sections.

Attachment -2 Workplace Policy (on HIV/AIDS Prevention & Control)

Haryana Rail Infrastructure Development Corporation Limited (HRIDC) recognizes HIV/AIDS as a developmental challenge and realizes the need to respond to it by implementing regular HIV/AIDS prevention programmes and creating a non- discriminatory work environment for HIV infected workmen engaged by Contractors. For the purpose of making conscientious, sensitive and compassionate decision in addressing the realities of HIV/AIDS, HRIDC has established these guidelines based on ILO code of practice on HIV/AIDS.

- Creating awareness through professional agency using IEC (Information, Education and Communication) package specially designed for migrant workers.
- Institutional capacity building by training the project implementation team, Environmental, Social, Health & Safety (ESHS) Managers, establishing linkages for deficient diagnosis and treatment of the affected workers, effective monitoring of implementation and documentation for further learning.
- Establishing peer educators by selecting them in consultation with Contractors and training them through professional agencies so that they become focal point for any information, education and awareness campaigns among the workmen throughout the contract period.
- Promotion of social marketing of condom

Attachment -3 Workplace Policy on COVID-19 Prevention and Control

It is likely that Corona virus Disease 2019 (COVID-19) will continue to occur in the community in the foreseeable future. It is therefore necessary to have a plan/policy in place to prevent the spread of this virus within the workplace. In order to reduce the risk of infection, Haryana Rail Infrastructure Development Corporation Limited (HRIDC) recommends to the Contractor to consider the following measures:

a) The Contractor shall ensure that the latest guidelines issued by Ministry of Health and Family Welfare (MoHFW), local government and the district administration are strictly followed at the construction works site.

b) On day 0, before resuming the work on sites post lockdown period, mandatory medical check-up will be arranged for all workers.

c) Only medically fit workers will be deployed at site and medical assistance will be arranged for unfit workers.

d) A unique photo identity card with serial number will be issued to all the workers and their family members staying at site.

e) All the essential items will be made available to them at site only. Mandatorily wear face masks while working on site or going outside.

f) No outside worker will be allowed to stay at site without following proper procedure and instructions.

g) The workers staying outside (which are always nearby) shall reach the site either by walking or by their individual mode of transport (bicycle, two-wheeler etc.).

h) During attendance, training and other sessions, social distancing guidelines will be followed along with provision of no-touch attendance.

i) All workers may be advised to take care of their own health and look out for respiratory symptoms/fever and, if feeling unwell, shall leave the workplace immediately after informing their reporting officers.

j) Workers shall not shake hands when greeting others and while working on the site.

k) Avoid large gatherings or meetings. Maintain at least 1 meter (3 feet) distance from persons, especially with those having flu-like symptoms, during interaction.

l) Workers shall clean hands frequently by washing them with soap and water for at least 40 seconds.

m) Workers shall not share their belongings like food, water bottles, utensils, mobile phones etc. with others.

n) The utensils shall be washed properly post use at designated places.

o) Post work, workers shall change their clothes before leaving the site and clothing shall not be shook out.

p) Avoid touching your eyes, nose, or mouth with unwashed hands.

Attachment -4 Reference for ESHS Activities

General Instruction: ESHS/GI/001

Topics for ESHS Orientation Trainings for Workmen for First Day at Work

1) **Hazard Identification Procedure**

Hazards on site:

- Working at Height, Electricity, lifting work, Work close to railway tracks or roads, Construction machinery and Safety of nearby located structures.

2) **Personal Protective Equipment**

- What is available?
- How to obtain it?
- Correct use and care.

3) **Health**

- Site welfare facilities;
- Potential health hazards;
- First Aid/Cardiopulmonary Resuscitation (CPR). /Automated External defibrillator (AED).

4) **Duties of the Contractor**

- Brief outline of the responsibilities of the Contractor by law;
- Details of the Contractor's ESHS Policy;
- The Employer ESHS Management Manual (if any);
- Building and other Constructions Welfare Law.

5) **Employee's Duties**

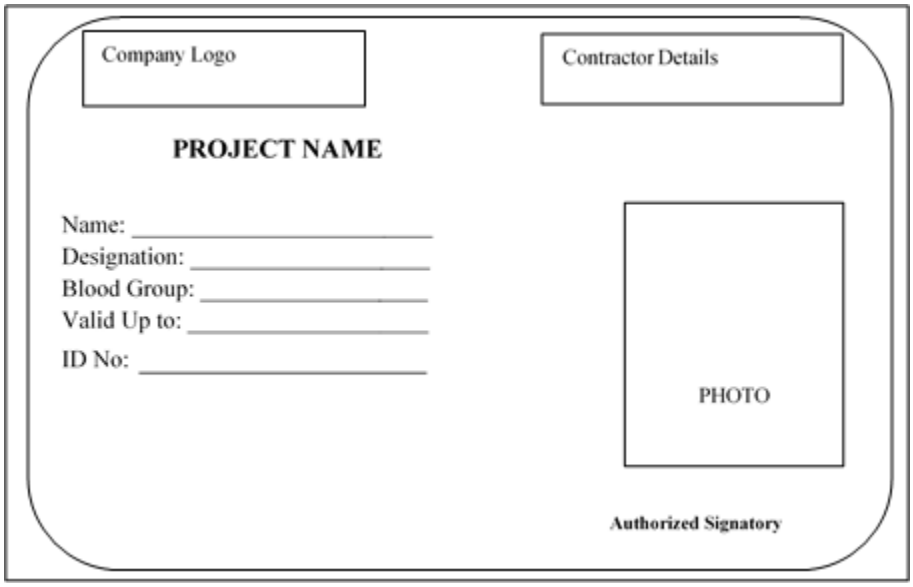
- Brief outline of responsibilities of employee under law

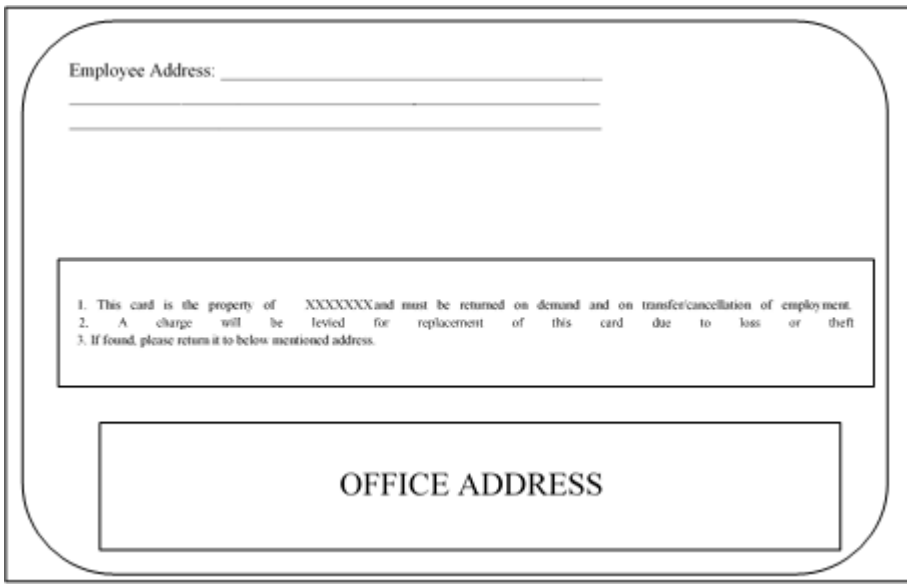
6) **Environment And Social**

- Contractor's Environment Policy
- Key legal requirements
- Avoidance of Nuisance
- Environmental Sanitation
- Dust Control Measures
- Water Pollution and Control
- Occupational noise mitigation
- Waste Management and Disposal
- Gender Based Violence and Sexual Exploitation and abuse (GBV/SEA)
- HIV/AIDS prevention
- Grievance Redressal Mechanism for GBV/SEA

General Instruction: ESHS/GI/002

ID CARD FORMAT (85 mm x 55mm) FRONT SIDE OF ID CARD:





General Instruction: ESHS/GI/003

WEEK/DAYS TO BE OBSERVED FOR CREATING ESHS AWARENESS

1st Monday to Sunday of January	Road Safety Week (Subjected to confirmation from Ministry of Road Transport, Govt. of India every year.)
16th February	Kyoto Protocol Day
March	Red Cross Month
4th March	National Safety Day
8th March	International Women's Day
22ndMarch	World Water Day
7th April	World Health Day
14th April	Fire Safety Day
18th to 22nd April	Earth Week
20th April	Earth Day
20th April	Noise Awareness Day
28th April	ILO World Day for Safety and Health at Work Day
1st to 7th May	Emergency Preparedness Week
5th June	World Environmental Day
12th June	World Day against Child Labours
21st June	World Yoga Day
9th July	Occupational Health Day
17th October	World Trauma Day
1st December	World AIDS Day

General Instruction: ESHS/GI/004

Minimum Requirements of ESHS Communication Posters/Signage/Video:

a) Every Contractor shall prepare a ESHS Communication Plan as a part of site specific ESHS Management Plan and shall include the following minimum requirement of Posters/Signage/Video as applicable. In case readymade posters are available in any of the category from National Safety Council or any other safety related organizations they may procure the same and display it. In case the same is not available, then the Contractors shall make necessary arrangements to get the posters designed and printed on their own. All posters shall each be in Hindi, English and the regional language; and

b) All the above is to be detailed in the Contractor's ESHS Management Plan and he shall obtain the Engineer's prior consent for the numbers, contents, locations, etc.

Table No.: 1 - Minimum No. of Posters

Sl. No	ESHS Poster Title	No. of Posters/Signages
1.	Daily Safety Oath	5
2. a)	Signage to display the messages like PPE ZONE,NO PPE ZONE, HARD HAT AREA etc.	5
b)	Helmet	5
c)	Shoe	5
d)	Goggles & Ear Protection	5
e)	Full Body Harness	5
f)	Hi-Vi Jacket	5
3.	Working at Heights	5
a)	Ladder, Stairway, Scaffold -Signage to display the messages like SAFE, UNSAFE, FIT FOR USE, AVOID USE etc.	5
4.	Site Electricity	5
5.	Crane Safety	5
6.	Rigging Procedures	5
7.	Excavation	5

7.	Occupational Health (Mosquito Control, HIV/AIDS awareness, DustControl, Noise Control, No Smoking/Spitting, etc.)	5
8.	First – Aid	5
9.	Labour Welfare Measures (Payment of Minimum Wages, Avoidance of Child labour, signing in the MusterRoll, in case of accidents- what to do? Etc.	5
10.	Traffic Safety (Speed limit, safe crossingand working within barricaded area etc.)	5
11.	Environmental Management	5

Note: The above minimum numbers are for guidance only. The actual number, material of posters/signages will be as per project specific requirement.

Table No.: 2 – Size of Posters/Signage

Sl. No	Item	Size
1.	Posters – Standard	17”x22” –135 GSM 4 Colour Printing
2.	Posters – Special (Wherever required)	17”x22” card laminated FA Poster
3.	Posters - Mega size (Wherever required)	32”x40” Flex FA Poster
4.	First-Aid Booklet	6”x4”
5.	Safety Handbook	6”x4”
6.	Signage	Small: 12”x6” Big: 24”x12”
7.	Road Traffic Sign Boards	Strictly as per Indian Road Congress (IRC) specifications

Table No.: 3 – Safety Signage Colour (as per IS: 9457)

Sl. No	Type of signage	Colour
1	Mandatory	Blue
2	Danger	Yellow
3	Prohibitory	Red
4	Safe conditions	Green

Attachment -5 Safe Work Procedure for Work Near Railway Track

1.0 Safety precautions and measures to be observed during execution of ROB/ RUB/ Viaduct/ any other works in Railway and adjoining areas:

1.1 The Contractor(s) shall not allow any road vehicle belonging to him or his suppliers, etc. to ply in HRIDC/railway land next to the running line. If for execution of certain works viz. earthwork for parallel railway line and supply of ballast for new or existing rail line gauge conversion, etc. road vehicles are necessary to be used in railway/HRIDC land next to the railway line, the Contractor(s) shall apply to the Engineer-in-Charge for permission giving the type and number of individual vehicles, names and license particulars of the drivers, location, duration and timings for such work/movement. The Engineer-in-Charge or his authorized representative will personally counsel, examine and certify the road vehicle drivers, Contractor(s)' flagmen and supervisors and will give written permission giving names of road vehicle drivers, Contractor(s)' flagmen and supervisors to be deployed on the work, location, period and timing of the work. This permission will be subject to be following obligatory conditions:

1.2 **Construction Activities and Safety:**

a) The 'Methodology of Working' shall be incorporated in GAD and Temporary Arrangement Drawings.

b) The activities of work to be taken up during the railway traffic block/under speedrestriction, etc. should be clearly mentioned in such drawings. If at any stage of execution, any discrepancy is found in the drawing with respect to the site condition affecting safety or some new activity of work is required to be done, the same should be brought to the notice of Railway & HRIDC Engineers and such works should be done only after approval by Railways & HRIDC representative. In such cases, scheme may be modified and, if required, fresh CRS sanction shall have to be obtained.

1.2.1 The works required to be done under traffic block protection, are to be carried out only in the presence of Railway & HRIDC Engineering Officials. The Railway's and HRIDC's Supervisor has to certify safe conditions for passage of trains before resumption of traffic. The works to be done under traffic shall be carried out under the provision of banner flag and protection by Engineering Flagman.

1.2.2 Following important activities of works shall be carried out under supervision of Railway/HRIDC Engineer or his nominated Supervisor:

a) Excavation at foundation/ground level near to railway track

b) Concrete casting and/or masonry work very close to railway track

c) Erection of temporary structures near to running lines.

d) Casting of structures like girder/slab over railway track

e) Stage-prestressing of girders when placed across railway tracks properly supported

f) Launching of precast/pre-assembled girders across railway tracks

g) Any work of lifting, side shifting and slewing of girders over the railway track

h) Dismantling of temporary structures, shuttering, scaffolding, etc. adjacent to and above the railway track. For carrying out activities of casting, erection, launching, handling, and dismantling as listed above, the Contractor's Engineer shall furnish the Construction Programme in advance to HRIDC Supervising Engineer & Engineer representative. No such work should be taken up in absence of the HRIDC Supervising Engineer & Engineer representative. For the activities which are to be done in presence of the HRIDC Engineer and prior intimation shall be given in writing and acknowledgement obtained from HRIDC's representative.

1.2.3 To ensure 'Safety' during construction activities, HRIDC Site Engineer & Engineer representative may direct the Contractor's Supervisor/Engineer or their nominated representative for safe working procedures/ instructions, notwithstanding the contractual or MOU conditions prevailing between/ among Railways/other Departments like NHAI/Contractors/ Concessionaire.

1.2.4 All the records of Quality Assurance/Quality Control, testing of the materials and satisfactory completion of an activity shall be maintained at site by the Contractor's Engineer and Supervisor. On the basis of these records, HRIDC Site Engineer shall do stage-wise clearance of the works at following stages:

i) Completion of foundation

ii) Completion of substructure

iii) Completion of superstructure

Without such stage clearance, the work in next stage of construction shall not be allowed by the HRIDC Supervisor, unless proper system of check and exercise is followed at the site.

1.2.5 Normally, the high beam PSC girders are designed with wider top flange and shorter bottom flange with very high beam which makes the girder unsuitable during lowering, slewing and launching time.

1.2.6 During launching of girders and subsequent adjustments for placement of bearing, special attention and precautions are required at site to be followed rigorously without resorting to shortcut practice or leaving the work at site to untrained or inexperienced Engineers. Normally, end diaphragms are not cast for the extreme both side girders. These shall be cast minimum 300mm on both sides for all 'I' beam girders to provide temporary supports for ensuring stability.

"OR"

For side adjustments and bearing placements below 'I' section girders, end brackets made of steel angles should be provided for all 'I' beams sequentially to avoid side titling of individual girders. End brackets shall be removed only after placing girders on bearing and casting of diaphragms.

1.2.7 During lowering, the jacks shall be operated duly keeping wooden packing of various thicknesses fixing the amount of lowering to the barest minimum, so that even if the jack fails, the wooden packing will take load and further stability of girder is not endangered.

1.2.8 Temporary crib support staging shall be interlaced with clamps and angles. Adequate base width shall be maintained proportionate to the height of stage, which is very essential for avoiding the oblong effect during launching of girders. During launching by RH girder method, the movement of the PSC girders shall be controlled both from front and rear with sync mechanism having simultaneous operation, so that the speed of the launching is always under the control. Spare hydraulic jacks shall always be kept at site. Lowering of girder shall always be carried out at one end only. Further, other end should be adequately secured by wire ropes, end brackets, etc. Thereafter, the process shall be continued alternately.

1.2.9 As far as possible, launching of girders by temporary staging shall be avoided and launching by heavy capacity cranes, wherever feasible, shall be adopted.

1.2.10 Steel girder launcher if used for launching of PSC girders should be pre-tested for the critical loading (likely to be encountered during actual launching) before deployment on the approaches regarding its strength as well as amount of permissible deflection using actual test PSC girder as a testing load. Connections at supports shall be inspected and certified prior to actual launching. It shall be adequately secured to the base support system

on the pier cap.

1.3 General Construction Safety:

1.3.1 General safety precautions as applicable for civil works shall be adopted in field.

1.3.2 Working near running line: Safe practices at site and at all times non-infringement to moving trains shall be ensured. Road vehicles, material trolleys, dollies with any tendency to roll off towards the running lines to be checked by providing chains, locking arrangements, blocks, etc. shall be ensured and the Site-in-Charge of the Contractor shall be primarily responsible, secondary responsibility being of Contractor's Consultant.

1.3.3 Testing of cranes, lifting jacks and other equipment: All equipment like cranes, lifting jacks shall be tested, duly calibrated and certified prior to the use at construction site.

1.3.4 Routine safety checks, validity of test certificates for load bearing equipment especially for cranes outsourced from third party shall be ensured prior to deployment.

1.3.5 Construction workers at site shall be provided with personal safety gear like reflective vest, helmet, Safety shoes, gloves & eyewear approved as per construction industry standards. For persons working at pier top/girder level, temporary supports, hand railing, protection with help of ropes, slings and temporary railings shall be provided.

2.0 Safety Guidelines and Precautions for working close to Railway tracks

2.1 A large number of men and machinery are deployed by the contractors for track renewals, gauge conversions, doublings, bridge rebuilding etc. It is therefore essential that adequate safety measures are taken for safety of the trains as well as the work force. The following measures should invariably be adopted.

A. The contractor shall not start any work without the presence of HRIDC Engineer at site.

B. Wherever the road vehicles and/or machinery are required to work in the close vicinity of railway line, the work shall be so carried out that there is no infringement to the Railway's schedule of dimensions. For this purpose, the area where road vehicles and/or machinery are required to ply, shall be demarcated and acknowledged by the contractor. Special care shall be taken for turning/ reversal of road vehicles/machinery withoutinfringing the running track. Barricading shall be provided wherever justified and feasibleas per site conditions.

C. The look out and whistle caution orders shall be issued to the trains and speed restrictions imposed where considered necessary. Suitable flagmen/detonators shall be provided where necessary for protection of trains.

D. The supervisor/workmen should be counseled about safety measures. A competency certificate to the contractor's supervisor as per Performa annexed shall be issued by DGM/HRIDC, which will be valid only for the work for which it has been issued.

E. The unloaded ballast/rails/sleepers/other P-Way materials after unloading along track should be kept clear off moving dimensions and stacked as per the specified heights and distance from the running track.

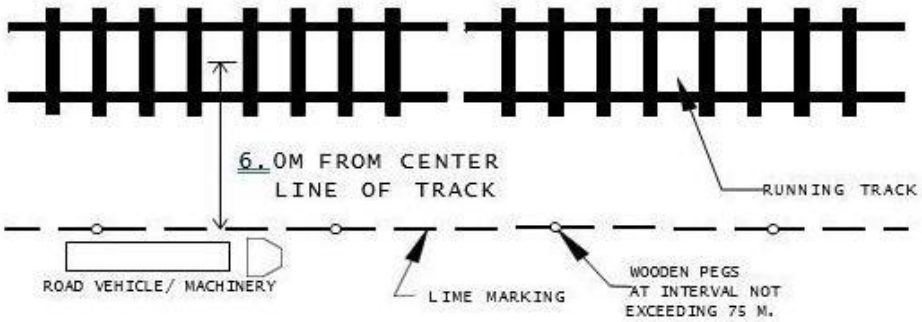
F. Supplementary site-specific instructions, wherever considered necessary shall be issued by the HRIDC's representative.

2.2 PLYING OF ROAD VEHICLES AND WORKING OF MACHINERIES CLOSE TO RUNNING TRACKS

A. Normally, the road vehicles shall be run, or machinery shall be worked so as not to come closer than 6.0m from centre line of nearest running track.

B. The land strip adjacent to running tracks, where road vehicle is to ply or machinery is to work, shall be demarcated by lime in advance in consultation with the Railway's &

HRIDC's Engineer. Wooden pegs at interval not exceeding 75mtr. shall be provided along the line marking as permanent marks. The road vehicles shall ply or machinery shall work so as not to infringe the line of demarcation.



C. If a road vehicle or machinery is to work closer to 6.0m due to site conditions or requirement of work, following precautions shall be observed:

a) In no case the road vehicle shall run or machinery shall work at distance less than 3.5m from centre line of track.

b) Demarcation of land shall be done by bright colored ribbon/nylon cord suspended on 120 cm high wooden/bamboo posts at distance of 3.5 m from centre line of nearest running track.

c) Presence of an authorized HRIDC's representative shall be ensured before plying of vehicle or working of machinery.

d) Railway's Supervisor shall issue suitable caution order to Drivers of approaching train about road vehicles plying or machineries working close to running tracks. The train drivers shall be advised to whistle freely to warn about the approaching train. Whistle boards shall be provided wherever considered necessary.

e) Lookout men shall be posted along the track at a distance of 800m from suchlocations who will carry red flag and whistles to warn the road vehicle/machinery users about the approaching trains.

f) On curves where visibility is poor, additional lookout men shall be posted.

D. If vehicle/machinery is to be worked closer to 3.5m from running track - Under unavoidable conditions, if road vehicles is to ply or machinery is to work closer to 3.5m due to site conditions or requirement of work, following precautions shall be observed:

a) Plying of vehicles or working of machinery closer to 3.5m of running track shall be done only under protection of track. Traffic block shall be imposed wherever considered necessary. The site shall be protected as per provisions of Para No. 806 & 807 of P-Way Manual as case may be.

b) Presence of a Railway's/, HRIDC's Supervisor shall be ensured at worksite.

c) Railway's& HRIDC's Supervisor shall issue suitable caution order to Drivers of approaching train about road vehicles plying or machineries working close to running tracks. The train drivers shall be advised to whistle freely to warn about the approaching train.

E. Precaution to be taken while reversing road vehicle alongside the track

The location where vehicle will take a turn shall be demarcated duly approved by Railway's/HRIDC's representative. The road vehicle driver shall always face the Railway track during the course of turning/reversing his vehicle. Presence of an authorized

Railway/HRIDC representative shall be ensured at such location.

F. Road vehicle shall not be allowed to run along the track during night hours generally. In unavoidable situations, however, vehicles shall be allowed to work during night hours only in the presence of an authorized Railway's/HRIDC's representative and whereadequate lighting arrangements are made and where adequate precautions as mentioned earlier have been ensured.

G. Road vehicles/machinery/plant etc. when stabled near running tracks shall be properly secured against any possible roll off and always be manned even during off hours.

2.3 EXECUTION OF WORKS CLOSE TO OR ON RUNNING LINES

A. Any work close to or on running tracks shall be executed under the presence of a HRIDC's Supervisor only.

B. **Precaution to be taken to ensure safety of trains while execution of work close to the running line or on running lines**.

a) Such works shall be planned and necessary drawings particularly with regard to infringement to moving dimensions shall be finalized duly approved by competent authority before execution of work. The work shall be executed only as per approved procedure and drawings.

b) All temporary arrangements required to be made during execution of work shall be made in such a manner that moving dimension do not infringe.

c) Suitable speed restriction shall be imposed, or Traffic block shall be ensured as required. *The requirement of Traffic and Power Blocks shall be submitted by the Contractor to the Engineer for approval. The Traffic and Power Blocks will be finalized in consultation with Delhi Division of Northern Railway. No cost shall be charged for Traffic and Power Blocks from the Contractor.*

d) Necessary equipment for safety of trains during emergency shall be kept ready at site.

C. Precaution to be taken to ensure safety of electrical/signal/ telephone cables while excavating near tracks.

a) Particular care shall be taken to mark the locations of buried electrical/signal/telephone cables on the plans jointly with S & T/Electric supervisor and also at site so that these are not damaged during excavation.

b) Copy of the cable plan should be given to the contractor's authorized representative before handing over the site to start the work.

c) Due care shall be taken to ensure that any part of the equipment or machinery or temporary arrangement does not come close to cables while working.

d) Joint procedure order No. 17/2013 issued by Railway Board vide letter No.2003/Tele/RCIL/1 Pt IX dated 24.06.2013 shall be followed for undertaking digging work in the vicinity of underground signaling, electrical and telecommunication cables.

D. Precaution to be taken during execution of works requiring traffic blocks.

a) Any work, which infringes the moving dimensions, shall be started only after the traffic block has been imposed.

b) Before closing the work, the track shall be left with the proper track geometry so that the trains run safely.

c) After completion of work the released sleeper and fittings should be properly stacked away from the track to be kept clear of moving dimensions.

d) Block shall be removed only when all the temporary arrangement, machineries, tools, plants etc. have been kept clear of moving dimensions.

E. Precaution to be taken during execution of works during night:

The work close to running line, generally, shall be carried out only during day hours. At locations, however, where night working is unavoidable, proper lighting arrangement should be made. The engineering indicator boards shall be lighted during night hours as per the provisions of IRPWM. The staff deputed for night working should have taken adequate rest before deploying them in night shift. We can specify duration of night shift from 20.00 hrs to 04.00 hrs. All other safety precautions applicable for daytime work should be strictly observed during night working.

F. Precautions to be taken to ensure safety of workers while working close to running lines:

a) Necessary lookout men with red flags and whistles shall be provided to warn the workmen about the approaching train.

b) Railway's/HRIDC's supervisor shall issue suitable caution order to Drivers of approaching train for whistling to warn the workers about the approaching train. Whistle boards shall be provided wherever considered necessary.

c) A "First aid kit" shall always be kept ready at site

G. Precaution shall be taken for safety of public or passengers, while executing works at locations, used by passengers and public

The worksite shall be suitably demarcated to keep public and passengers away from work area. Necessary signage boards such as "Work in progress. Inconvenience is regretted" etc. shall be provided at appropriate locations to warn the public/ passengers. Adequate lighting arrangement of worksite wherever required shall be done to ensure safety of public/passengers during night.

H. Precaution to be taken before stacking materials alongside the track to ensure that safety of trains is not affected –

The following precautions shall be taken before stacking the materials along the track for stacking of ballast, rails, sleepers etc.

a) The sites for material stacking should be selected in advance in such a manner as to ensure that no part of the material to be stacked is infringing the Standard Moving Dimensions. A plan of proposed stacking locations be made and signed jointly by an authorized HRIDC's/Railway's representative and contractor's representative.

b) The selected locations shall be marked by lime in advance.

c) Presence of an authorized HRIDC's/Railway's representative while unloading and stacking shall be ensured.

d) The material shall be stacked in such a height so as to not to infringe SOD in case of accidental roll off.

I. Precaution for handling of departmental material trains –

Instructions for working of material trains are contained in Chapter VIII of IRPWM which should be brought to the notice of the supervisors and other staff working on the material trains. In addition to this,following precautions should be taken:

a) Issue of 'fit to run' certificate:

As per Para 848 before a material train is allowed to work, the complete rake should be examined by the Carriage and Wagon staff and a 'fit to run' certificate issued tothe Guard.

b) As per Para 849 of IRPWM, a qualified Engineering official should be deputed on the train to ensure working of the material train as the Guard is not qualified to carry out such duties like Supervising of loading and unloading of materials.

c) As per Para 845 of IRPWM, the material train should not be permitted to work during the period of poor visibility due to fog, storm or any other cause except with the permission of the ADEN/DEN. Working of the material trains carrying labour should not be permitted between sunset and sunrise except in an emergency.

d) While unloading rail panels by the side of the running track, placement of the panels, clear of the maximum moving dimensions should be ensured.

e) Unloading of rail panels should be done by a team of trained staff under the active supervision of competent Supervisor/Officer.

f) Before unloading of rail panels, site should be prepared by way of leveling/removing extra ballast, if any, from the crib and shoulder with the objective to ensure requisite lateral and vertical clearances so as to prevent slippage of rail panels due to vibration during the passage of trains.

g) Reasonably adequate block should be asked and provided for unloading of the material and the work should be done preferably in day light to avoid shortcut in haste which may infringe the safety requirements.

J. Safety aspects to be observed while working in OHE area

a) No electrical work close to running track shall be carried out without permission of HRIDC representative.

b) A minimum distance of 2m has to be maintained between live OHE wire and body part of worker or tools or metallic supports etc.

c) No electric connection etc. can be tapped from OHE.

d) Authorized OHE staff should invariably be present when the relaying work or any major work is carried out.

e) Power block is correctly taken and 'permit to work' is issued.

f) The structure bonds, track bonds, cross bonds, longitudinal rail bonds are not disturbed and if disconnected for the work, they are reconnected properly when the work is completed.

g) The track level is not raised beyond the permissible limit during the work

2.4 PROTECTION OF TRACK DURING EMERGENCY

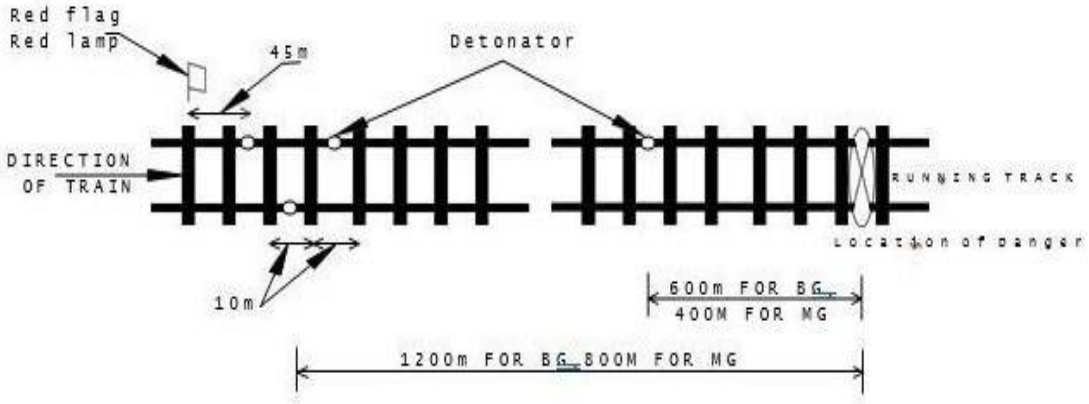
A. Action to be taken when a contractor's supervisor or vehicle operator apprehends any unusual circumstances likely to infringe the track and endanger safe running of trains.

a) At any time if a contractor's supervisor or vehicle operator observes any unusual circumstances likely to infringe the track and apprehend danger to safe running of track, he shall take immediate steps to advise a HRIDC official of such danger and assist him in protection of track.

b) The track shall be protected as under. One person shall immediately plant a red flag (red lamp during night) at the spot and proceed with all haste in the direction of approaching train with a red flag in hand (red lamp during night) and plant a detonator on rail at a distance of 600m from the place of obstruction of BG track (400m for MG track) after which he shall further proceed for not less than 1200m from the place of obstruction from BG track (800m for MG track) and plant three detonators at 10m apart on rails. After this he shall display the red flag (red lamp during night) at a distance of

45m from the detonators.

c) Attempts shall also be made to send an advice to nearest Railway/HRIDC station about the incident immediately.



B. Action to be taken if train is seen approaching to site of danger and there is no time to protect the track as per guidelines mentioned above.

In such a case the detonators shall be planted on rails immediately at distance away from place of danger as far as possible and attention of driver of approaching train shall be invited by whistling, waving the red flag vigorously, gesticulating and shouting.

C. What action shall be taken if more than one track is obstructed.

a) In case of single line protection as above shall be done in both the directions from place of danger.

b) In case of double line or multiple lines, if other tracks are also obstructed, theprotection as above shall be done for other track also.

c) The protection shall be done in that direction and on that track first on which train is likely to arrive first.

d) The Contractor's Supervisors, Operators and lookout men shall be properly explained about the direction of trains on running tracks.

D. Equipment required for protection of track.

Minimum compliment of protection equipment i.e. 10 detonators, 4 red hand flags, 4 red hand lamps, 4 banner flags and whistles etc. shall always be kept ready at worksites for use in case of emergency. HRIDC will arrange to provide detonators, whereas Contractor shall arrange other equipment at his own cost.

E. Arrangement of lookout men and competency required for lookout man to warn labour about approaching train.

a) Contractor will provide lookout men.

b) The lookout men shall be properly trained in warning to staff at worksite about approaching train.

c) Only those lookout men shall be provided at site who have been issued with a competency certificate by the Railway's/HRIDC's Supervisor.

d) In case, it is felt necessary to provide lookout men by Contractor, the charges for the same as fixed by HRIDC Administration shall be recovered from Contractor.

2.5 Training to Supervisors and Operators of Contractor

The Supervisors and Operators of the contractor proposed to be deployed at wok site, which is close to the running track, shall be imparted mandatory training by the HRIDC at site free of cost about the safety measures to be adopted while working in the vicinity of running track. HRIDC's Engineer-in charge of the work shall decide the scale, extent & adequacy of training. In case training is imparted at a recognized Railway training institute, the charges for the same, as decided by HRIDC, shall be recovered from the Contractor. A competency certificate to this effect to the individual Supervisor/Operator shall be issued as given below,by a HRIDC Officer not below the rank of DGM/HRIDC. No Supervisor/Operator of the Contractor shall work or allowed to work in the vicinity of running track that is not in possession of valid competency certificate.

All the labour, materials, tools, plants etc. except detonators, required for ensuring safe running of trains shall be provided by Contractor at his own cost. Wherever lookout men are provided by HRIDC, charges at the rate of Rs. 1000/- per man day shall be recovered from Contractor.

A sample of training competency certificate is provided below for reference:

Competency Certificate

Certified that Shri …… Supervisor/Operator of M/s. ……has been trained and examined in safety measures to be followed while working in the vicinity of running railway track for the work. His knowledge has been found satisfactory and he is capable of supervising the work safely.

This certificate is valid only for the work mentioned in this certificate only.

Signature and designation of the officer

Bid Document for Works

(Two-Envelope Bidding Process)

Name of work: Contract Package MNS-01: Composite Works Contract for Design and Construction of Station Building, balance works of IMD Building, Electrical, S&T and track maintenance office S&T huts, station approach roads including General Electrical Services and other associated works at Manesar in connection with laying of New BG Double Railway Line of Haryana Orbital Rail Corridor (HORC) Project.

Bid No: HORC/HRIDC/MNS-01/STN/2025

Contract title: Composite Works Contract (Civil, Electrical, Road works and other associated works)

Project: Haryana Orbital Rail Corridor Project

Employer: Haryana Orbital Rail Corporation Limited

Country: INDIA

Issued on: 06.02.2025

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General Conditions

1. General Provisions

1.1 Definitions In the Conditions of Contract ("these Conditions"), which include Special Conditions of Contract, Parts A and B, and these General Conditions, the following words and expressions shall have the meanings stated. Words indicating persons or parties include corporations and other legal entities, except where the context requires otherwise.

1.1.1 The Contract

1.1.1.1 "**Contract**" means the Contract Agreement, the Letter of Acceptance, the Letter of Bid, these Conditions, the Specification, the Drawings, the Schedules, and the further documents (if any) which are listed in the Contract Agreement or in the Letter of Acceptance.

1.1.1.2 "**Contract Agreement"** means the contract agreement (*if any*) **referred** to in Sub-Clause 1.6 [Contract Agreement].

1.1.1.3 **"Letter of Acceptance**" means the letter of formal acceptance, signed by the Employer, of the Letter of Bid, including any annexed memoranda comprising agreements between and signed by both Parties. If there is no such letter of acceptance, the expression "Letter of Acceptance" means the Contract Agreement and the date of issuing or receiving the Letter of Acceptance means the date of signing the Contract Agreement.

1.1.1.4 **"Letter of Bid"** means the document entitled letter of bid, which was completed by the Contractor and includes the signed offer to the Employer for the Works.

1.1.1.5 **"Specification**" means the document entitled specification, as included in the Contract, and any additions and modifications to the specification in accordance with the Contract. Such document specifies the Works.

1.1.1.6 **"Drawings"** means the drawings of the Works, as included in the **Contract**, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract.

1.1.1.7 **"Schedules"** means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Bid, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices.

1.1.1.8 **"Bid/Tender"** means the Letter of Technical Bid **and** Letter of Price Bid and all other documents which the Contractor submitted with the Letter of Technical Bid and Letter of Price Bid , as

included in the Contract.

1.1.1.9 **"Bill of Quantities"** and **"Daywork Schedule**" and "Schedule of Payment Currencies" mean the documents so named (if any) which are comprised in the Schedules.

1.1.1.10 **"Contract Data"** means the pages completed by the Employer entitled contract data which constitute Part A of the Special Conditions of Contract.

1.1.1.11 **"Works' Requirements"** means the document entitled Works Requirements and as included in the Contract, and any additions and modifications to such document in accordance with the Contract. Such document specifies the purpose, scope, and/or design and/or other technical criteria, for the works.

1.1.2 Parties and Persons

1.1.2.1 **"Party"** means the Employer or the Contractor, as the context requires.

1.1.2.2 **"Employer"** means the person named as employer in the Contract Data and the legal successors in title to this person.

1.1.2.3 **"Contractor"** means the person(s) named as contractor in the Letter of Bid accepted by the Employer and the legal successors in title to this person(s).

1.1.2.4 **"Engineer"** means the person nominated by the Employer to act as the Engineer for the purposes of the Contract and named in the Contract Data, or other person appointed from time to time by the Employer and notified to the Contractor under Sub-Clause 3.4 [Replacement of the Engineer].

1.1.2.5 **"**Contractor's **Representative"** means the person named by the Contractor in the Contract or appointed from time to time by the Contractor under Sub-Clause 4.3 [Contractor's Representative], who acts on behalf of the Contractor.

1.1.2.6 "Employer's **Representative"** means the person named by the Employer in the Contract or appointed from time to time by the Employer who acts on behalf of the Employer.

1.1.2.7 **"Employer's Personnel"** means the Engineer, the assistants referred to in Sub-Clause 3.2 [Delegation by the Engineer] and all other staff, labour and other employees of the Engineer and of the Employer; and any other personnel notified to the Contractor, by the Employer or the Engineer, as Employer's Personnel.

1.1.2.8 **"Contractor's Personnel"** means the Contractor's Representative and all personnel whom the Contractor utilises on Site, who may include the staff, labour and other employees of the Contractor and of each Subcontractor; and any other personnel assisting the Contractor in the execution of the Works.

1.1.2.9 **"**Subcontractor**"** means any person named in the Contract as a

subcontractor, or any person appointed as a subcontractor, for a part of the Works; and the legal successors in title to each of these persons.

1.1.3 Dates, Tests, Periods and Completion

1.1.3.1 **"Base Date"** means the date 28 days prior to the deadline for submission of bids.

1.1.3.2 **"**Commencement **Date**" means the date notified under Sub-Clause 8.1 [Commencement of Works].

1.1.3.3 **"Time for Completion"** means the time for completing the Works or a Section (as the case may be) and Key Dates under Sub-Clause 8.2 [Time for Completion] , as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

1.1.3.4 **"Tests on Completion"** means the tests which are specified in the Contract or agreed by both Parties or instructed as a Variation, and which are carried out under Clause 9 [Tests on Completion] before the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.5 **"Taking-Over Certificate"** means a certificate issued under Clause 10 [Employer's Taking Over].

1.1.3.6 **"Tests after Completion"** means the tests (if any) which are specified in the Contract and which are carried out in accordance with the Specification after the Works or a Section (as the case may be) are taken over by the Employer.

1.1.3.7 **"Defects Notification Period"** means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects], as stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

1.1.3.8 **"Performance Certificate"** means the certificate issued under Sub-Clause 11.9 [Performance Certificate].

1.1.3.9 "**Day"** means any (working or non-working) calendar day from 00:00 hrs. to 24:00 hrs.

1.1.3.10 **"Months"** means any calendar month of the Gregorian calendar year.

1.1.3.11 **"Year"** means 365 days

1.1.3.12 "**Time** Periods" Any reference to time period commencing "from" the specified day or date "till" or "until" a specified day shall

include both such days.

1.1.3.13 Any reference to **"Time"** shall be according to Indian Standard Time (IST).

1.1.4 Money and Payments

1.1.4.1 "**Accepted Contract Amount"** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. In the Letter of Acceptance, the Accepted Contract Amount shall have two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

1.1.4.2 **"Contract Price"** means the price defined in Sub-Clause 14.1 [The Contract Price], and includes adjustments in accordance with the Contract.

1.1.4.3 **"Cost"** means all expenditure reasonably incurred (or to be incurred) by the Contractor, whether on or off the Site, including overhead and similar charges, but does not include profit.

1.1.4.4 **"Final** Payment **Certificate"** means the payment certificate issued under Sub-Clause 14.13 [Issue of Final Payment Certificate].

1.1.4.5 **"Final Statement"** means the statement defined in Sub-Clause 14.11 [Application for Final Payment Certificate].

1.1.4.6 **"Foreign Currency"** means a currency in which part (or all) of the Contract Price is payable, but not the Local Currency.

1.1.4.7 **"Interim Payment Certificate**" means a payment certificate issued under Clause 14 [Contract Price and Payment], other than the Final Payment Certificate.

1.1.4.8 **"Local Currency"** means the currency in Indian Rupees.

1.1.4.9 **"Payment Certificate"** means a payment certificate issued under Clause 14 [Contract Price and Payment].

1.1.4.10 **"Provisional Sum"** means a sum (if any) which is specified in the Contract as a provisional sum, for the execution of any part of the Works or for the supply of Plant, Materials or services under Sub-Clause 13.5 [Provisional Sums].

1.1.4.11 **"Retention Money"** means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause 14.9 [Payment of Retention Money].

1.1.4.12 **"Statement"** means a statement submitted by the Contractor as part of an application, under Clause 14 [Contract Price and Payment], for a payment certificate.

1.1.5 Works and

1.1.5.1 **"Contractor's Equipment**" means all apparatus, machinery,

Goods vehicles and other things required for the execution and completion of the Works and the remedying of any defects. However, Contractor's Equipment excludes Temporary Works, Employer's Equipment (if any), Plant, Materials and any other things intended to form or forming part of the Permanent Works.

1.1.5.2 **"Goods"** means Contractor's Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 **"Materials"** means things of all kinds (other than Plant) intended to form or forming part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

1.1.5.4 **"Permanent Works"** means the permanent works to be executed by the Contractor under the Contract.

1.1.5.5 **"Plant"** means the apparatus, machinery and vehicles intended to form or forming part of the Permanent Works.

1.1.5.6 **"Section**" means a part of the Works specified in the Contract Data as a Section (if any).

1.1.5.7 **"Temporary Works"** means all temporary works of every kind (other than Contractor's Equipment) required on Site for the execution and completion of the Permanent Works and the remedying of any defects.

1.1.5.8 **"Works"** mean the Permanent Works and the Temporary Works, or either of them as appropriate.

1.1.6 Other Definitions

1.1.6.1 **"Contractor's** Documents" means the calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract.

1.1.6.2 **"Country**" means India, the country in which the Site (or most of it) is located, where the Permanent Works are to be executed.

1.1.6.3 **"Employer's Equipment**" means the apparatus, machinery and vehicles (if any) made available by the Employer for the use of the Contractor in the execution of the Works, as stated in the Specification; but does not include Plant which has not been taken over by the Employer.

1.1.6.4 **"Force Majeure**" is defined in Clause 19 [Force Majeure].

1.1.6.5 **"Laws"** means all national (or state) legislation, statutes, ordinances and other laws, and regulations and by-laws of any legally constituted public authority.

1.1.6.6 **"Performance Security**" means the security (or securities, if any) under Sub-Clause 4.2 [Performance Security].

1.1.6.7 **"Site"** means the places where the Permanent Works are to be executed , including storage and working area, and to which Plant

and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

1.1.6.8 **"Unforeseeable**" means not reasonably foreseeable and against which adequate preventive precautions could not reasonably be taken by an experienced contractor by the date for submission of the Bid.

1.1.6.9 **"Variation**" means any change to the Works, which is instructed or approved as a variation under Clause 13 [Variations and Adjustments].

1.1.6.10 **"Railway"** means a railway, or any portion of a railway for public carriage of passengers and goods as defined in the Railways ACT 1989. Any reference to railway means the Indian Railways and the respective Zonal Railway

1.2 Interpretation In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree," "agreed" or "agreement" require the agreement to be recorded in writing;

(d) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and

(e) the word "tender" is synonymous with "bid", and "tenderer" with "bidder" and the words "tender documents" with "bidding documents"

The marginal words and other headings shall not be taken into consideration in the interpretation of these Conditions.

In these Conditions, provisions including the expression "Cost plus profit" require this profit to be one twentieth (5%) of this Cost unless otherwise indicated in the Contract Data.

1.3 Communications Wherever these Conditions provide for the giving or issuing of approvals, certificates, consents, determinations, notices, requests and discharges, these communications shall be:

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient's communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was

issued.

Approvals, certificates, consents and determinations shall not be unreasonably withheld or delayed. When a certificate is issued to a Party, the certifier shall send a copy to the other Party. When a notice is issued to a Party, by the other Party or the Engineer, a copy shall be sent to the Engineer or the other Party, as the case may be.

1.4 Law and Language

The Contract shall be governed by the law of the country or other jurisdiction stated in the Contract Data.

The ruling language of the Contract shall be that stated in the Contract Data.

The language for communications shall be that stated in the Contract Data. If no language is stated there, the language for communications shall be the ruling language of the Contract.

1.5 Priority of Documents

The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence:

(a) the Contract Agreement (if any),

(b) the Letter of Acceptance,

(c) the Letter of bid,

(d) the Schedules (including Priced Bill of Quantities),

(e) Special Conditions of Contract:

  (i) Part A – Contract Data

  (ii) Part B - Specific Provisions

(f) the General Conditions of Contract

(g) Works Requirements,

(h) the Drawings,

(i) any other documents forming part of the Contract including minutes of prebid meeting.

If an ambiguity or discrepancy is found in the documents, the Engineer shall issue any necessary clarification or instruction.

1.6 Contract Agreement

The Parties shall enter into a Contract Agreement within 28 days after the Contractor receives the Letter of Acceptance, unless they agree otherwise. The Contract Agreement shall be based upon the form annexed to the Special Conditions of Contract. The costs of stamp duties and similar charges (if any) imposed by law in connection with entry into the Contract Agreement shall be borne by the Employer.

1.7 Assignment

Neither Party shall assign the whole or any part of the Contract or any benefit or interest in or under the Contract. However, either Party:

(a) may assign the whole or any part with the prior agreement of the other Party, at the sole discretion of such other Party, and

(b) may, as security in favour of a bank or financial institution, assign its right to any moneys due, or to become due, under the Contract.

1.8 Care and Supply of Documents

The Specification and Drawings shall be in the custody and care of the Employer. Unless otherwise stated in the Contract, two copies of the Contract and of each subsequent Drawing shall be supplied to the Contractor, who may make or request further copies at the cost of the Contractor.

Each of the Contractor's Documents shall be in the custody and care of the Contractor, unless and until taken over by the Employer. Unless otherwise stated in the Contract, the Contractor shall supply to the Engineer six copies of each of the Contractor's Documents.

The Contractor shall keep, on the Site, a copy of the Contract, publications named in the Specification, the Contractor's Documents (if any), the Drawings and Variations and other communications given under the Contract. The Employer's Personnel shall have the right of access to all these documents at all reasonable times.

If a Party becomes aware of an error or defect in a document which was prepared for use in executing the Works, the Party shall promptly give notice to the other Party of such error or defect.

1.9 Delayed Drawings or Instructions

The Contractor shall give notice to the Engineer whenever the Works are likely to be delayed or disrupted if any necessary drawing or instruction is not issued to the Contractor within a particular time, which shall be reasonable. The notice shall include details of the necessary drawing or instruction, details of why and by when it should be issued, and details of the nature and amount of the delay or disruption likely to be suffered if it is late.

If the Contractor suffers delay and/or incurs Cost as a result of a failure of the Engineer to issue the notified drawing or instruction within a time which is reasonable and is specified in the notice with supporting details, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Engineer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time, Cost or profit

1.10 Employer's Use of Contractor's Documents

As between the Parties, the Contractor shall retain the copyright and other intellectual property rights in the Contractor's Documents and other design documents made by (or on behalf of) the Contractor.

The Contractor shall be deemed (by signing the Contract) to give to the Employer a non-terminable transferable non-exclusive royalty-free licence to copy, use and communicate the Contractor's Documents, including making and using modifications of them. This licence shall:

(a) apply throughout the actual or intended working life (whichever is longer) of the relevant parts of the Works,

(b) entitle any person in proper possession of the relevant part of the Works to copy, use and communicate the Contractor's Documents for the purposes of completing, operating, maintaining, altering, adjusting, repairing and demolishing the Works, and

(c) in the case of Contractor's Documents which are in the form of computer programs and other software, permit their use on any computer on the Site and other places as envisaged by the Contract, including replacements of any computers supplied by the Contractor.

The Contractor's Documents and other design documents made by (or on behalf of) the Contractor shall not, without the Contractor's consent, be used, copied or communicated to a third party by (or on behalf of) the Employer for purposes other than those permitted under this Sub-Clause.

1.11 Contractor's Use of Employer's Documents

As between the Parties, the Employer shall retain the copyright and other intellectual property rights in the Specification, the Drawings and other documents made by (or on behalf of) the Employer. The Contractor may, at his cost, copy, use, and obtain communication of these documents for the purposes of the Contract. They shall not, without the Employer's consent, be copied, used or communicated to a third party by the Contractor, except as necessary for the purposes of the Contract.

1.12 Confidential Details

The Contractor shall disclose all such confidential and other information as the Engineer may reasonably require in order to verify the Contractor's compliance with the Contract.

The Contractor shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out the Contractor's obligations under the Contract or to comply with applicable Laws. The Contractor shall not publish or disclose any particulars of the Works without the previous agreement of the

Employer. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects.

1.13 Compliance with Laws

The Contractor shall, in performing the Contract, comply with applicable Laws. Unless otherwise stated in the Special Conditions of Contract:

(a) the Employer shall have obtained (or shall obtain) the planning, zoning or similar permission for the Permanent Works, and any other permissions described in the Specification as having been (or being) obtained by the Employer; and the Employer shall indemnify and hold the Contractor harmless against and from the consequences of any failure to do so; and

(b) the Contractor shall give all notices, pay all taxes, duties and fees, and obtain all permits, licences and approvals, as required by the Laws in relation to the execution and completion of the Works and the remedying of any defects; and the Contractor shall indemnify and hold the Employer harmless against and from the consequences of any failure to do so.

1.14 Joint and Several Liability

If the Contractor constitutes (under applicable Laws) a joint venture of two or more persons/firms:

(a) these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;

(b) these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and

(c) the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

(d) In the event of default by any partner of joint venture, on or after achieving 25% of the financial progress (excluding advance if any) the lead partner or remaining partner(s), in case the defaulting partner is the lead partner, shall notify the Employer within twenty eight (28) days of the occurrence and within Fifty six (56) days of the said notification, the lead partner or remaining partner(s), who are not the defaulting partner, shall assign the works of the defaulting partner, to equally competent party with prior consent of the Employer. For this purpose the term "equally competent party" shall mean as under:

"The new JV partner replacing the defaulting partner should meet the EQC requirement of package/combination of packages which was met by the defaulting partner on the basis of which the original tender was awarded."

The replacement of any defaulting partner, with the new partner shall be subject to the condition that the new partner has to submit additional performance security equal to 10% of balance cost of work of the JV partner being replaced. The performance security submitted by the defaulting partner shall also continue with EMPLOYER till satisfactory completion of the work.

(e) Notwithstanding the consent of the Employer for change in composition or legal status of the joint venture the partners shall continue to be jointly and severally liable to the Employer.

(f) The joint venture shall enter into a joint venture agreement incorporating the provisions of sub-paras (a) to (e) based upon the form annexed to the Conditions of Contract. The JV agreement shall indicate precisely the specific role of all members of the JV in respect of planning, design, construction equipment, key personnel, work execution, and financing of the project. The authority to sign the agreement shall be evidenced by approved legal instruments.

Notwithstanding the contents of the sub-clauses above, if the performance of any JV partner is not found satisfactory by the Employer, in respect of the responsibilities assigned to him as per JV agreement which is a part of this agreement, the Employer may issue notice of such default to the said JV partner or the JV (depending upon reasons of default) and declare the said JV partner or the JV as Poor Performer. The issue of such notice shall automatically debar the JV partner or JV as the case may be from participating in any EMPLOYER tender from the date of issue of notice of default.

1.15 Inspections by the Employer The Contractor shall permit the Employer and/or persons appointed by the Employer to inspect the Site and/or the Contractor's records relating to the performance of the Contract.

2. The Employer

2.1 Right of Access to the Site The Employer shall give the Contractor right of access to, and possession of, all parts of the Site within the time (or times) stated in the Contract Data. The right and possession may not be exclusive to the Contractor. If, under the Contract, the Employer is required to give (to the Contractor) possession of any foundation, structure, plant or means of access, the Employer shall do so in the time and manner stated in the Specification. However, the Employer may withhold any such right or possession until the Performance Security has been received.

If no such time is stated in the Contract Data, the Employer shall give the Contractor right of access to, and possession of, the Site within such times as may be required to enable the Contractor to proceed in accordance with the programme submitted under Sub-Clause 8.3 [Programme].

If the Contractor suffers delay as a result of a failure by the Employer to give any such right or possession within such time, the Contractor shall give notice to the Engineer and shall be entitled to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) new rates in terms of clause 12.3.1 (c).

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

However, if and to the extent that the Employer's failure was caused by any error or delay by the Contractor, including an error in, or delay in the submission of, any of the Contractor's Documents, the Contractor shall not be entitled to such extension of time or new rates.

2.2 Permits, Licenses or Approvals

The Employer shall (where he is in a position to do so) provide reasonable assistance to the Contractor at the request of the Contractor:

(a) by obtaining copies of the Laws of the Country which are relevant to the Contract but are not readily available, and

(b) for the Contractor's applications for any permits, licences or approvals required by the Laws of the Country:

(i) which the Contractor is required to obtain under Sub-Clause 1.13 [Compliance with Laws],

(ii) for the delivery of Goods, including clearance through customs, and

(iii) for the export of Contractor's Equipment when it is removed from the Site.

2.3 Employer's Personnel

The Employer shall be responsible for ensuring that the Employer's Personnel and the Employer's other contractors on the Site:

(a) co-operate with the Contractor's efforts under Sub-Clause 4.6 [Co-operation], and

(b) take actions similar to those which the Contractor is required to take under sub-paragraphs (a), (b) and (c) of Sub-Clause 4.8 [Safety Procedures] and under Sub-Clause 4.18 [Protection of the Environment].

2.4 Employer's Financial Arrangements

The Employer has sourced the funds to finance the project.

2.5 Employer's Claims

If the Employer considers himself to be entitled to any payment under any Clause of these Conditions or otherwise in connection with the Contract, and/or to any extension of the Defects Notification Period, the Employer or the Engineer shall give notice and particulars to the Contractor. However, notice is not required for payments due under Sub-Clause 4.19 [Electricity, Water and Gas], under Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], under Sub-Clause 8.7 [Extension of Time for Completion with Delay Damages] or under Sub-Clause 8.7.1 [Delay Damages for failure to achieve Key Dates] or for other services requested by the Contractor.

The notice shall be given as soon as practicable after the Employer became aware, or should have become aware, of the event or circumstances giving rise

to the claim. A notice relating to any extension of the Defects Notification Period shall be given before the expiry of such period.

The particulars shall specify the Clause or other basis of the claim, and shall include substantiation of the amount and/or extension to which the Employer considers himself to be entitled in connection with the Contract. The Engineer shall then proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the amount (if any) which the Employer is entitled to be paid by the Contractor, and/or (ii) the extension (if any) of the Defects Notification Period in accordance with Sub-Clause 11.3 [Extension of Defects Notification Period].

This amount may be included as a deduction in the Contract Price and Payment Certificates. The Employer shall only be entitled to set off against or make any deduction from an amount certified in a Payment Certificate, or to otherwise claim against the Contractor, in accordance with this Sub-Clause.

3. The Engineer

3.1 Engineer's Duties and Authority

The Employer shall appoint the Engineer who shall carry out the duties assigned to him in the Contract. The Engineer's staff shall include suitably qualified engineers and other professionals who are competent to carry out these duties.

The Engineer shall have no authority to amend the Contract.

The Engineer may exercise the authority attributable to the Engineer as specified in or necessarily to be implied from the Contract.

However, the Engineer shall obtain the specific approval of the Employer before taking action under the-following Sub-Clauses of these Conditions:

(a) Sub-Clause 4.12-Unforeseeable Physical Conditions: Agreeing or determining an extension of time and/or additional cost.

(b) Sub-Clause 8.4-Extension of Time for Completion: Agreeing or determining extension of time.

(c) Sub-Clause 11.9-Performance Certificate: Issue of Performance Certificate.

(d) Sub-Clause 13.1-Instructing a Variation: Except,

i) in an emergency situation as determined by the Engineer and as amplified in sub-paras (h) and (i) below, or

ii) for other situations, if the variation in quantity of any item does not exceed 25% of the stipulated quantity in the agreement, the variation in quantity in such item does not result in increase in excess of 0.1% of contract price and variation in quantity in such item does not result in cumulative variation in contract price in excess of 2%.

(e) Sub-Clause 13.3-Variation Procedure: Approving a proposal for Variation submitted by the Contractor in accordance with Sub Clause 13.1 or 13.2.

(f) Sub-Clause 13.4-Payment in applicable Currencies: Specifying the amount payable in each of the applicable currencies for a Variation.

(g) Clause 20.1: Contractor Claims for extension of time and/or additional payment.

(h) Notwithstanding the obligation, as set out above, to obtain approval, if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Employer.

(i) In case the emergency mentioned in above Sub-paras occurs on account of failure of Contractor, by way of not adhering to the approved scheme of work or not taking adequate safety precautions or by any other reason attributable to the contractor, then no additional amounts shall be paid to the Contractor for attending to such emergencies and the Contractor shall be liable for Employer's claims.

(j) Sub-clause 4.4 regarding deployment of Sub-Contractors.

3.2 Delegation by the Engineer

The Engineer may from time to time assign duties and delegate authority to assistants, and may also revoke such assignment or delegation. These assistants may include a resident engineer, and/or independent inspectors appointed to inspect and/or test items of Plant and/or Materials. The assignment, delegation or revocation shall be in writing and shall not take effect until copies have been received by both Parties.

However, unless otherwise agreed by both Parties, the Engineer shall not delegate the authority to determine any matter in accordance with Sub-Clause 3.5 [Determinations].

Assistants shall be suitably qualified persons, who are competent to carry out these duties and exercise this authority, and who are fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language].

Each assistant, to whom duties have been assigned or authority has been delegated, shall only be authorised to issue instructions to the Contractor to the extent defined by the delegation. Any approval, check, certificate, consent, examination, inspection, instruction, notice, proposal, request, test, or similar act by an assistant, in accordance with the delegation, shall have the same effect as though the act had been an act of the Engineer. However:

(a) any failure to disapprove any work, Plant or Materials shall not constitute approval, and shall therefore not prejudice the right of the Engineer to reject the work, Plant or Materials;

(b) if the Contractor questions any determination or instruction of an assistant, the Contractor may refer the matter to the Engineer, who shall promptly confirm, reverse or vary the determination or instruction.

3. Instructions of the Engineer

The Engineer may issue to the Contractor (at any time) instructions and additional or modified Drawings which may be necessary for the execution of the Works and the remedying of any defects, all in accordance with the Contract. The Contractor shall only take instructions from the Engineer, or from an assistant to whom the appropriate authority has been delegated under this Clause. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

The Contractor shall comply with the instructions given by the Engineer or delegated assistant, on any matter related to the Contract. Whenever practicable, their instructions shall be given in writing. If the Engineer or a delegated assistant,

(a) gives an oral instruction and

(b) receives a written confirmation of the instruction, from (or on behalf of) the Contractor, within two working days after giving the instruction, and

(c) does not reply by issuing a written rejection and/or instruction within two working days after receiving the confirmation,

(d) then the confirmation shall constitute the written instruction of the Engineer or delegated assistant (as the case may be).

3.4 Replacement of the Engineer

Notwithstanding Sub-Clause 3.1, if the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the replacement Engineer.

3.5 Determinations

Whenever these Conditions provide that the Engineer shall proceed in accordance with this Sub-Clause 3.5 to agree or determine any matter, the Engineer shall consult with each Party in an endeavour to reach agreement. If agreement is not achieved, the Engineer shall make a fair determination in accordance with the Contract, taking due regard of all relevant circumstances.

The Engineer shall give notice to both Parties of each agreement or determination, with supporting particulars. Each Party shall give effect to each agreement or determination unless and until revised under Clause 20 [Claims, Disputes and Arbitration].

4. The Contractor

4.1 Contractor's General Obligations

The Contractor shall design (to the extent specified in the Contract), execute and complete the Works in accordance with the Contract and with the Engineer's instructions, and shall remedy any defects in the Works.

The Contractor shall provide the Plant and Contractor's Documents specified in the Contract, and all Contractor's Personnel, Goods, consumables and other things and services, whether of a temporary or permanent nature, required in and for this design, execution, completion and remedying of defects.

All equipment, and material, to be incorporated in or required for the Works shall be procured from approved sources as stipulated in the Contract.

The Contractor shall be responsible for the adequacy, stability and safety of all Site operations and of all methods of construction. Except to the extent specified in the Contract, the Contractor (i) shall be responsible for all Contractor's Documents, Temporary Works, and such design of each item of Plant and Materials as is required for the item to be in accordance with the Contract, and (ii) shall not otherwise be responsible for the design or specification of the Permanent Works.

The Contractor shall, whenever required by the Engineer, submit details of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works. No significant alteration to these arrangements and methods shall be made without this having previously been notified to the Engineer.

On completion of the works, the contractor shall arrange to furnish to the Employer two (2) bound sets of all "As Built" drawings for every component of the Works at his own cost, all such copies being on Polyester film of quality to be approved by the Engineer or his Representative. The Taking – over Certificate of the Works, as per the provisions of Clause 10.1 herein, shall not be issued by the Engineer in the event of the Contractor's failure to furnish the aforesaid "As Built" drawings for the entire works.

If the Contract specifies that the Contractor shall design any part of the Permanent Works, then unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall submit to the Engineer the Contractor's Documents for this part in accordance with the procedures specified in the Contract;

(b) these Contractor's Documents shall be in accordance with the Specification and Drawings, shall be written in the language for communications defined in Sub-Clause 1.4 [Law and Language], and shall include additional information required by the Engineer to add to the Drawings for co-ordination of each Party's designs;

(c) the Contractor shall be responsible for this part and it shall, when the Works are completed, be fit for such purposes for which the part is intended as are specified in the Contract; and

(d) prior to the commencement of the Tests on Completion, the Contractor shall submit to the Engineer the "as-built" documents and operation and maintenance manuals in accordance with the Specification and in sufficient detail for the Employer to operate, maintain, dismantle,

reassemble, adjust and repair this part of the Works. Such part shall not be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections] until these documents and manuals have been submitted to the Engineer.

4.2 Performance Security

The Contractor shall obtain (at his cost) a Performance Security and an additional Performance Security, if any in terms of ITB 35.5, for proper performance of the contract, for the amount, currencies and validity period for Performance Security stated in the Contract Data. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

The Contractor shall deliver the Performance Security and additional Performance Security, if any, to the Employer within 28 days after receiving the Letter of Acceptance, and shall send a copy to the Engineer.

In the event the Contractor fails to provide the Performance Security within 28 days from the date of issue of the LOA, it may seek an extension of time for providing the performance security for a period not exceeding a further 14 days on payment of damages for such extended period in a sum calculated at the rate of 0.005% of the Accepted Contract Amount for each day until the Performance Security is provided. The Contractor shall maintain the said Performance Security at its own expense, so that it shall remain in full force and effect until the period specified in the Contract Data.

Whenever Variations and/or adjustments under Clause 13 [Variations and Adjustments] result in an accumulative increase or decrease of the Contract Price by more than twenty percent (20%) of the Accepted Contract Amount:

(a) in the case of such an increase, at the Employer's request the Contractor shall promptly increase the amount of the Performance Security in that currency by a percentage equal to the accumulative increase. If the Contractor incurs Cost as a result of this Employer's request, Sub-Clause 13.3.1 [*Variation by Instruction*] shall apply as if the increase had been instructed by the Engineer; or

(b) in the case of such a decrease, subject to the Employer's prior consent the Contractor may decrease the amount of the Performance Security in that currency by a percentage equal to the accumulative decrease.

The cost of obtaining the Performance Security shall be at the expense of the Contractor. The Contractor shall submit the Performance Security in any of the following forms:

(a) Unconditional and irrevocable Bank Guarantee from the specified banks in the form appearing in Section 8 [Contract Forms] as under:

(i) a scheduled bank (excluding co-operative banks) in India, or

(ii) a Foreign Bank having arrangement with a nationalized bank or scheduled banks (excluding co-operative banks) in India;

(b) Banker's Cheque or Demand Draft drawn on a scheduled bank (excluding co-operative banks) or nationalized bank in India.

The scheduled bank issuing the bank guarantee shall be on "Structure Financial Messaging System (SFMS)" platform. A separate advice of the bank guarantee shall invariably be sent by the issuing bank to Employer's Bank through SFMS and only of the same by the Employer's Bank, the bank guarantee shall become operative and acceptable to the Employer. Further, the bank guarantees in original form along with a copy of "MT760COV (in case of bank guarantee message)/ MT767COV (in case of bank guarantee amendment message) Report" sent by the concerned issuing bank sealed in an envelope shall be submitted to the Employer.

The Issuing Bank shall send the SFMS to:

Beneficiary: Haryana Orbital Rail Corporation Limited.

Bank Name:

IFSC Code:

Note: All the instruments mentioned in (a) & (b) above should be in favour of Haryana Orbital Rail Corporation Limited., IRCON Tower-2, Plot No. 16, Sector-32, Gurugram, Haryana-122018.

The Contractor shall ensure that the Performance Security is valid and enforceable until the Contractor has executed and completed the Works and remedied defects, if any. If, (a) the Contractor does not complete the Works for any reasons whatsoever, and (b) the Contractor has not become entitled to receive the Performance Certificate by 28 days prior to the expiry date of the Performance Security, the Contractor shall be bound to extend the validity of the Performance Security until the Works have been completed and the defects have been remedied. If the Performance Security is or becomes invalid or unenforceable for any reason whatsoever, or if such security is withdrawn or expires, the Contractor must immediately notify the Employer and obtain within 3 days a replacement guarantee in the form appearing in Section 8 [Contract Forms] and which is acceptable to the Employer in its absolute discretion.

The provision, maintenance and renewal by the Contractor of the Performance Security in accordance with this Sub-Clause 4.2 [Performance Security] shall be a condition precedent to any payment by the Employer to the Contractor under the Contract.

If the Contractor fails to provide, maintain and renew the Performance Security in accordance with the Contract, the Employer shall, without prejudice to any other rights and remedies to which it may be entitled, shall have the right to invoke the Performance Security for the value equal to the damages to the Employer as a result of the Contractor's failure and/or by written notice terminate the Contract in accordance with Clause 15.

The Guarantees shall be unconditional and irrevocable. The Employer shall return the Performance Security to the Contractor within 28 days after issue of the Performance Certificate or passing of the Final Payment Certificate whichever is later.

The Employer shall return additional Performance Security submitted in terms of ITB 35.5 as per the following;

(a) If the contractor submits an application stating that all the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed in all respect, then the Employer, on being satisfied with the claim of the Contractor, shall return the full additional Performance Security against the particular schedule(s). Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

(b) If the contractor submits an application stating that majority of the works (physical progress being not less than 90%) against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5 have been completed and execution of balance works is held up for reasons not attributable to the Contractor, then the Employer, on being satisfied with the claim of the contractor, shall return 75% of the amount of additional Performance Security against the particular schedule(s). The balance amount of additional Performance Security shall however be returned only after completion of the works against the particular schedule(s)/bill(s) for which additional Performance Security was submitted in terms of ITB 35.5, in all respects to the satisfaction of the Employer. Decision of the Employer regarding completion of works against a particular schedule/bill shall be final and binding on the contractor.

Wherever the contract is terminated under Clause 15.2, the Performance Guarantee shall be encashed by the Employer:

i) taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause, in case of termination of the contract as a whole; Or

ii) at the discretion of the Employer it may be encashed in part/parts proportionate to the Contract price of the bill/schedule to which the terminated part of work belongs i.e P=(A x B)÷C where

P=Proportionate Bank Guarantee Amount.

A=Contract price of the particular bill/schedule to which the terminated part of work belongs.

B=Performance Guarantee amount in terms of GCC sub clause 4.2.

C=Total Contract price.

Plus additional performance Guarantee amount, if any, taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter in terms of this clause against this particular bill/schedule to which the terminated part of the work belongs, in case of termination in part/parts.

The balance work should be got done separately, and independently by EMPLOYER without risk and cost of the original contractor. The original contractor shall be debarred from participating in the tender for executing the balance work.

4.3 Contractor's Representative

The Contractor shall appoint the Contractor's Representative and shall give him all authority necessary, including financial powers, to act on the Contractor's behalf under the Contract.

Unless the Contractor's Representative is named in the Contract, the Contractor shall, prior to the Commencement Date, submit to the Engineer for consent the name and particulars of the person the Contractor proposes to appoint as Contractor's Representative. If consent is withheld or subsequently revoked, or if the appointed person fails to act as Contractor's Representative, the Contractor shall similarly submit the name and particulars of another suitable person for such appointment.

The Contractor shall not, without the prior consent of the Engineer, revoke the appointment of the Contractor's Representative or appoint a replacement.

The whole time of the Contractor's Representative shall be given to directing the Contractor's performance of the Contract. If the Contractor's Representative is to be temporarily absent from the Site during the execution of the Works, a suitable replacement person shall be appointed, subject to the Engineer's prior consent, and the Engineer shall be notified accordingly.

The Contractor's Representative shall, on behalf of the Contractor, receive instructions under Sub-Clause 3.3 [Instructions of the Engineer].

The Contractor's Representative may delegate any powers, functions and authority to any competent person, and may at any time revoke the delegation. Any delegation or revocation shall not take effect until the Engineer has received prior notice signed by the Contractor's Representative, naming the person and specifying the powers, functions and authority being delegated or revoked.

The Contractor's Representative shall be fluent in the language for communications defined in Sub-Clause 1.4 [Law and Language]. If the Contractor's Representative's delegates are not fluent in the said language, the

Contractor shall make competent interpreters available during all working hours in a number deemed sufficient by the Engineer.

The Contractor shall depute his Representative to attend all the review meetings notified by the Engineer

4.4 Sub-contractors The Contractor shall not subcontract the whole of the Works. The Contractor shall be responsible for the acts or defaults of any Subcontractor, his agents or employees, as if they were the acts or defaults of the Contractor.

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall not be required to obtain consent to suppliers solely of Materials, or to a subcontract for which the Subcontractor is named in the Contract or as specifically provided in the Contract data or value of any sub-contract for Works, or the aggregate value of such sub-contracts with any Subcontractor, does not exceed 5% (five per cent) of the Contract Price provided that such works are not to be executed by specialist subcontractor(s);

(b) the prior consent of the Engineer shall be obtained to other proposed Subcontractors and/or suppliers. While submitting his proposal in this regard, the Contractor shall ensure that;

(i) total value of Works requiring such consent for subcontracting shall not be more than 40% (forty per cent) of the Contract Price;

(ii) No banning/blacklisting/declaration as poor performer by EMPLOYER is in force on the proposed subcontractor (on the date of grant of consent by the Engineer);

(iii) No contract of the proposed subcontractor has been terminated by EMPLOYER during the last two years (to be reckoned from the date of grant of consent by the Engineer);

(iv) the Contractor shall submit the proposal for subcontracting with the name, particulars and the relevant experience of the proposed subcontractor;

(c) the Contractor shall give the Engineer not less than 28 days' notice of the intended date of the commencement of each Subcontractor's work, and of the commencement of such work on the Site;

(d) each subcontract shall include provisions which would entitle the Employer to require the subcontract to be assigned to the Employer under Sub-Clause 4.5 [Assignment of Benefit of Subcontract] (if or when applicable) or in the event of termination under Sub-Clause 15.2 [Termination by Employer]; and

(e) On getting consent from the Engineer, the Contractor shall provide to the Engineer copy of the agreement entered with such subcontractor.

The Contractor shall ensure that the requirements imposed on the Contractor by Sub-Clause 1.12 [Confidential Details] apply equally to each Subcontractor.

Where practicable, the Contractor shall give fair and reasonable opportunity for contractors from the Country to be appointed as Subcontractors.

The Contractor shall endeavour to resolve all matters and payments amicably and speedily with the sub-contractors.

The Contractor shall indemnify and hold the Employer harmless against and from any claim of subcontractors or suppliers of the materials.

The Contractor shall release payment to the Sub-contractors/Suppliers promptly and shall endeavour to resolve all issues amicably and speedily with the Sub-contractors/Suppliers, so that the execution of work is not affected in any manner whatsoever.

In case a Sub-contractor/Supplier represents to the Engineer in writing with supporting documents, stating that he has not received payment due as per the agreement/work or purchase order for the works executed by such Sub-contractor or supplies made by such Supplier, which have been covered in previous Payment Certificates and the Engineer finds such representation having merit, the Engineer, before issuing next Payment Certificate, may forward a copy of the representation to the Contractor requesting the Contractor to supply reasonable evidence that the amount stated to be outstanding by the Sub-contractor/Supplier for the works executed or supplies made, which have been covered in previous Payment Certificates has been paid and if not, why the same is not payable. The Engineer may recommend to make payment to the Sub-contractor/Supplier unless the Contractor submits reasonable evidence to the Engineer:

(i) that the amount claimed has been paid, or

(ii) satisfying the Engineer in writing that the Contractor is entitled to withhold or that the amount is not payable.

On the recommendation of the Engineer, the Employer may (at his sole discretion) directly pay to the Sub-contractor/Supplier the amount due for and on behalf of the Contractor, part or all of such amounts previously certified (less applicable deductions) as are found due to the Sub-contractor/Supplier by the Engineer. The Employer shall adjust the amount paid directly to the Sub-contractor/Supplier from any amount due by it to the Contractor. The Contractor shall repay the amount, in case no amount is found due by the Employer to the Contractor.

That the payment by Employer, on behalf of the Contractor to its Sub-contractor/Supplier, shall not alter any terms of agreement between the Employer and the Contractor and nor the same shall result in any privity of contract between the Employer and the Sub-contractor/Supplier.

4.5 Assignment of Benefit of Subcontract

If a Subcontractor's obligations extend beyond the expiry date of the relevant Defects Notification Period and the Engineer, prior to this date, instructs the Contractor to assign the benefit of such obligations to the Employer, then the

Contractor shall do so. Unless otherwise stated in the assignment, the Contractor shall have no liability to the Employer for the work carried out by the Subcontractor after the assignment takes effect.

4.6 Co-operation

The Contractor shall, as specified in the Contract or as instructed by the Engineer, allow appropriate opportunities for carrying out work to:

(a) the Employer's Personnel,

(b) any other contractors employed by the Employer, and

(c) the personnel of any legally constituted public authorities,

who may be employed in the execution on or near the Site of any work not included in the Contract.

Any such instruction shall constitute a Variation if and to the extent that it causes the Contractor to incur Unforeseeable Cost. Services for these personnel and other contractors may include the use of Contractor's Equipment, Temporary Works or access arrangements which are the responsibility of the Contractor.

If, under the Contract, the Employer is required to give to the Contractor possession of any foundation, structure, plant or means of access in accordance with Contractor's Documents, the Contractor shall submit such documents to the Engineer in the time and manner stated in the Specification.

4.7 Setting Out

The Contractor shall set out the Works in relation to original points, lines and levels of reference specified in the Contract or notified by the Engineer. The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the works, notifying the Engineer within 28 days of the date of commencement

In the event of such discrepancy arising during the course of the work, for which Employer's documents are handed over after the date of commencement, the contractor shall seek clarifications within 14 days of receipt of such documents

The Employer shall be responsible for any errors in these specified or notified items of reference, but the Contractor shall use reasonable efforts to verify their accuracy before they are used.

Contractor shall promptly notify the Employer and the Engineer of any error, omission, fault, or any other defect in the design, drawing or specifications for the works, which he discovers when reviewing the Contract Documents, and in the process of execution of the Works. The contractor shall be responsible to ensure correlation in various drawings and bill of quantities, before commencement and execution of work. In case of any discrepancy the contractor shall bring it to notice of the Engineer for clarification within 28 days of the issue of Letter of Acceptance. In the event of such discrepancy arising during the course of the work, for which drawings are given after the date of issue of Letter of Acceptance, the contractor shall seek clarifications within 14

days of receipt of such drawings.

4.8 Safety Procedures

The Contractor shall follow the provisions laid down in ESHS Manual of Section 5 (Works Requirements) and shall:

(a) comply with all applicable safety regulations,

(b) take care for the safety of all persons entitled to be on the Site,

(c) use reasonable efforts to keep the Site and Works clear of unnecessary obstruction so as to avoid danger to these persons,

(d) provide fencing, lighting, guarding and watching of the Works until completion and taking over under Clause 10 [Employer's Taking Over], and

(e) provide any Temporary Works (including roadways, footways, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

4.8.1 Deleted.

4.9 Quality Assurance

The Contractor shall institute a quality assurance system to demonstrate compliance with the requirements of the Contract. The system shall be in accordance with the details stated in the Contract. The Engineer shall be entitled to audit any aspect of the system.

Details of all procedures and compliance documents shall be submitted to the Engineer for information before each design and execution stage is commenced. When any document of a technical nature is issued to the Engineer, evidence of the prior approval by the Contractor himself shall be apparent on the document itself.

Compliance with the quality assurance system shall not relieve the Contractor of any of his duties, obligations or responsibilities under the Contract.

4.10 Site Data

The Employer shall have made available to the Contractor for his information, prior to the Base Date, all relevant data in the Employer's possession on sub-surface and hydrological conditions at the Site, including environmental aspects. The Employer shall similarly make available to the Contractor all such data which come into the Employer's possession after the Base Date. The Contractor shall be responsible for interpreting all such data.

To the extent which was practicable (taking account of cost and time), the Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Bid or Works. To the same extent, the Contractor shall be deemed to have inspected and examined the Site, its surroundings, the above data and other available information, and to have been satisfied before submitting the Bid as to all relevant matters, including (without limitation):

(a) the form and nature of the Site, including sub-surface conditions,

(b) the hydrological and climatic conditions,

(c) the extent and nature of the work and Goods necessary for the execution and completion of the Works and the remedying of any defects,

(d) the Laws, procedures and labour practices of the Country, and

(e) the Contractor's requirements for access, accommodation, facilities, personnel, power, transport, water and other services.

(f) Data made available by the Employer in accordance with the preceding paragraph shall be deemed to include data listed elsewhere in the contract as open for inspection at the address stipulated in the Contract.

4.11 Sufficiency of the Accepted Contract Amount

The Contractor shall be deemed to:

(a) have satisfied himself as to the correctness and sufficiency of the Accepted Contract Amount, and

(b) have based the Accepted Contract Amount on the data, interpretations, necessary information, inspections, examinations and satisfaction as to all relevant matters referred to in Sub-Clause 4.10 [Site Data].

Unless otherwise stated in the Contract, the Accepted Contract Amount covers all the Contractor's obligations under the Contract (including those under Provisional Sums, if any) and all things necessary for the proper execution and completion of the Works and the remedying of any defects.

4.12 Unforeseeable Physical Conditions

In this Sub-Clause, "physical conditions" means natural physical conditions and man-made and other physical obstructions and pollutants, which the Contractor encounters at the Site when executing the Works, including sub-surface and hydrological conditions but excluding climatic conditions.

If the Contractor encounters adverse physical conditions which he considers to have been Unforeseeable, the Contractor shall give notice to the Engineer as soon as practicable.

This notice shall describe the physical conditions, so that they can be inspected by the Engineer, and shall set out the reasons why the Contractor considers them to be Unforeseeable. The Contractor shall continue executing the Works, using such proper and reasonable measures as are appropriate for the physical conditions, and shall comply with any instructions which the Engineer may give. If an instruction constitutes a Variation, Clause 13 [Variations and Adjustments] shall apply.

If and to the extent that the Contractor encounters physical conditions which are Unforeseeable, gives such a notice, and suffers delay and/or incurs Cost due to these conditions, the Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving such notice and inspecting and/or investigating these physical conditions, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) whether and (if so) to what extent these physical conditions were Unforeseeable, and (ii) the matters described in sub-paragraphs (a) and (b) above related to this extent.

However, before additional Cost is finally agreed or determined under sub-paragraph (ii), the Engineer may also review whether other physical conditions in similar parts of the Works (if any) were more favourable than could reasonably have been foreseen when the Contractor submitted the Bid. If and to the extent that these more favourable conditions were encountered, the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the reductions in Cost which were due to these conditions, which may be included (as deductions) in the Contract Price and Payment Certificates. However, the net effect of all adjustments under sub-paragraph (b) and all these reductions, for all the physical conditions encountered in similar parts of the Works, shall not result in a net reduction in the Contract Price.

The Engineer may take account of any evidence of the physical conditions foreseen by the Contractor when submitting the Bid, which may be made available by the Contractor, but shall not be bound by any such evidence.

4.13 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special and/or temporary rights-of-way which he may require, including those for access to the Site. The Contractor shall also obtain, at his risk and cost, any additional facilities outside the Site which he may require for the purposes of the Works.

In case any operation connected with traffic necessitates diversion, obstruction or closure of any road, railway or any other right of way, the approval of the Engineer and the concerned authorities shall be obtained well in advance by the Contractor.

Provided that if it is found necessary for the Contractor to move one or more loads of heavy constructional plants and equipment, materials or Pre-constructed units or parts of units of work over roads, highways, bridges on which such oversized and overweight items that are not normally to be moved, the contractor shall obtain prior permission from the concerned authorities.

Payments for complying with the requirements, if any, for protection or strengthening of the roads, highways or bridges shall be made by the contractor and such expenses shall be deemed to be included in his quoted contract price.

4.14 Avoidance of Interference

The Contractor shall not interfere unnecessarily or improperly with:

(a) the convenience of the public, or

(b) the access to and use and occupation of all roads and footpaths, irrespective of whether they are public or in the possession of the Employer or of others or

(c) Passenger amenities at stations and station platforms.

The Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from any such unnecessary or improper interference.

4.15 Access Route

The Contractor shall be deemed to have been satisfied as to the suitability and availability of access routes to the Site. The Contractor shall use reasonable efforts to prevent any road or bridge from being damaged by the Contractor's traffic or by the Contractor's Personnel. These efforts shall include the proper use of appropriate vehicles and routes.

Except as otherwise stated in these Conditions:

(a) the Contractor shall (as between the Parties) be responsible for any maintenance which may be required for his use of access routes;

(b) the Contractor shall provide all necessary signs or directions along access routes, and shall obtain any permission which may be required from the relevant authorities for his use of routes, signs and directions;

(c) the Employer shall not be responsible for any claims which may arise from the use or otherwise of any access route;

(d) the Employer does not guarantee the suitability or availability of particular access routes; and

(e) Costs due to non-suitability or non-availability, for the use required by the Contractor, of access routes shall be borne by the Contractor.

4.16 Transport of Goods

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site;

(b) the Contractor shall be responsible for packing, loading, transporting, receiving, unloading, storing and protecting all Goods and other things required for the Works; and

(c) the Contractor shall indemnify and hold the Employer harmless against and from all damages, losses and expenses (including legal fees and expenses) resulting from the transport of Goods, and shall negotiate and pay all claims arising from their transport.

4.17 Contractor's Equipment

The Contractor shall be responsible for all Contractors' Equipment. When brought on to the Site, Contractor's Equipment shall be deemed to be exclusively intended for the execution of the Works. The Contractor shall not remove from the Site any major items of Contractor's Equipment without the consent of the Engineer. However, consent shall not be required for vehicles transporting Goods or Contractor's Personnel off Site.

In the event of Contractor imports any equipment the following shall apply" :

(a) Custom Clearance: The Employer will assist the contractor, when required by furnishing letters of recommendation for obtaining expeditious clearance through customs of constructional plants, material and other things required for the works and then for re-export, if any. The following publications, may be referred to by the contractor for guidance about custom regulations etc :

(i) Import & export policy, together with amendments, if any, published by Govt. of India, Ministry of Commerce.

(ii) Hand Book of Procedures, together with amendments, if any, Volume 1 and 2 published by Ministry of Commerce.

(iii) Customs Tariff, together with amendments, if any published by Central Customs.

The Contractor shall be responsible to follow the latest rules and regulations without any liability of the Employer.

(b) Re-export of contractors equipment: The contractor shall obtain all the relevant information regarding procedure for the import and subsequent re-export of his equipment and materials from the Chief Controller of Imports and Exports, New Delhi, and shall inform himself and keep himself informed on the details of custom charges and draw-back regulations as applicable to the items of Constructional plant. The contractor shall provide the necessary guarantee/bonds where these are required by the customs notwithstanding that import licenses may be granted in the name of Employer.

(c) Notwithstanding the provisions mentioned above, Contractor's Equipment, including essential spare parts therefore, imported by the Contractor for the sole purpose of executing the Contract shall be temporarily exempt from the payment of import duties and taxes upon initial importation, provided the Contractor shall post with the customs authorities at the port of entry an approved export bond or bank guarantee, valid until the Time for Completion plus six months, in an amount equal to the full import duties and taxes which would be payable on the assessed imported value of such Contractor's Equipment and spare parts, and **callable** in the event the Contractor's Equipment is not exported from the Country on completion of the Contract. A copy of the **bond** or bank guarantee endorsed by the custom authorities shall be provided by the Contractor to the Employer upon the importation of individual items of Contractor's Equipment and spare parts. Upon export of individual items of Contractor's Equipment or

spare parts, or upon the completion of the Contract, Contractor shall prepare for approval by the customs authority the authorities, an assessment of the residual value of the Contractor's Equipment and spare parts to be exported based on the depreciation scale(s) and other criteria used by the customs authorities for such purposes under the provisions of the applicable Laws. Import duties and taxes shall be due and payable to the customs authorities by the Contractor on (a) the difference between the initial imported value and the residual value of the contractor's equipment and spare parts to be exported and (b) on the initial imported value that contractor's equipments and spare parts remaining in the Country after completion of the Contract. Upon payment of such dues within 28 days of being invoiced, the bond or bank guarantee shall be reduced or released accordingly; otherwise the security shall be called in the full amount remaining in the Country.

(d) **Conditions of hire of the contractor's equipment:** A certified copy of the agreement in respect of any item of Equipment held by contractor under any agreement for hire or hire purchase thereof, shall be supplied to the Engineer/Employer."

4.18 Protection of the Environment

The Contractor shall take all reasonable steps to protect the environment (both on and off the Site) and to limit damage and nuisance to people and property resulting from pollution, noise and other results of his operations.

The Contractor shall ensure that emissions, surface discharges and effluent from the Contractor's activities shall not exceed the values stated in the Specification or prescribed by applicable Laws.

4.19 Electricity, Water and Gas

The Contractor shall, except as stated below, be responsible for the provision of all power, water and other services he may require.

The Contractor shall be entitled to use for the purposes of the Works such supplies of electricity, water, gas and other services as may be available on the Site and of which details and prices are given in the Specification. The Contractor shall, at his risk and cost, provide any apparatus necessary for his use of these services and for measuring the quantities consumed.

The quantities consumed and the amounts due (at these prices) for such services shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

4.20 Employer's Equipment and Free-Issue Material

The Employer shall make the Employer's Equipment (if any) available for the use of the Contractor in the execution of the Works in accordance with the details, arrangements and prices stated in the Specification. Unless otherwise stated in the Specification:

(a) the Employer shall be responsible for the Employer's Equipment, except that

(b) the Contractor shall be responsible for each item of Employer's Equipment whilst any of the Contractor's Personnel is operating it, driving it, directing it or in possession or control of it.

The appropriate quantities and the amounts due (at such stated prices) for the use of Employer's Equipment shall be agreed or determined by the Engineer in accordance with Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations]. The Contractor shall pay these amounts to the Employer.

The Employer shall supply, free of charge, the "free-issue materials" (if any) in accordance with the details stated in the Contract data. The Employer shall, at his risk and cost, provide these materials at the time and place specified in the Contract. The Contractor shall then visually inspect them, and shall promptly give notice to the Engineer of any shortage, defect or default in these materials. Unless otherwise agreed by both Parties, the Employer shall immediately rectify the notified shortage, defect or default.

In case materials are handed over, in accordance with the procedure prescribed by the Engineer, after proper measurement and accounted for, the contractor shall be solely liable for any shortage, damage, defect or default in such material, and shall indemnify the Employer until the final accountal of materials is made by the Contractor on completion of the work.

4.21 Progress Reports

Unless otherwise stated in the Special Conditions of Contract, Daily Progress Reports and monthly progress reports (in the format approved by the Engineer) shall be prepared by the Contractor and submitted to the Engineer in six copies. Daily Progress Reports shall be submitted from the Commencement Date. The first monthly progress report shall cover the period up to the end of the first calendar month following the Commencement Date. Reports shall be submitted monthly thereafter, each within 7 days after the last day of the period to which it relates.

Reporting shall continue until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

Each monthly progress report as a minimum shall include:

(a) charts and detailed descriptions of progress, including each stage of design (if any), Contractor's Documents, procurement, manufacture, delivery to Site, construction, erection and testing; and including these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),

(b) photographs showing the status of manufacture and of progress on the

Site;

(c) for the manufacture of each main item of Plant and Materials, the name of the manufacturer, manufacture location, percentage progress, and the actual or expected dates of:

(i) commencement of manufacture,

(ii) Contractor's inspections,

(iii) tests, and

(iv) shipment and arrival at the Site;

(d) the details described in Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment];

(e) copies of quality assurance documents, test results and certificates of Materials;

(f) list of notices given under Sub-Clause 2.5 [Employer's Claims] and notices given under Sub-Clause 20.1 [Contractor's Claims];

(g) safety statistics, including details of any hazardous incidents and activities relating to environmental aspects and public relations; and

(h) comparisons of actual and planned progress of all activities, with details of any events or circumstances which may jeopardise the completion in accordance with the Contract, and the measures being (or to be) adopted to overcome delays.

4.22 Security of the Site

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contractor shall be responsible for keeping unauthorised persons off the Site, and

(b) authorised persons shall be limited to the Contractor's Personnel and the Employer's Personnel; and to any other personnel notified to the Contractor, by the Employer or the Engineer, as authorised personnel of the Employer's other contractors on the Site.

4.23 Contractor's Operations on Site

The Contractor shall confine his operations to the Site, and to any additional areas which may be obtained by the Contractor and agreed by the Engineer as working areas. The Contractor shall take all necessary precautions to keep Contractor's Equipment and Contractor's Personnel within the Site and these additional areas, and to keep them off adjacent land.

During the execution of the Works, the Contractor shall keep the Site free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment or surplus materials. The Contractor shall clear away and remove from the Site any wreckage, rubbish and Temporary Works which are no longer required.

Upon the issue of a Taking-Over Certificate, the Contractor shall clear away and

remove, from that part of the Site and Works to which the Taking-Over Certificate refers, all Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works. The Contractor shall leave that part of the Site and the Works in a clean and safe condition. However, the Contractor may retain on Site, during the Defects Notification Period, such Goods as are required for the Contractor to fulfill obligations under the Contract.

4.24 Fossils

All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings.

The Contractor shall, upon discovery of any such finding, promptly give notice to the Engineer, who shall issue instructions for dealing with it. If the Contractor suffers delay and/or incurs Cost from complying with the instructions, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

5. Nominated Subcontractors

5.1 Definition of nominated Subcontractor

In the Contract, "nominated Subcontractor" means a Subcontractor:

(a) who is stated in the Contract as being a nominated Subcontractor, or

(b) whom the Engineer, under Clause 13 [Variations and Adjustments], instructs the Contractor to employ as a Subcontractor.

5.2 Objection to Nomination

The Contractor shall not be under any obligation to employ a nominated Subcontractor against whom the Contractor raises reasonable objection by notice to the Engineer as soon as practicable, with supporting particulars. An objection shall be deemed reasonable if it arises from (among other things) any of the following matters, unless the Employer agrees to indemnify the Contractor against and from the consequences of the matter:

(a) there are reasons to believe that the Subcontractor does not have sufficient competence, resources or financial strength;

(b) the subcontract does not specify that the nominated Subcontractor shall indemnify the Contractor against and from any negligence or misuse of Goods by the nominated Subcontractor, his agents and employees; or

(c) the subcontract does not specify that, for the subcontracted work (including design, if any), the nominated Subcontractor shall:

(i) undertake to the Contractor such obligations and liabilities as will enable the Contractor to discharge his obligations and liabilities under the Contract, and

(ii) indemnify the Contractor against and from all obligations and liabilities arising under or in connection with the Contract and from the consequences of any failure by the Subcontractor to perform these obligations or to fulfil these liabilities.

5.3 Payments to nominated Subcontractors

The Contractor shall pay to the nominated Subcontractor the amounts which the Engineer certifies to be due in accordance with the subcontract. These amounts plus other charges shall be included in the Contract Price in accordance with sub-paragraph (b) of Sub-Clause 13.5 [Provisional Sums], except as stated in Sub-Clause 5.4 [Evidence of Payments].

5.4 Evidence of Payments

Before issuing a Payment Certificate which includes an amount payable to a nominated Subcontractor, the Engineer may request the Contractor to supply reasonable evidence that the nominated Subcontractor has received (Within 7 days of receipt of previous payment by the contractor) all amounts due in accordance with previous Payment Certificates, less applicable deductions for retention or otherwise. Unless the Contractor:

(a) submits this reasonable evidence to the Engineer, or

(b)

1. (i) satisfies the Engineer in writing that the Contractor is reasonably entitled to withhold or refuse to pay these amounts, and
2. (ii) submits to the Engineer reasonable evidence that the nominated Subcontractor has been notified of the Contractor's entitlement,

then the Employer may (at his sole discretion) pay, direct to the nominated Subcontractor, part or all of such amounts previously certified (less applicable deductions) as are due to the nominated Subcontractor and for which the Contractor has failed to submit the evidence described in sub-paragraphs (a) or (b) above. The Contractor shall then repay, to the Employer, the amount which the nominated Subcontractor was directly paid by the Employer.

6. Staff and Labour

6.1 Engagement of Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, housing, feeding and transport.

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labor with appropriate qualifications and experience from sources within the Country.

6.2 Rates of Wages and Conditions of Labour

The Contractor shall pay rates of wages, and observe conditions of labour, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.

If the Employer is obliged to provide amenities or arrange payment of wages to contract labour employed by the contractor either directly or through sub-contractor under the contract on account of failures on the part the contractor to provide the amenities and / or arrange payment of wages to the contract labour as required of him under the provision of the said act / rules made there under, the Engineer/Employer shall be at liberty without prejudice to the rights of Engineer/Employer under Section 20(2) and 21(4) of the contract labour (Regulation and Abolition) Act 1970 to recover the whole or part of the expenditure so incurred on the wages so paid by the Engineer/Employer/Railway from the security deposit and/or from any sum or sums due to the contractor whether under this contract or any other contract.

The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages, allowances, and any benefits as are subject to taxes under the Laws of the Country for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there-under, regulation or notifications including amendment. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/ regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities provide by the said Act and said Rules.

The Contractor and his Sub Contractors shall comply with all applicable

Labour Laws, and should not employ Child Labour for construction and maintenance activities. The Contractor shall provide appropriate facilities for children in Construction Camp sites.

The Contractors shall not differentiate wages between men and women for work of equal value.

6.3 Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labour from amongst persons in the service of the Employer or the Engineer.

6.4 Labour Laws

The Contractor shall comply with all the relevant labour Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration, and emigration, and shall allow them all their legal rights. The contractor and his sub-contractors shall be responsible to ensure at his own cost, compliance to all laws, bye-laws, rules and regulations for the time being in force pertaining to the employment of local or imported labour and shall take all necessary precautions to ensure and preserve the health and safety of all staff employed directly or through sub-contractors or petty contractors on the works, which shall include all the acts listed in Appendix – 1 but not limited to the same.

The Contractor shall require his employees to obey all applicable Laws, including those concerning safety at work.

During continuance of the Contract, the Contractor and his Sub-Contractors shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notifications and bye laws of the State or Central government or local authority and any other labour laws (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given in Appendix 1 to these Conditions of Contract.

6.5 Working Hours

No work shall be carried out on the Site on locally recognised days of rest, or outside the normal working hours stated in the Contract Data, unless:

(a) otherwise stated in the Contract,

(b) the Engineer gives consent, or

(c) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.

6.6 Facilities for Staff and Labour

Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.

The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.

6.7 Health and Safety

The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and a standing arrangement for ambulance service are available at a phone call at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same. The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the execution of the Works, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.

The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence.

HIV-AIDS Prevention. The Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.

Epidemics

In the event of any outbreak of illness of an epidemic nature, the Contractor shall comply with and carry out such regulations, orders and requirements as may be made by the Government or the local medical or sanitary authorities, for the purpose of dealing with and overcoming the same.

Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

Submission of Returns: :

The contractor shall be responsible for timely submission of all returns and statements to the concerned authorities in full compliance of all rules, bye-laws

and regulations for the time being in force.

The Contractor shall throughout the contract (including the Defects Notification Period): (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

6.8 Contractor's Superintendence

Throughout the execution of the Works, and as long thereafter as is necessary to fulfil the Contractor's obligations, the Contractor shall provide all necessary superintendence to plan, arrange, direct, manage, inspect and test the work.

Superintendence shall be given by a sufficient number of persons having adequate knowledge of the language for communications (defined in Sub-Clause 1.4 [Law and Language]) and of the operations to be carried out (including the methods and techniques required, the hazards likely to be encountered and methods of preventing accidents), for the satisfactory and safe execution of the Works.

The Contractor shall employ the key personnel named in the Works Requirements to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

The Contractor shall not employ any retired government Gazetted officer, who has either not completed one year after the date of retirement, or has not obtained permission to employment with the Contractor.

6.9 Contractor's Personnel

The Contractor's Personnel shall be appropriately qualified, skilled and experienced in their respective trades or occupations. The Engineer may require the Contractor to remove (or cause to be removed) any person employed on the Site or Works, including the Contractor's Representative if applicable, who:

(a) persists in any misconduct or lack of care,

(b) carries out duties incompetently or negligently,

(c) fails to conform with any provisions of the Contract, or

(d) persists in any conduct which is prejudicial to safety, health, or the protection of the environment.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven (7) days and has no further connection with the work in the Contract. The replacement person shall be appointed within fourteen (14) days of the notification by the Engineer.

A reasonable proportion of the Contractor's Superintending Staff shall have a working knowledge of the English language or the Contractor shall have available on site at all times a sufficient number of competent interpreters to ensure the proper transmission of instructions and information. If appropriate, the Contractor shall then appoint (or cause to be appointed) a suitable replacement person.

6.10 Records of Contractor's Personnel and Equipment

The Contractor shall submit, to the Engineer, details showing the number of each class of Contractor's Personnel occupations, actual working hours of each class of Contractor's Personnel, and type and actual working hours of each of the Contractor's Equipmenton the Site. Details shall be submitted each calendar month, in a form approved by the Engineer, until the Contractor has completed all work which is known to be outstanding at the completion date stated in the Taking-Over Certificate for the Works.

6.11 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst the Contractor's Personnel, and to preserve peace and protection of persons and property on and near the Site.

6.12 Foreign Personnel

The Contractor may bring in to the country any foreign personnel who are necessary for the execution of the Works to the extent allowed by the applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer will,without any financial liability, if requested by the Contractor, use his best endeavours in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these personnel to the place where they were recruited or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor

shall similarly be responsible for making the appropriate arrangements for their return or burial. Contractor shall also be responsible for any legal liabilities during their stay.

6.13 Supply of Foodstuffs The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

6.14 Supply of Water The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

6.15 Measures against Insect and Pest Nuisance The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

The Contractor shall provide his staff and labour with suitable prophylactics for the prevention of malaria, and take steps to prevent the formation of stagnant pools of water. He shall comply with all the regulations of the local health authorities in these respects and shall in particular arrange to spray thoroughly with approved insecticides all buildings erected on the site such treatment shall be carried out at least once a year or as instructed by the Engineer. The Contractor shall warn his staff and labour of the dangers of diseases like Malaria, Filaria and other contagious diseases etc. and also Scorpions, Snakes, Wild animals etc. and preventive actions required to be taken by the labour and staff.

6.16 Alcoholic Liquor or Drugs The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal thereto by Contractor's Personnel.

6.17 Arms and Ammunition The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

6.18 Festivals and Religious Customs The Contractor shall respect the Country's recognized festivals, days of rest and religious or other customs.

6.19 Funeral Arrange-ments The Contractor shall be responsible, to the extent required by local regulations, for making any funeral arrangements for any of his local employees who may die while engaged upon the Works.

6.20 Prohibition of Forced or Compulsory Labour

The contractor shall not employ "forced or compulsory labour" in any form. "Forced or compulsory labour" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

6.21 Prohibition of Harmful Child Labour

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development.

6.22 Employment Records of Contractor's Personnel

The Contractor shall keep complete and accurate records of the employment of Contractor's Personnel at the Site. The records shall include the names, ages, genders, hours worked and wages paid to all Contractor's Personnel. These records shall be summarized on a monthly basis and shall be available for inspection by the Engineer during normal working hours. These records shall be included in the details to be submitted by the Contractor under Sub-Clause 6.10 [Records of Contractor's Personnel and Equipment].

7. Plant, Materials and Workmanship

7.1 Manner of Execution

The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works:

(a) in the manner (if any) specified in the Contract,

(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and

(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.

7.2 Samples

The Contractor shall submit the following samples of Materials, and relevant information, to the Engineer for consent prior to using the Materials in or for the Works:

(a) manufacturer's standard samples of Materials and samples specified in the Contract, all at the Contractor's cost, and

(b) additional samples instructed by the Engineer as a Variation.

Each sample shall be labelled as to origin and intended use in the Works.

7.3 Inspection

The Employer's Personnel shall at all reasonable times:

(a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and

(b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials.

The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.

The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.

7.4 Testing

This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any).

The Contractor shall provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works.

The Engineer may, under Clause 13 [Variations and Adjustments], vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract.

The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence.

If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost , which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the

readings as accurate.

7.5 Rejection

If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract.

If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer.

7.6 Remedial Work

Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to:

(a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract,

(b) remove and re-execute any other work which is not in accordance with the Contract, and

(c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise.

The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in the instruction, or immediately if urgency is specified under sub-paragraph (c).

If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer all costs arising from this failure.

7.7 Ownership of Plant and Materials

Each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances:

(a) when it is delivered to the Site;

(b) when the Contractor is entitled to payment of the value of the Plant and Materials under Sub-Clause 8.10 [Payment for Plant and Materials in Event of Suspension].

7.8 Royalties

Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for:

(a) natural Materials obtained from outside the Site, and

(b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

8. Commencement, Delays and Suspension

8.1 Commencement of Works

The Engineer shall give the Contractor not less than 7 days' notice of the Commencement Date.

The Contractor shall commence the execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay.

8.2 Time for Completion

The Contractor shall complete the whole of the Works, and each Section (if any), within the Time for Completion for the Works or Section (as the case may be), including:

(a) achieving the passing of the Tests on Completion, and

(b) completing all work which is stated in the Contract as being required for whole of the Works or Section(s) to be considered to be completed for the purposes of taking-over under Sub-Clause 10.1 [Taking Over of the Works and Sections].

8.3 Programme

The Contractor shall submit a detailed time programme to the Engineer within 28 days after receiving the notice under Sub-Clause 8.1 *[Commencement of Works]*. The program shall include the physical and Financial Progress vis-à-vis program and forecast cash flow adopting Project Management Software Primavera/Sure Track/MS Project or as mutually agreed. The program must identify the milestones, interface requirements and program reporting elements. The Contractor shall supply, free of cost one set of authorized software to the Engineer and the soft copy of structured program for the project. This shall be updated every month. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligations. Each programme shall include:

(a) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of design (if any), Contractor's Documents, procurement, manufacture of Plant, delivery to Site, construction, erection and testing,

(b) each of these stages for work by each nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]),

(c) the sequence and timing of inspections and tests specified in the Contract, and

(d) a supporting report which includes:

(i) a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and

(ii) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of

Contractor's Equipment, required on the Site for each major stage.

Unless the Engineer, within 21 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligations under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Engineer of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price or delay the execution of the Works. The Engineer may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and/or a proposal under Sub-Clause 13.3 [Variation Procedure].

If, at any time, the Engineer gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Engineer within 15 days in accordance with this Sub-Clause.

8.4 Extension of Time for Completion

The Contractor shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to an extension of the Time for Completion if and to the extent that completion for the purposes of Sub-Clause 10.1 [Taking-Over of the Works and Sections] is or will be delayed by any of the following causes:

(a) a Variation (unless an adjustment to the Time for Completion has been agreed under Sub-Clause 13.3 [Variation Procedure]) or other substantial change in the quantity of an item of work included in the Contract,

(b) a cause of delay giving an entitlement to extension of time under a Sub-Clause of these Conditions,

(c) exceptionally adverse climatic conditions,

(d) Unforeseeable shortages in the availability of personnel or Goods caused by epidemic or governmental actions, or

(e) any delay, impediment or prevention caused by or attributable to the Employer, the Employer's Personnel, or the Employer's other contractors.

If the Contractor considers himself to be entitled to an extension of the Time for Completion, the Contractor shall give notice to the Engineer in accordance with Sub-Clause 20.1 [Contractor's Claims]. When determining each extension of time under Sub-Clause 20.1, the Engineer shall review previous determinations and may increase, but shall not decrease, the total extension of time.

8.5 Delays Caused by Authorities

If the following conditions apply, namely:

(a) the Contractor has diligently followed the procedures laid down by the relevant legally constituted public authorities in the Country,

(b) these authorities delay or disrupt the Contractor's work, and

(c) the delay or disruption was Unforeseeable,

then this delay or disruption will be considered as a cause of delay under sub-paragraph (b) of Sub-Clause 8.4 [Extension of Time for Completion].

8.6 Rate of Progress If, at any time:

(a) actual progress is too slow to complete within the Time for Completion, and/or

(b) progress has fallen (or will fall) behind the current programme under Sub-Clause 8.3 [Programme],

other than as a result of a cause listed in Sub-Clause 8.4 [Extension of Time for Completion], then the Engineer may instruct the Contractor to submit, under Sub-Clause 8.3 [Programme], a revised programme and supporting report describing the revised methods which the Contractor proposes to adopt in order to expedite progress and complete within the Time for Completion.

Unless the Engineer notifies otherwise, the Contractor shall adopt these revised methods, which may require increases in the working hours and/or in the numbers of Contractor's Personnel and/or Goods, at the risk and cost of the Contractor. If these revised methods cause the Employer to incur additional costs, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay these costs to the Employer, in addition to delay damages (if any) under Sub-Clause 8.7 below.

8.7 Extension of Time for Completion with Delay Damages If the Contractor fails to comply with Sub-Clause 8.2 [Time for Completion for entire work or for specified section wise completion period], and he is not entitled to an extension of time under sub clause 8.4 then the Employer may grant extension of time with delay damage in such case, the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay delay damages to the Employer for this default. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate.

a. In case delay is fully attributable to the Contractor, then the Employer may grant extension of time with delay damage as stated in the Contract Data. The decision of the Employer in this regard will be final and binding.

b. In case delay is partly attributable to the Contractor, then the Employer may grant extension of time without or with delay damages as stated in the Contract Data, keeping in view the delays attributable to the Contractor, delays for other reasons and in overall interest of completion of the work. The decision of Employer in this regard will be final and binding.

These delay damages shall be the only damages due from the Contractor for such default, other than in the event of termination under Sub-Clause 15.2 [Termination by Employer] prior to completion of the Works. These damages shall not relieve the Contractor from his obligation to complete the Works, or

from any other duties, obligations or responsibilities which he may have under the Contract.

The total amount due under this Sub- Clause shall not exceed the maximum amount of delay damages (if any) stated in the Contract Data.

The imposition of delay damages under this sub clause shall debar the Contractor from raising any claims for extended stay.

8.7.1 Delay Damages for non achievement of Key Date

In case of non-achievement of Key Dates, for the reasons attributed to the contractor, delay damages as stated in Contract Data shall be imposed. These delay damages shall be the sum stated in the Contract Data, which shall be paid for every day which shall elapse between the relevant Time for Completion and the date stated in the Taking-Over Certificate.

If the Contractor complete the entire works within the original completion period or extended completion period under clause 8.4 of GCC (without imposition of delay damages), the entire amount deducted for delay damages levied for non-achievement of Key Date shall be refunded to the Contractor. In case the Contractor is unable to complete the entire works within the original completion period or extended completion period under clause 8.4 of GCC resulting in delay in completion of the project under clause 8.7 of GCC (with imposition of delay damages),then delay damages for non-achievement of Key Date(s) shall not be refunded and additional delay damages shall be imposed on the Contractor as per Sub-Clause 8.7 above.

8.8 Suspension of Work

The Engineer may at any time instruct the Contractor to suspend progress of part or all of the Works. During such suspension, the Contractor shall protect, store and secure such part or the Works against any deterioration, loss or damage.

The Engineer may also notify the cause for the suspension. If and to the extent that the cause is notified and is the responsibility of the Contractor, the following Sub-Clauses 8.9, 8.10 and 8.11 shall not apply.

8.9 Consequences of Suspension

If the Contractor suffers delay and/or incurs Cost from complying with the Engineer's instructions under Sub-Clause 8.8 [Suspension of Work] and/or from resuming the work, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

The Contractor shall not be entitled to an extension of time for, or to payment of the Cost incurred in, making good the consequences of the Contractor's faulty design, workmanship or materials, or of the Contractor's failure to protect, store or secure in accordance with Sub-Clause 8.8 [Suspension of Work].

8.10 Payment for Plant and Materials in Event of Suspension

The Contractor shall be entitled to payment of the value (as at the date of suspension)of Plant and/or Materials, if:

(a) the work on Plant or delivery of Plant and/or Materials has been suspended for more than 28 days,

(b) the Contractor has marked the Plant and/or Materials as the Employer's property in accordance with the Engineer's instructions, and

(c) Such materials or plant is received at site.

8.11 Prolonged Suspension

If the suspension under Sub-Clause 8.8 [Suspension of Work] has continued for more than 84 days, the Contractor may request the Engineer's permission to proceed. If the Engineer does not give permission within 28 days after being requested to do so, the Contractor may, by giving notice to the Engineer, treat the suspension as an omission under Clause 13 [Variations and Adjustments] of the affected part of the Works. If the suspension affects the whole of the Works, the Contractor may give notice of termination under Sub-Clause 16.2 [Termination by Contractor].

8.12 Resumption of Work

After the permission or instruction to proceed is given, the Contractor and the Engineer shall jointly examine the Works and the Plant and Materials affected by the suspension. The Contractor shall make good any deterioration or defect in or loss of the Works or Plant or Materials, which has occurred during the suspension.

8.13

Deleted.

9. Tests on Completion

9.1Contractor's Obligations

The Contractor shall carry out the Tests on Completion in accordance with this Clause and Sub-Clause 7.4 [Testing], after providing the documents in accordance with sub-paragraph (d) of Sub-Clause 4.1 [Contractor's General Obligations].

The Contractor shall give to the Engineer not less than 21 days' notice of the date after which the Contractor will be ready to carry out each of the Tests on Completion. Unless otherwise agreed, Tests on Completion shall be carried out within 14 days after this date, on such day or days as the Engineer shall instruct.

In considering the results of the Tests on Completion, the Engineer shall make allowances for the effect of any use of the Works by the Employer on the performance or other characteristics of the Works. As soon as the Works, or a Section, have passed any Tests on Completion, the Contractor shall submit a certified report of the results of these Tests to the Engineer.

9.2 Delayed Tests

If the Tests on Completion are being unduly delayed by the Employer, Sub-Clause 7.4 [Testing] (fifth paragraph) and/or Sub-Clause 10.3 [Interference with Tests on Completion] shall be applicable.

If the Tests on Completion are being unduly delayed by the Contractor, the Engineer may by notice require the Contractor to carry out the Tests within 21

days after receiving the notice. The Contractor shall carry out the Tests on such day or days within that period as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within the period of 21 days, the Employer's Personnel may proceed with the Tests at the risk and cost of the Contractor. The Tests on Completion shall then be deemed to have been carried out in the presence of the Contractor and the results of the Tests shall be accepted as accurate.

9.3 Retesting

If the Works, or a Section, fail to pass the Tests on Completion, Sub-Clause 7.5 [Rejection] shall apply, and the Engineer or the Contractor may require the failed Tests, and Tests on Completion on any related work, to be repeated under the same terms and conditions.

9.4 Failure to Pass Tests on Completion

If the Works, or a Section, fail to pass the Tests on Completion repeated under Sub-Clause 9.3 [Retesting], the Engineer shall be entitled to:

(a) order further repetition of Tests on Completion under Sub-Clause 9.3;

(b) if the failure deprives the Employer of substantially the whole benefit of the Works or Section, reject the Works or Section (as the case may be), in which event the Employer shall have the same remedies as are provided in sub-paragraph (c) of Sub-Clause 11.4 [Failure to Remedy Defects]; or

(c) issue a Taking-Over Certificate, if the Employer so requests.

In the event of sub-paragraph (c), the Contractor shall proceed in accordance with all other obligations under the Contract, and the Contract Price shall be reduced by such amount as shall be appropriate to cover the reduced value to the Employer as a result of this failure. Unless the relevant reduction for this failure is stated (or its method of calculation is defined) in the Contract, the Employer may require the reduction to be (i) agreed by both Parties (in full satisfaction of this failure only) and paid before this Taking-Over Certificate is issued, or (ii) determined and paid under Sub-Clause 2.5 [Employer's Claims] and Sub-Clause 3.5 [Determinations].

9.5 Deleted

10. Employer's Taking Over

10.1 Taking Over of the Works and Sections

Except as stated in Sub-Clause 9.4 [Failure to Pass Tests on Completion], the Works shall be taken over by the Employer/HRIDC when (i) the Works have been completed in accordance with the Contract, including the matters described in Sub-Clause 8.2 [Time for Completion] and except as allowed in sub-paragraph (a) below, and (ii) a Taking-Over Certificate for the Works has been issued, or is deemed to have been issued in accordance with this Sub-Clause.

The Contractor may apply by notice to the Engineer for a Taking-Over Certificate not earlier than 14 days before the Works will, in the Contractor's opinion, be complete and ready for taking over. If the Works are divided into

Sections, the Contractor may similarly apply for a Taking-Over Certificate for each Section.

In case the works are to be taken over in accordance with sub-clause 9.5, the completed works shall be taken over by the Employer with the procedure specified by the Engineer.

The Engineer shall, within 28 days after receiving the Contractor's application:

(a) issue the Taking-Over Certificate to the Contractor, stating the date on which the Works or Section were completed in accordance with the Contract, except for any minor outstanding work and defects which will not substantially affect the use of the Works or Section for their intended purpose (either until or whilst this work is completed and these defects are remedied); or

(b) reject the application, giving reasons and specifying the work required to be done by the Contractor to enable the Taking-Over Certificate to be issued. The Contractor shall then complete this work before issuing a further notice under this Sub-Clause.

If the Engineer fails either to issue the Taking-Over Certificate or to reject the Contractor's application within the period of 28 days, and if the Works or Section (as the case may be) are substantially in accordance with the Contract, the Taking-Over Certificate shall be deemed to have been issued on the last day of that period.

10.2 Taking Over of Parts of the Works

The Engineer may, at the sole discretion of the Employer, issue a Taking-Over Certificate for any part of the Permanent Works.

The Employer shall not use any part of the Works (other than as a temporary measure which is either specified in the Contract or agreed by both Parties) unless and until the Engineer has issued a Taking-Over Certificate for this part. However, if the Employer does use any part of the Works before the Taking-Over Certificate is issued:

(a) the part which is used shall be deemed to have been taken over as from the date on which it is used,

(b) the Contractor shall cease to be liable for the care of such part as from this date, when responsibility shall pass to the Employer, and

(c) if requested by the Contractor, the Engineer shall issue a Taking-Over Certificate for this part.

After the Engineer has issued a Taking-Over Certificate for a part of the Works, the Contractor shall be given the earliest opportunity to take such steps as may be necessary to carry out any outstanding Tests on Completion. The Contractor shall carry out these Tests on Completion as soon as practicable before the expiry date of the relevant Defects Notification Period.

If the Contractor incurs Cost as a result of the Employer taking over and/or using a part of the Works, other than such use as is specified in the Contract or agreed by the Contractor, the Contractor shall (i) give notice to the Engineer and

(ii) be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to payment of any such Cost, which shall be included in the Contract Price. After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this Cost and profit.

If a Taking-Over Certificate has been issued for a part of the Works (other than a Section), the delay damages thereafter for completion of the remainder of the Works shall be reduced. Similarly, the delay damages for the remainder of the Section (if any) in which this part is included shall also be reduced. For any period of delay after the date stated in this Taking-Over Certificate, the proportional reduction in these delay damages shall be calculated as the proportion which the value of the part so certified bears to the value of the Works or Section (as the case may be) as a whole. The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these proportions. The provisions of this paragraph shall only apply to the daily rate of delay damages under Sub-Clause 8.7 [Delay Damages], and shall not affect the maximum amount of these damages.

10.3 Interference with Tests on Completion

If the Contractor is prevented, for more than 14 days, from carrying out the Tests on Completion by a cause for which the Employer/Engineer/other Contractors of the Employer,

are responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion would otherwise have been completed.

The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry date of the Defects Notification Period. The Engineer shall require the Tests on Completion to be carried out by giving 14 days' notice and in accordance with the relevant provisions of the Contract.

If the Contractor suffers delay and/or incurs Cost as a result of this delay in carrying out the Tests on Completion, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

10.4 Surfaces Requiring Reinstatement

Except as otherwise stated in a Taking-Over Certificate, a certificate for a Section or part of the Works shall not be deemed to certify completion of any ground or other surfaces requiring reinstatement.

11. Defects Liability

11.1 Completion of Outstanding Work and Remedying Defects

In order that the Works and Contractor's Documents, and each Section, shall be in the condition required by the Contract (fair wear and tear excepted) by the expiry date of the relevant Defects Notification Period or as soon as practicable thereafter, the Contractor shall:

(a) complete any work which is outstanding on the date stated in a Taking-Over Certificate, within such reasonable time as is instructed by the Engineer, and

(b) execute all work required to remedy defects or damage, as may be notified by (or on behalf of) the Employer on or before the expiry date of the Defects Notification Period for the Works or Section (as the case may be).

If a defect appears or damage occurs, the Contractor shall be notified accordingly, by (or on behalf of) the Employer.

11.2 Cost of Remedying Defects

All work referred to in sub-paragraph (b) of Sub-Clause 11.1 [Completion of Outstanding Work and Remedying Defects] shall be executed at the risk and cost of the Contractor, if and to the extent that the work is attributable to:

(a) any design for which the Contractor is responsible,

(b) Plant, Materials or workmanship not being in accordance with the Contract, or

(c) failure by the Contractor to comply with any other obligation.

If and to the extent that such work is attributable to any other cause, the Contractor shall be notified promptly by (or on behalf of) the Employer, and Sub-Clause 13.3 [Variation Procedure] shall apply.

11.3 Extension of Defects Notification Period

The Employer shall be entitled subject to Sub-Clause 2.5 [Employer's Claims] to an extension of the Defects Notification Period for the Works or a Section if and to the extent that the Works, Section or a major item of Plant (as the case may be, and after taking over) cannot be used for the purposes for which they are intended by reason of a defect or damage. However, a Defects Notification Period shall not be extended by more than two years.

If delivery and/or erection of Plant and/or Materials was suspended under Sub-Clause 8.8 [Suspension of Work] or Sub-Clause 16.1 [Contractor's Entitlement to Suspend Work], the Contractor's obligations under this Clause shall not apply to any defects or damage occurring more than two years after the Defects Notification Period for the Plant and/or Materials would otherwise have expired.

11.4 Failure to Remedy Defects

If the Contractor fails to remedy any defect or damage within a reasonable time, a date may be fixed by (or on behalf of) the Employer, on or by which the defect or damage is to be remedied. The Contractor shall be given reasonable notice of this date.

If the Contractor fails to remedy the defect or damage by this notified date and this remedial work was to be executed at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Employer may (at his option):

(a) Carry out the work himself or by others, in a reasonable manner and at the Contractor's cost, but the Contractor shall have no responsibility for this work; and the Contractor shall subject to Sub-Clause 2.5 [Employer's Claims] pay to the Employer the costs reasonably incurred by the Employer in remedying the defect or damage;

(b) require the Engineer to agree or determine a reasonable reduction in the Contract Price in accordance with Sub-Clause 3.5 [Determinations]; or

(c) if the defect or damage deprives the Employer of substantially the whole benefit of the Works or any major part of the Works, terminate the Contract as a whole, or in respect of such major part which cannot be put to the intended use. Without prejudice to any other rights, under the Contract or otherwise, the Employer shall then be entitled to recover all sums paid for the Works or for such part (as the case may be), plus financing costs and the cost of dismantling the same, clearing the Site and returning Plant and Materials to the Contractor.

11.5 Removal of Defective Work

If the defect or damage cannot be remedied expeditiously on the Site and the Employer gives consent, the Contractor may remove from the Site for the purposes of repair such items of Plant as are defective or damaged. This consent may require the Contractor to increase the amount of the Performance Security by the full replacement cost of these items, or to provide other appropriate security.

11.6 Further Tests

If the work of remedying of any defect or damage may affect the performance of the Works, the Engineer may require the repetition of any of the tests described in the Contract. The requirement shall be made by notice within 28 days after the defect or damage is remedied.

These tests shall be carried out in accordance with the terms applicable to the previous tests, except that they shall be carried out at the risk and cost of the Party liable, under Sub-Clause 11.2 [Cost of Remedying Defects], for the cost of the remedial work.

11.7 Right of Access

Until the Performance Certificate has been issued, the Contractor shall have such right of access to the Works as is reasonably required in order to comply with this Clause, except as may be inconsistent with the Employer's reasonable security restrictions.

11.8 Contractor to Search

The Contractor shall, if required by the Engineer, search for the cause of any defect, under the direction of the Engineer. Unless the defect is to be remedied

at the cost of the Contractor under Sub-Clause 11.2 [Cost of Remedying Defects], the Cost of the search shall be agreed or determined by the Engineer in accordance with Sub-Clause 3.5 [Determinations] and shall be included in the Contract Price.

11.9 Performance Certificate

Performance of the Contractor's obligations shall not be considered to have been completed until the Employer has issued the Performance Certificate to the Contractor, stating the date on which the Contractor completed his obligations under the Contract.

The Employer shall issue the Performance Certificate within 28 days after the latest of the expiry dates of the Defects Notification Periods, or as soon thereafter as the Contractor has supplied all the Contractor's Documents and completed and tested all the Works, including remedying any defects.

Only the Performance Certificate shall be deemed to constitute acceptance of the Works.

11.10 Unfulfilled Obligations

After the Performance Certificate has been issued, each Party shall remain liable for the fulfilment of any obligation which remains unperformed at that time. For the purposes of determining the nature and extent of unperformed obligations, the Contract shall be deemed to remain in force.

11.11 Clearance of Site

Upon receiving the Performance Certificate, the Contractor shall remove any remaining Contractor's Equipment, surplus material, wreckage, rubbish and Temporary Works from the Site.

If all these items have not been removed within 28 days after the Employer receives a copy of the Performance Certificate, the Employer may sell or otherwise dispose of any remaining items. The Employer shall be entitled to be paid the costs incurred in connection with, or attributable to, such sale or disposal and restoring the Site.

Any balance of the moneys from the sale shall be paid to the Contractor. If these moneys are less than the Employer's costs, the Contractor shall pay the outstanding balance to the Employer.

12. Measurement and Evaluation

12.1 Works to be Measured

The Works shall be measured, and valued for payment, in accordance with this Clause.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

(a) promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and

(b) supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made

by (or on behalf of) the Engineer shall be accepted as accurate.

Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured from records, these shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend, the records shall be accepted as accurate.

If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall give notice to the Engineer of the respects in which the records are asserted to be inaccurate. After receiving this notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so give notice to the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.

12.2 Method of Measurement

Except as otherwise stated in the Contract and notwithstanding local practice:

(i) measurement shall be made of the net actual quantity of each item of the Permanent Works, and

(ii) the method of measurement shall be in accordance with the Bill of Quantities or other applicable Schedules.

12.3 Evaluation

12.3.1 Except as otherwise stated in the contract, the Engineer shall proceed in accordance with sub clause 3.5 (Determinations) to agree or determine the contract price by evaluating each item of work, applying the measurement agreed or determined in accordance with the above sub clause 12.1 and 12.2 and the appropriate rate or price for the item.

For each item of work, the appropriate rate or price for the item shall be in the following order:

(i) the rate or price specified for such item in the Contract, or

(ii) the rate or price specified for similar work in the contract, or

(iii) the rates of such items shall be taken from North Western Railway Unified Standard Schedule of Rates (NWR USSOR)-2019 duly adjusted for escalation @5% per annum from Nov’ 2019 or

(iv) the rates of such items shall be taken from Delhi Schedule of Rates (DSR)-2021 Vol I & II duly adjusted for escalation @ 5% per annum from Apr’ 2021

12.3.2 However, a new rate or price shall be appropriate for an item of work if :

(a) all the following conditions are met for existing item of the contract:

(i) the measured quantity of the item is increased by more than 50% from the quantity of this item in the Bill of Quantities or the

Schedule,

(ii) this item is not specified in the contract as a "fixed rate item".

(b) the work is instructed under clause 13 [Variations and Adjustments]and

(i) no rate or price is specified in the contract for this item,

(ii) no specified rate or price is appropriate because the item of work is not of similar character, or is not executed under similar conditions, as any item in the contract and

(iii) no rate or price is specified in North Western Railway Unified Standard Schedule of Rates (NWR USSOR)-2019 and Delhi Schedule of Rates (DSR)-2021 Vol I & II .

(c) On passage of original completion period stipulated in the contract, if site in some stretches has not been handed over for execution of the work due to any of the reasons mentioned below:

(i) non acquisition of land,

(ii) non availability of forest/wild life clearances,

(iii) non removal of encroachments, delay in shifting of utilities (to be shifted by other agencies) and

(iv) non handing over of the sites by other agencies/authorities and the contractor otherwise has been executing the works satisfactorily on other sites, as certified by the Engineer, the contractor shall be entitled for new rates for the items and quantities of work which could not be executed in the stretches still to be handed over. In case the progress is not satisfactory, the contractor shall not be entitled for new rates and the Employer shall have the option either to continue the work in these stretches through the same agency or get it executed through other means.

In case of entitlement for new rates, if the contractor is not willing to take up the work in these stretches, he will have the option to say so in writing or if no agreement is reached on new rates, the remaining works of such stretches shall be excluded from the scope of the contract through a variation statement. In such a case the contractor shall not be entitled for any claim or compensation on this account. The Employer shall get the remaining works on these stretches executed through other means.

12.3.3

(i) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (a) & (c) above shall be derived from an assessment of the reasonable cost of executing the work with an additional

element of 5% towards overheads and profit of the Contractor.

(ii) Each new rate or price for item(s) as described in sub paragraph 12.3.1 (b) above shall be derived from an assessment of the reasonable cost of executing the work with an additional element of 5% towards overheads and profit of the Contractor.

(iii) Deleted.

(iv) The assessment of reasonable cost of executing the work (except over heads and profit which shall be 5%) shall be arrived at based on the prevailing rates and by taking guidance from the following documents. The priority of the documents shall be in accordance with the following sequence:

a) Analysis of Unified SOR of Indian Railway;

b) Analysis issued by MORTH;

c) Analysis of Delhi Schedule of Rates issued by CPWD;

d) Market analysis.

(v) If the final rate decided by the competent authority is not acceptable to the contractor, the contractor will be bound to execute the work at the rates as decided by the competent authority of the EMPLOYER but he may refer the dispute in rate for settlement as per provisions of clause 20 of General Conditions of Contract. Until such time as an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 90% of the rate proposed by him and accepted by the concerned CPM/GM in charge of the project.

Until such time an appropriate rate or price is agreed or determined, the Engineer shall make the Interim payment at the rate of 90% of the rate proposed by him and accepted by the concerned CPM/GM in charge of the project.

12.4 Omissions

Whenever the omission of any work forms part (or all) of a Variation, the value of which has not been agreed, if:

(a) the Contractor will incur (or has incurred) cost which, if the work had not been omitted, would have been deemed to be covered by a sum forming part of the Accepted Contract Amount;

(b) the omission of the work will result (or has resulted) in this sum not forming part of the Contract Price; and

(c) this cost is not deemed to be included in the evaluation of any substituted work;

then the Contractor shall give notice to the Engineer accordingly, with supporting particulars. Upon receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine this cost, which shall be included in the Contract Price.

13. Variations and Adjustments

13.1 Right to Vary

Variations may be initiated by the Employer at any time prior to issuing the Taking-Over Certificate for the Works, either by an instruction or by making a request to the Contractor to submit a proposal.

The Contractor shall execute and be bound by each Variation till the price does not exceed 50% of the agreement value as specified in letter of acceptance / original agreement. For variation beyond the above the Contractor shall be bound to execute, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that the Contractor cannot readily obtain the Goods required for the Variation. Upon receiving this notice, the Engineer shall cancel, confirm or vary the instruction.

Each Variation may include:

(a) changes to the quantities of any item of work included in the Contract,

(b) changes to the quality and other characteristics of any item of work,

(c) changes to the levels, positions and/or dimensions of any part of the Works,

(d) omission of any work unless it is to be carried out by others,

(e) any additional work, Plant, Materials or services necessary for the Permanent Works, including any associated Tests on Completion, boreholes and other testing and exploratory work, or

(f) changes to the sequence or timing of the execution of the Works.

(g) Re-work arising out of revision in drawings / designs / methodology of execution, after actual execution of work; excluding any re-work arising from any default of the Contractor, such as non-conformity to the quality of work /prescribed standards etc. in the performance of obligations.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation.

13.2 Value Engineering

Not Applicable

13.3 Variation Procedure

If the Engineer requests a proposal, prior to instructing a Variation, the Contractor shall respond in writing as soon as practicable, either by giving reasons why he cannot comply (if this is the case) or by submitting:

(a) a description of the proposed work to be performed and a programme for its execution,

(b) the Contractor's proposal for any necessary modifications to the programme according to Sub-Clause 8.3 [Programme] and to the Time for Completion, and

(c) the evaluation of the Variation shall be as specified in Clause 12.3

Evaluation.

The Engineer shall, as soon as practicable after receiving such proposal (under Sub-Clause 13.2 [Value Engineering] or otherwise), respond with approval, disapproval or comments. The Contractor shall not delay any work whilst awaiting a response.

Each instruction to execute a Variation, with any require Fements for the recording of Costs, shall be issued by the Engineer to the Contractor, who shall acknowledge receipt.

Each Variation shall be evaluated in accordance with Clause 12 [Measurement and Evaluation], unless the Engineer instructs or approves otherwise in accordance with this Clause.

13.4 Payment in Applicable Currencies

If the Contract provides for payment of the Contract Price in more than one currency, then whenever an adjustment is agreed, approved or determined as stated above, the amount payable in each of the applicable currencies shall be specified. For this purpose, reference shall be made to the actual or expected currency proportions of the Cost of the varied work, and to the proportions of various currencies specified for payment of the Contract Price.

13.5 Provisional Sums

Each Provisional Sum shall only be used, in whole or in part, in accordance with the Engineer's instructions, and the Contract Price shall be adjusted accordingly. The total sum paid to the Contractor shall include only such amounts, for the work, supplies or services to which the Provisional Sum relates, as the Engineer shall have instructed. For each Provisional Sum, the Engineer may instruct:

(a) work to be executed (including Plant, Materials or services to be supplied) by the Contractor and valued under Sub-Clause 13.3 [Variation Procedure]; and/or

(b) Plant, Materials or services to be purchased by the Contractor, from a nominated Subcontractor (as defined in Clause 5 [Nominated Subcontractors]) or otherwise; and for which these shall be included in the Contract Price:

(i) the actual amounts paid (or due to be paid) by the Contractor, and

(ii) a sum for overhead charges and profit, calculated as a percentage of these actual amounts by applying the relevant percentage rate (if any) stated in the appropriate Schedule. If there is no such rate, the percentage rate stated in the Contract Data shall be applied.

The Contractor shall, when required by the Engineer, produce quotations, invoices, vouchers and accounts or receipts in substantiation.

13.6 Day work

For work of a minor or incidental nature, the Engineer may instruct that a Variation shall be executed on a daywork basis. The work shall then be valued in accordance with the Daywork Schedule included in the Contract, and the following procedure shall apply. If a Daywork Schedule is not included in the Contract, this Sub-Clause shall not apply.

Before ordering Goods for the work, the Contractor shall submit quotations to the Engineer. When applying for payment, the Contractor shall submit invoices, vouchers and accounts or receipts for any Goods.

Except for any items for which the Daywork Schedule specifies that payment is not due, the Contractor shall deliver each day to the Engineer accurate statements in duplicate which shall include the following details of the resources used in executing the previous day's work:

(a) the names, occupations and time of Contractor's Personnel,

(b) the identification, type and time of Contractor's Equipment and Temporary Works, and

(c) the quantities and types of Plant and Materials used.

One copy of each statement will, if correct, or when agreed, be signed by the Engineer and returned to the Contractor. The Contractor shall then submit priced statements of these resources to the Engineer, prior to their inclusion in the next Statement under Sub-Clause 14.3 [Application for Interim Payment Certificates].

13.7 Adjustments for Changes in Legislation

The Contract Price shall be adjusted to take account of any increase or decrease in Cost resulting from a change in the Laws of the Country (including the introduction of new Laws and the repeal or modification of existing Laws) or in the judicial or official governmental interpretation of such Laws, made after the Base Date, which affect the Contractor in the performance of obligations under the Contract.

If the Contractor suffers (or will suffer) delay and/or incurs (or will incur) additional Cost as a result of these changes in the Laws or in such interpretations, made after the Base Date, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

In case there is a decrease in cost as a result of changes of Law by Legislation after the Base Date, the Engineer shall proceed in accordance with Sub Clause 3.5 (determination) to agree or determine these matters without waiting for Contractor's / Employer's Notice.

Notwithstanding the foregoing, the Contractor shall not be entitled to such an extension of time if the same shall already have been taken into account in determining an extension and such Cost shall not be separately paid if the same shall already have been taken into account in the indexing of any inputs to the table of adjustment data in accordance with the provisions of Sub-Clause 13.8.

13.8 Adjustment for changes in cost.

(A) Price Adjustment

The amounts payable to the Contractor and valued at base rates and prices pursuant to Sub-Clause 14.3 (a) hereof shall be adjusted in respect of the rise or fall in the indexed costs for labour, Contractor's Equipment and plant, materials and other inputs to the Works, by the addition or subtraction of the amounts determined by the formulae prescribed in this clause.

(B) Other Changes in Cost

To the extent that full compensation for any rise or fall in the costs to the Contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates and prices included in the Contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

(C) Adjustment Formulae

The contract price shall be adjusted for increase or decrease in rates and price of labour, materials fuels and lubricants in accordance with the

following principles and procedures as per formulae given in Volume II Bill of Quantities. The amount certified in each payment certificate is adjusted by applying respective price adjustment factor to the payment amounts due in each currency:

a. Price adjustment shall apply only for work carried out within the stipulated time or extensions granted by the Employer for delays not attributable to the Contractor and shall not apply to work carried out beyond the stipulated time for Completions of the Works for delays attributable to the Contractor. Price adjustment for extensions for reasons attributable to the Contractor, shall be paid in accordance with sub-clause 13.8 (c)

b. Price adjustment shall be calculated for the local and foreign components of the payment for the work done as per formulae given Volume II Bill of Quantities.

c. LIMIT OF PRICE ADJUSTMENT: Provided that, in determining all such price adjustment in accordance with the aforesaid Sub-Clauses:

No account will be taken of any amount by which any cost incurred by the Contractor has been increased by default or negligence of the Contractor.

e. If the Contractor fails to complete the work within time for completion prescribed under Clause 8.2, the adjustment of prices thereafter until the completion of the works shall be made using either the indices or prices, whichever is more favourable to the Employer, provided that if an extension of time is granted pursuant to Sub-Clause 8.4, the above position shall apply to the adjustments made after expiry of such extension of time.

14. Contract Price and Payment

14.1 The Contract Price

Unless otherwise stated in the Special Conditions of Contract:

(a) the Contract Price shall be agreed or determined under Sub-Clause 12.3 [Evaluation] and be subject to adjustments in accordance with the Contract;

(b) the Contractor shall pay all taxes, duties and fees required to be paid by him under the Contract, and the Contract Price shall not be adjusted for any of these costs except as stated in Sub-Clause 13.7 [Adjustments for Changes in Legislation];

(c) any quantities which may be set out in the Bill of Quantities or other Schedule are estimated quantities and are not to be taken as the actual and final quantities:

(i) of the Works which the Contractor is required to execute, or

(ii) for the purposes of Clause 12 [Measurement and Evaluation]; and

(d) the Contractor shall submit to the Engineer, within 28 days after the Commencement Date, a proposed breakdown of each lump sum price in the Schedules, if applicable. The Engineer may take account of the breakdown

when preparing Payment Certificates, but shall not be bound by it.

(e) It may be noted that in the event of the Contractor not making the due payments stated in sub-clause (b) above, and the concerned party puts up a claim with the Employer / Engineer, then the Employer / Engineer may make such payments and deduct the same from the sums due to the Contractor.

14.2 Advance Payment

14.2.1 Mobilization Advance

The Employer shall make payment, an Interest free advance for mobilization, when the Contractor submits a guarantee in accordance with this Sub-Clause. The total advance payment, the number and timing of instalments (if more than one), and the applicable currencies and proportions, shall be as stated in the Contract Data.

Unless and until the Employer receives this guarantee, or if the total advance payment is not stated in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall issue an interim payment certificate for the first installment of mobilisation advance after receiving an application for advance payment (under sub clause 14.3 [Application for Interim Payment Certificates]) and after the Employer receives (i) the Performance Security in accordance with Sub-Clause 4.2 [Performance Security] and (ii) a guarantee in amounts and currencies equal to the advance payment plus 10%. The next installment shall be released only when the contractor submits statement of having utilized the previous installment of mobilization advance and the Employer is satisfied that the utilization has been done in purposeful manner.

14.2.2 Advance against Plant and Machinery

Interest bearing advance against plant and machinery, is payable for procurement of plant, equipment and machinery to be utilized specifically for the subject works, with following stage payments:

Stage-1: At the stage of Purchase Order	50% of the total permissible advance payment or actual payment made whichever is less, provided that the contractor has submitted copy of Purchase Order and the invoices duly certified from the firm and against a guarantee in amounts and currencies equal to the stage advance payment plus 10%.
Stage-2: At the stage of dispatch of the plant and machinery from manufacturing unit/ assembly point	Cumulative 90% of the permissible advance payment or actual payment made whichever is less, against a guarantee in amounts and currencies equal to the stage advance payment plus 10%. In case of domestic manufacture, provided the contractor has submitted GST invoice and

	Delivery Challan (Interstate movement Challan to the worksite) and in case of foreign manufacture provided the contractor has submitted Bill of Lading (BOL), Final Inspection Certificate and Transit Insurance.
Stage-3: At the stage of arrival of plant & machinery at the work site	Remaining of the permissible advance payment, against a guarantee in amounts and currencies equal to the stage advance payment plus 10%. Provided Plant & Machinery have reached the site, physical verification by Engineer and submission of commissioning certificate of the Plant & Machinery.

The total advance payment under this sub-clause, including the applicable currencies and proportions, shall be as stated in the Contract Data.

All such plant, equipment and machinery shall be used only for executing the works under this Contract. No such plant, equipment and machinery shall be removed from the site, unless advance equivalent to the advance against such machinery has been fully repaid and prior permission of the Engineer has been obtained.

The Engineer shall decide whether a particular plant, equipment or machinery is actually required to execute the work. No advance is payable against items identified as unnecessary. The plant and machinery admissible for advance payment and its valuation shall be done by the Engineer on following considerations;

i. New items: 80% of purchase price.
ii. Used or Second-hand items: Not to be considered.
iii. New Items valued at less than ₹ 10,00,000 each: Not to be considered.

14.2.3 Guarantees

Advances as mentioned in sub-clauses 14.2.1 & 14.2.2 above, shall be payable against acceptable Bank Guarantees from banks as specified in clause 4.2. The guarantees shall be in the form as given in Section 8 (Contract Forms) or in another form approved by the Employer. The Contractor shall ensure that the guarantees are valid and enforceable until the advance amount paid as has been repaid, but its amount may be progressively reduced by the amount repaid by theContractor as indicated in the Payment Certificates. If the terms of the guarantee specify its expiry date, and the advance payment has not been repaid by the date 28 days prior to the expiry date, the Contractor shall extend the validity of the guarantee until the advance payment has been repaid.

14.2.4 Recovery of Advances

Unless stated otherwise in the Contract Data, the advance payment shall be repaid through percentage deductions from the interim payments determined by the Engineer in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates], as follows:

(a) deductions shall commence in the next interim Payment Certificate following that in which the total of all certified interim payments (excluding the advance payment) exceeds 5 percent of the Accepted Contract Amount less Provisional Sums or passage of six months from the date of release of first advance payment, whichever is earlier; and

(b) deductions shall be made for accrued interest on the advance up to the month and advance at the rate stated in the Contract Data of the amount of each Interim Payment Certificate (excluding the advance payment and deductions and repayments of retention) in the currencies and proportions of the advance payment until such time as the advance payment and accrued interest has been repaid; provided that the advance payment and accrued interest shall be completely repaid prior to the time when 80 percent of the Accepted Contract Amount has been certified for payment. If the amount of interim payment certificate is not sufficient for recovery of accrued interest or in the opinion of the Employer satisfactory progress is not being achieved by the contractor, then the contractor will have to deposit the accrued interest and return the mobilisation advance in part or in full as demanded by the Employer, failing which Employer shall have the right to encash the Bank Guarantee(s)

The Contractor shall always have the option to start repayment earlier and/or to complete the repayment earlier than the due date.

If the advance payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [Termination by Employer], Clause 16 [Suspension and Termination by Contractor] or Clause 19 [Force Majeure] (as the case may be), the whole of the balance then outstanding shall immediately become due and payable by the Contractor to the Employer.

14.2.5 Advances to be Used only for this work.

The advances shall be used by the Contractor strictly for the purpose of the Contract, and for the purpose for which they are paid. Under no circumstances, shall the advances be diverted for other purposes. Any such diversion shall be construed as a breach of the Contract and the Contractor shall be asked to return the advance at once and pay interest at 15% per annum till the advance is recovered back from him. The Contractor shall return the advance and pay the interest in one go without demur.

Employer retains the right for any other remedy prescribed for breach of Contract in this regard.

The Contractor, if required by the Engineer shall provide the details of

utilisation of Mobilisation advance.

14.3 Application for Interim Payment Certificates

The Contractor shall submit a Statement in six copies to the Engineer in accordance with the payment procedure specified by the Engineer, after the end of each month, in a form approved by the Engineer, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Sub-Clause 4.21 [Progress Reports] and Record Measurement Sheets.

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described in sub-paragraphs (b) to (g) below);

(b) any amounts to be added and deducted for changes in legislation and changes in cost, in accordance with Sub-Clause 13.7 [Adjustments for Changes in Legislation] and Sub-Clause 13.8 [Adjustments for Changes in Cost];

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;

(d) Any amounts to be added and deducted for the advance payments and repayments in accordance with sub clause 14.2 [Advance Payment];

(e) any amounts to be added and deducted for Plant and Materials in accordance with Sub-Clause 14.5 [Plant and Materials intended for the Works];

(f) any other additions or deductions which may have become due under the Contract or otherwise, including those under Clause 20 [Claims, Disputes and Arbitration]; and

(g) the deduction of amounts certified in all previous Payment Certificates.

(h) for invoicing as per GST Laws, the estimated contract value of the Works executed in terms of (a) above and any amounts added or deducted as per (b), (e) to (g) above is to be broken up in two components i.e. (i) the base amount excluding GST (ii) GST component (calculated at the rate for works contract service as per GST Laws).

(i) Statement of interim payments certificates should be submitted by the Contractor to the Engineer by the 7th day of each month for the work executed upto the end of the previous month.

(j) An amount to be deducted for the payments to be made to different Departments towards payments liable to be made by the Contractor.

14.4 Schedule of Payments

If the Contract includes a schedule of payments specifying the instalments in which the Contract Price will be paid, then unless otherwise stated in this schedule:

(a) the instalments quoted in this schedule of payments shall be the estimated contract values for the purposes of sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates];

(b) Sub-Clause 14.5 [Plant and Materials intended for the Works] shall not apply; and

(c) if these instalments are not defined by reference to the actual progress achieved in executing the Works, and if actual progress is found to be less than that on which this schedule of payments was based, then the Engineer may proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine revised instalments, which shall take account of the extent to which progress is less than that on which the instalments were previously based.

If the Contract does not include a schedule of payments, the Contractor shall submit non-binding estimates of the payments which he expects to become due during each quarterly period. The first estimate shall be submitted within 42 days after the Commencement Date. Revised estimates shall be submitted at quarterly intervals, until the Taking-Over Certificate has been issued for the Works.

14.5 Plant and Materials intended for the Works

If this Sub-Clause applies, Interim Payment Certificates shall include, under sub-paragraph (e) of Sub-Clause 14.3:

(i) an amount for Plant and Materials which have been sent to the Site for incorporation in the Permanent Works, and

(ii) a reduction when the contract value of such Plant and Materials is included as part of the Permanent Works under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates].

If the lists referred to in sub-paragraphs (b)(i) or (c)(i) below are not included in the Contract Data, this Sub-Clause shall not apply.

The Engineer shall determine and certify each addition if the following conditions are satisfied:

(a) the Contractor has:

(i) kept satisfactory records (including the orders, receipts, Costs and use of Plant and Materials) which are available for inspection, and

(ii) submitted a statement of the Cost of acquiring and delivering the

Plant and Materials to the Site, supported by satisfactory evidence;

and either:

(b) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when shipped,

(ii) have been shipped to the Country, en route to the Site, in accordance with the Contract; and

(iii) are described in a clean shipped bill of lading or other evidence of shipment, which has been submitted to the Engineer together with evidence of payment of freight and insurance, any other documents reasonably required, and a bank guarantee in a form and issued by an entity approved by the Employer in amounts and currencies equal to the amount due under this Sub-Clause: this guarantee may be in a similar form to the form referred to in Sub-Clause 14.2 [Advance Payment] and shall be valid until the Plant and Materials are properly stored on Site and protected against loss, damage or deterioration;

or

(c) the relevant Plant and Materials:

(i) are those listed in the Schedules for payment when delivered to the Site,

(ii) the original 'Invoice' and the original 'Inspection Certificate' by the approved Inspection agency marked 'for payment' is furnished with the Application for IPC [sub-Clause 14.3].

(iii) have been delivered to and are properly stored on the Site, are protected against loss, damage or deterioration, and appear to be in accordance with the Contract.

The additional amount to be certified shall be the equivalent of eighty percent of the Engineer's determination of the cost of the Plant and Materials (including delivery to Site), taking account of the documents mentioned in this Sub-Clause and of the contract value of the Plant and Materials. The amount shall be certified on receipt of an Indemnity Bond for the stated amount in the Form approved by the Employer.

The currencies for this additional amount shall be the same as those in which payment will become due when the contract value is included under sub-paragraph (a) of Sub-Clause 14.3 [Application for Interim Payment Certificates]. At that time, the Payment Certificate shall include the applicable reduction which shall be equivalent to, and in the same currencies and proportions as, this additional amount for the relevant Plant and Materials.

14.6 Issue of Interim Payment Certificates

No amount will be certified or paid until the employer has received and approved the performance security. Thereafter, the Engineer shall within two days after receiving a statement and supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)), issue to the Employer a provisional interim payment certificate which shall state the amount which the Engineer determines to be due after preliminary check as per EMPLOYER's procedure order. After this the Engineer shall, within 28 days after receiving a statement and supporting documents, issue to the employer an Interim Payment Certificate which shall state the amount which the Engineer fairly determines to be due, with supporting particulars.

However, prior to issuing the Taking-Over Certificate for the Works, the Engineer shall not be bound to issue the Interim Payment Certificate in an amount which would (after retention and other deductions) be less than the minimum amount of Interim Payment Certificates (if any) stated in the Contract Data. In this event, the Engineer shall give notice to the Contractor accordingly.

An Interim Payment Certificate shall not be withheld for any other reason, although:

(a) if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or

(b) if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the Engineer, the value of this work or obligation may be withheld until the work or obligation has been performed.

The Engineer may in any Payment Certificate make any correction or modification that should properly be made to any previous Payment Certificate. A Payment Certificate shall not be deemed to indicate the Engineer's acceptance, approval, consent or satisfaction.

14.7 Payment

The Employer shall pay to the Contractor:

(a) the first instalment of the advance payment within 28 days after issuing

the Letter of Acceptance or within 21 days after receiving the documents in accordance with Sub-Clause 4.2 [Performance Security] and Sub-Clause 14.2 [Advance Payment], whichever is later;

(b) (i) After preliminary scrutiny and certifications by the Engineer, payment of 80% of the certified net payment due (after recoveries and deductions), shall be made by the Employer within 10 days of receiving IPC from the Engineer subject to the condition that last interim payment certificate has been settled after detailed check. In the event of the contractor submitting bills based on false measurements, the Engineer should issue a written warning to him to the effect that the facility of 80% payment without detailed check will be withdrawn in future. If the Contractor repeats the misconduct this facility should be withdrawn.

(ii) The amount certified in each Interim Payment Certificate within 56 days after the Engineer receives the Statement and supporting documents from the Contractor. Any discrepancy shall be rectified in the next payment to the Contractor; and

(c) the amount certified in the Final Payment Certificate within 56 days after the Employer receives this Payment Certificate or, the undisputed amount shown in the Final Statement, within 56 days after the date of notification of the suspension in accordance with Sub-Clause 16.2.

Payment of the amount due, unless specified in the Contract Data, shall be made in INR into the Bank account, nominated by the Contractor except for the Contract where the Contractor has opted for payment.

However, in case of JV, direct payment to individual JV partners shall be made on joint certification (about the net amounts payable to individual partners) by the authorized representative of the JV and concerned respective authorized representative of individual JV partners, after making requisite recoveries/deductions from the gross payment. In case of any dispute regarding the net amounts payable to individual partners, the Engineer shall decide the same on the basis of the execution of items of works under Schedules/Bills indicated in the JV agreement as the responsibility of execution of each JV partner. Payment to individual JV partners shall be treated as payment made to the JV. The said payment shall not alter any obligation of the JV and its individual Partners under the Agreement and their obligations under the agreement shall remain joint and several.

A foreign company shall have to submit proof of having opened their project office in India before any payment (including advance payment) is released to such a company. The required proof here shall be a copy of the report containing information as per format prescribed by Reserve Bank of India submitted to the Director General of Police (DGP) of the state concerned in which project office has been established.

14.8 Delayed Payment If the Contractor does not receive payment in accordance with Sub-Clause 14.7 [Payment], the Contractor shall be entitled to receive interest on the amount unpaid during the period of delay. This period shall be deemed to commence on the date for payment specified in Sub-Clause 14.7 [Payment], irrespective (in the case of its sub-paragraph (b)) of the date on which any Interim Payment Certificate is issued.

Unless otherwise stated in the Special Conditions of Contract, the interest amount be calculated at the rate specified in the Contract Data. If no rate is specified in the Contract Data the clause shall not apply.

The Contractor shall be entitled to this payment without formal notice or certification, and without prejudice to any other right or remedy.

14.9 Payment of Retention Money The Retention Money shall be certified and paid with the final payment certificate or bank guarantee against retention money shall be released, after making required adjustments for recovery for shortage/excess materials, if any **(except those quantities which become surplus due to change in planning/scheme by EMPLOYER) in case the recovery for surplus/excess materials is still balance after adjusting the amount payable in the final payment certificate.**

The Contractor shall be entitled to substitute a Bank Guarantee in the form approved by the Employer with the retention money amount recovered upto the date of request. Such substitution shall be permissible maximum upto 3 times. The Bank Guarantee shall be valid upto end of Defect Liability Period. In case of extension of date of completion of contract, the Contractor shall extend the validity of the Bank Guarantee(s) until the revised end of Defect Liability Period.

Wherever the contract is terminated under Clause 15.2, the Retention Money shall be forfeited and the balance work should be got done separately.

14.10 Statement at Completion Within 84 days after receiving the Taking-Over Certificate for the Works, the Contractor shall submit to the Engineer six copies of a Statement at completion with supporting documents, in accordance with Sub-Clause 14.3 [Application for Interim Payment Certificates], showing:

(a) the value of all work done in accordance with the Contract up to the date stated in the Taking-Over Certificate for the Works,

(b) any further sums which the Contractor considers to be due, and

(c) an estimate of any other amounts which the Contractor considers will become due to him under the Contract. Estimated amounts shall be shown separately in this Statement at completion.

The Engineer shall then certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates].

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents showing in detail in a form approved by the Engineer.

14.11 Application for Final Payment Certificate

Within 56 days after receiving the Performance Certificate, the Contractor shall submit, to the Engineer, six copies of a draft final statement as per procedure prescribed by the Engineer, with supporting documents (including Contractor's certificate in terms of Sub-Clause 6.22 (ii)) showing in detail in a form approved by the Engineer:

(a) the value of all work done in accordance with the Contract, and

(b) any further sums which the Contractor considers to be due to him under the Contract or otherwise, and

(c) the final statement of local content after completion of works in Form-MII provided in Section 4 Bidding Forms.

If the Engineer disagrees with or cannot verify any part of the draft final statement, as per procedure prescribed by the Engineer the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed. This agreed statement is referred to in these Conditions as the "Final Statement".

However if, following discussions between the Engineer and the Contractor and any changes to the draft final statement which are agreed, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer (with a copy to the Contractor) an Interim Payment Certificate for the agreed parts of the draft final statement. Thereafter, if the dispute is finally resolved under Sub-Clause 20.3 [Obtaining Dispute Board's Decision] or Sub-Clause 20.2 [Amicable Settlement], the Contractor shall then prepare and submit to the Employer (with a copy to the Engineer) a Final Statement.

14.12 Discharge

When submitting the Final Statement, the Contractor shall submit a discharge which confirms that the total of the Final Statement represents full and final settlement of all moneys due to the Contractor under or in connection with the Contract. This discharge may state that it becomes effective when the Contractor has received the Performance Security and the outstanding balance of this total, in which event the discharge shall be effective on such date.

14.13 Issue of Final Payment Certificate

Within 28 days after receiving the Final Statement and discharge in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall issue, to the Employer, the Final

Payment Certificate which shall state:

(a) the amount which he fairly determines is finally due, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance (if any) due from the Employer to the Contractor or from the Contractor to the Employer, as the case may be.

If the Contractor has not applied for a Final Payment Certificate in accordance with Sub-Clause 14.11 [Application for Final Payment Certificate] and Sub-Clause 14.12 [Discharge], the Engineer shall request the Contractor to do so. If the Contractor fails to submit an application within a period of 28 days, the Engineer shall issue the Final Payment Certificate for such amount as he fairly determines to be due.

14.14 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing under or inconnection with the Contract or execution of the Works, except to the extent that the Contractor shall have included an amount expressly for it:

(a) in the Final Statement and also

(b) (except for matters or things arising after the issue of the Taking-Over Certificate for the Works) in the Statement at completion described in Sub-Clause 14.10 [Statement at Completion].

However, this Sub-Clause shall not limit the Employer's liability under his indemnification obligations, or the Employer's liability in any case of fraud, deliberate default or reckless misconduct by the Employer.

14.15 Currencies of Payment

The Contract Price shall be paid in Indian Rupees (INR).

15. Termination by Employer

15.1 Notice to Correct

If the Contractor fails to carry out any obligation under the Contract as mentioned below, but not limited to, the Engineer/ Employer may serve the contractor with a 14 days notice in writing calling upon the contractor to make good the failure and to remedy it. If the Contractor;

(a) fails to comply with Sub-Clause 4.2 [Performance Security],

(b) abandons the Works or otherwise plainly demonstrates the intention not to continue performance of his obligations under the Contract,

(c) without reasonable excuse fails to:

(i) proceed with the Works in accordance with Clause 8 [Commencement, Delays and Suspension], or

(ii) comply with a notice issued under Sub-Clause 7.5 [Rejection] or Sub-Clause 7.6 [Remedial Work], within 28 days after receiving it, or

(iii) adhere to the agreed programme of work / activity on the critical path, by a margin of 10% of the stipulated period, or

(iv) take steps to deploy competent and adequate number of personnel, and equipment to achieve progress as per agreed programme or

(v) adhere to the instructions of Engineers/Employer persistently or

(vi) comply any provision of the contract or

(vii) provide the Engineer/Employer or their representative proper facilities for inspecting the works or any part thereof as required, under Clause 7.3 (Inspection) and 7.4 (Testing).

(d) subcontracts the whole or major part of the Works or assigns the Contract without prior written consent of the Employer.,

If the contractor does not, within 14 days of receipt of notice under this sub-clause, proceed to make good his default in so far as the same is capable of being made good and carry on the work of complying with such direction as contained in the notice under sub clause 15.1, to the entire satisfaction of the Engineer/Employer, the Employer shall be entitled to take action under sub-clause 15.1.1 or 15.1.2 or 15.2 below.

15.1.1 In case of contractor's repeated failure to adhere to the agreed program, and whereas the contractor has been served with a Notice to Correct under Clause 15.1 of GCC, if the contractor approaches EMPLOYER with a revised program with specific monthly physical and financial targets along with the proposal to deploy matching inputs in the form of manpower and other resources to the satisfaction of the Employer, then the Employer may consider whether to proceed with termination of the contract under Clause 15.2 of GCC or to continue with the contract. However, the request to continue with the contract shall only be considered if the contractor supports his earnestness to adhere to the revised program by submitting additional Performance Security in the form of Bank Guarantee(s) of specified number and value as decided by the Employer (total value of which will not exceed 10% of the contract price). The encashment of these additional Bank Guarantee(s) shall be linked with the non achievement of agreed physical/financial targets agreed upon by the Contractor and the Employer.

15.1.2 In case the contractor's failure is limited to only some of the works, and in response to Notice to Correct under Clause 15.1 of GCC, the contractor approaches the Employer that such works may be offloaded from him and got executed through another agency and additional cost incurred, if any, should be recovered from his dues, the Employer, on being convinced that the anticipated additional cost for such works will not be

substantial and can be recovered from the dues of the contractor and that such offloading will help in improving the overall progress of the project, may agree to such offloading without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. However, the Employer will not be under any compulsion to agree to such a request. The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

In case the Contractor does not approach the Employer for offloading but the Employer is convinced that:

(i) offloading of some works will help in improving the progress of the project;

(ii) termination/part termination of the contract at this stage will not be in the interest of the project;

(iii) the anticipated additional cost for such works will not be substantial and can be recovered from the dues of the Contractor;

The Employer may issue 7 days notice to the Contractor stating the resources required to be deployed against each work. If the contractor fails to deploy the required resources as indicated in the notice, the employer shall offload such works and proceed with getting the works executed through other agency(ies). The Contractor shall be informed of the LOA issued to other agency(ies) for such works.

Offloading under the sub clause 15.1.2 shall be without any repercussion on the performance security and/or additional bank guarantees, if any, submitted by the contractor. The Contractor would have no future claim on this account and the extra expenditure so incurred, if any, by the Employer in getting the offloaded work done, shall be recovered from subsequent payment certificates or any other dues of the contractor.

15.2 Termination by Employer

The Employer shall be entitled to terminate the Contract as a whole or any part or parts (as may be specified in the Notice of Termination under any of the above Sub-Clause issue) if the Contractor:

(a) fails to comply with the directions contained in the notice under Sub-Clause 15.1 [Notice to Correct],

(b) becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against it by Court or Statutory Authority him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events, or

(c) gives or offers to give (directly or indirectly) to any person any bribe, gift, gratuity, commission or other thing of value, as an inducement or reward:

(i) for doing or forbearing to do any action in relation to the Contract, or

(ii) for showing or forbearing to show favour or disfavour to any person in relation to the Contract,

or if any of the Contractor's Personnel, agents or Subcontractors gives or offers to give (directly or indirectly) to any person any such inducement or reward as is described in this sub-paragraph (c). However, lawful inducements and rewards to Contractor's Personnel shall not entitle termination

In any of these events or circumstances, the Employer may, by Notice Terminate the contract with immediate effect.

The Employer's election to terminate the Contract shall not prejudice any other rights of the Employer, under the Contract or otherwise.

The Contractor shall remove all his plants and machinery from the site then leave the Site and deliver any required Goods, all Contractors' Documents, and other design documents made by or for him, to the Engineer within 7 days from the issue of Notice of Termination, failing which Delay Damages as prescribed for delay in completion of works shall be imposed as per provision of clause 8.7. However, the Contractor shall use his best efforts to comply immediately with any reasonable instructions included in the notice of Termination (i) for the assignment of any subcontract, and (ii) for the protection of life or property or for the safety of the Works.

After termination, the Employer may complete the Works and/or arrange for any other entities to do so. The Employer and these entities may then use any Goods, Contractor's Documents and other design documents made by or on behalf of the Contractor for completing the work.

15.3 Valuation at Date of Termination

As soon as practicable after a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine the value of the Works, Goods and Contractor's Documents, and any other sums due to the Contractor for work executed in accordance with the Contract. For this purpose, the contractor shall be notified the date for witnessing of measurements and handing over of the materials for which contractor has already been paid. In case the contractor fails to attend or send a representative even after such notice, the Engineer shall ex parte proceed with measurements of the works executed and taking over of plants and materials etc. for which payment has already been made to the contractor, which shall be treated as final.

15.4 Payment after Termination

After a notice of termination under Sub-Clause 15.2 [Termination by Employer] has taken effect, the Employer may:

(a) proceed in accordance with Sub-Clause 2.5 [Employer's Claims],

(b) encash the Performance Guarantee and forfeit the Performance

Security:

i) In full including additional Performance Guarantee amount if any taken in

terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter, in case of termination of the contract as a whole; Or

ii) in part/parts proportionate to the contract price of the bill/schedule to which the terminated part of work belongs i.e.

P = (A x B) ÷ C where,

P = Proportionate Bank Guarantee Amount

A = Contract Price of the particular bill/schedule to which the terminated part of work belongs

B = Performance Guarantee amount in terms of GCC sub clause 4.2

C = Total Contract Price

Plus additional Performance Guarantee amount if any taken in terms of sub clause 35.5 of ITB and not due for release on the date of issue of termination letter against that particular bill/Schedule to which the terminated part of the work belongs in case of termination in part/parts.

(c) release any payment due to the contractor for works executed prior to termination and evaluation under clause 15.3 (valuation at date of termination, however, if by this time the Contractor has failed to make a payment due to the Employer, the same will be deducted from the payment due and any balance remaining shall then be paid to the Contractor.).

15.5 Employer's Entitlement to Termination for Convenience

The Employer shall be entitled to terminate the Contract, at any time for the Employer's convenience, by giving notice of such termination to the Contractor. The termination shall take effect 28 days after the later of the dates on which the Contractor receives this notice or the Employer returns the Performance Security. The Employer shall not terminate the Contract under this Sub-Clause in order to execute the Works himself or to arrange for the Works to be executed by another contractor or to avoid a termination of the Contract by the Contractor under Clause 16.2 [Termination by Contractor].

After this termination, the Contractor shall proceed in accordance with Sub-Clause 16.3 [Cessation of Work and Removal of Contractor's Equipment] and shall be paid in accordance with Sub-Clause 19.1 [Payment and Release in case of Optional Termination].

15.6 Corrupt or Fraudulent Practices

If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive or coercive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 15 shall apply as if such expulsion had been made under Sub-Clause 15.2.

For the purposes of this Sub-Clause:

(a) *"corrupt practice" means the offering, giving, receiving of soliciting of any thing of "value to influence the action of a public official in the*

procurement process or in the Contract execution.

(b) *"fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of the Contract to the detriment of the Employer, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.*

(i) (c) *"collusive practice" means a scheme or arrangement between two or more bidders, with or without the knowledge of the Employer, designed to establish bid prices at artificial, noncompetitive levels.*

(d) *"coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract.*

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

If the Engineer fails to certify in accordance with Sub-Clause 14.6 [Issue of Interim Payment Certificates] or the Employer fails to comply with Sub-Clause 2.4 [Employer's Financial Arrangements] or Sub-Clause 14.7 [Payment], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

The Contractor's action shall not prejudice his entitlements to interest under Sub-Clause 14.8 [Delayed Payment] and to termination under Sub-Clause 16.2 [Termination by Contractor].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in the relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost plus profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

16.2 Termination by Contractor

The Contractor shall be entitled to terminate the Contract if:

(a) the Contractor does not receive the reasonable evidence within 42 days after giving notice under Sub-Clause 16.1 [Contractor's Entitlement to

Suspend Work] in respect of a failure to comply with Sub-Clause 2.4 [Employer's Financial Arrangements],

(b) the Engineer fails, within 56 days after receiving a Statement and supporting documents, to issue the relevant Payment Certificate,

(c) the Contractor does not receive the amount due under an Interim Payment Certificate within 42 days after the expiry of the time stated in Sub-Clause 14.7 [Payment] within which payment is to be made (except for deductions in accordance with Sub-Clause 2.5 [Employer's Claims]),

(d) a prolonged suspension affects the whole of the Works as described in Sub-Clause 8.11 [Prolonged Suspension], or

(e) the Employer becomes bankrupt or insolvent, goes into liquidation, has a receiving or administration order made against him, compounds with his creditors, or carries on business under a receiver, trustee or manager for the benefit of his creditors, or if any act is done or event occurs which (under applicable Laws) has a similar effect to any of these acts or events.

In any of these events or circumstances, the Contractor may, upon giving 14 days' notice to the Employer, terminate the Contract. However, in the case of sub-paragraph (d) or (e), the Contractor may by notice terminate the Contract immediately.

The Contractor's election to terminate the Contract shall not prejudice any other rights of the Contractor, under the Contract or otherwise.

16.3 Cessation of Work and Removal of Contractor's Equipment

After a notice of termination under Sub-Clause 15.5 [Employer's Entitlement to Termination], Sub-Clause 16.2 [Termination by Contractor] or Sub-Clause 19.1 [Optional Termination, Payment and Release] has taken effect, the Contractor shall promptly:

(a) cease all further work, except for such work as may have been instructed by the Engineer for the protection of life or property or for the safety of the Works,

(b) hand over Contractor's Documents, Plant, Materials and other work, for which the Contractor has received payment, and

(c) remove all other Goods from the Site, except as necessary for safety, and leave the Site.

16.4 Payment on Termination

After a notice of termination under Sub-Clause 16.2 [Termination by Contractor] has taken effect, the Employer shall promptly:

(a) return the Performance Security to the Contractor,

(b) pay the Contractor in accordance with Sub-Clause 19.1 [Optional Termination, Payment and Release], and

(c) should the contract be terminated under sub-clause 15.5 of this clause and the contractor claims payment for expenditure incurred by him in the expectation of completing the whole of the work, the Employer shall admit and consider such claims as are deemed reasonable and are

supported by vouchers to the satisfaction of the Engineer. The Employer's decision on the necessity and propriety of such expenditure shall be final and conclusive.

(d) The Contractor shall have no claim to any payment of compensation or otherwise, howsoever on account of any profit or advantage which he might have derived from the execution of the work in full but which he did not derive in consequence of termination of contract.

17. Risk and Responsibility

17.1 Indemnities

The Contractor shall indemnify and hold harmless the Employer, the Employer's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of:

(a) bodily injury, sickness, disease or death, of any person including railway user whatsoever arising out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and

(b) damage to or loss of any property, real or personal (other than the Works), to the extent that such damage or loss arises out of or in the course of or by reason of the Contractor's design (if any), the execution and completion of the Works and the remedying of any defects, unless and to the extent that any such damage or loss is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel,, their respective agents, or anyone directly or indirectly employed by any of them.

The Employer shall indemnify and hold harmless the Contractor, the Contractor's Personnel, and their respective agents, against and from all claims, damages, losses and expenses (including legal fees and expenses) in respect of (1) bodily injury, sickness, disease or death, which is attributable to any negligence, wilful act or breach of the Contract by the Employer, the Employer's Personnel, or any of their respective agents, and (2) the matters for which liability may be excluded from insurance cover, as described in sub-paragraphs (d)(i), (ii) and (iii) of Sub-Clause 18.3 [Insurance Against Injury to Persons and Damage to Property].

17.2 Contractor's Care of the Works

The Contractor shall take full responsibility for the care of the Works and Goods from the Commencement Date until the Taking-Over Certificate is issued (or is deemed to be issued under Sub-Clause 10.1 [Taking Over of the Works and Sections] for the Works, when responsibility for the care of the Works shall pass to the Employer. If a Taking-Over Certificate is issued (or is so deemed to be issued) for any Section or part of the Works, responsibility for the care of the Section or part shall then pass to the Employer.

After responsibility has accordingly passed to the Employer, the Contractor shall take responsibility for the care of any work which is outstanding on the

date stated in a Taking-Over Certificate, until this outstanding work has been completed.

If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause not listed in Sub-Clause 17.3 [Employer's Risks], the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract.

The Contractor shall be liable for any loss or damage caused by any actions performed by the Contractor after a Taking-Over Certificate has been issued. The Contractor shall also be liable for any loss or damage which occurs after a Taking-Over Certificate has been issued and which arose from a previous event for which the Contractor was liable.

17.3 Employer's Risks The risks referred to in Sub-Clause 17.4 below, insofar as they directly affect the execution of the works in the Country, are:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war, within the Country,

(c) riot, commotion or disorder within the Country by persons other than the Contractor's Personnel,

(d) munitions of war, explosive materials, ionising radiation or contamination by radio-activity, within the Country, except as may be attributable to the Contractor's use of such munitions, explosives, radiation or radio-activity,

(e) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds,

(f) use or occupation by the Employer of any part of the Permanent Works, except as may be specified in the Contract,

(g) design of any part of the Works by the Employer's Personnel or by others for whom the Employer is responsible, and

(h) any operation of the forces of nature (except Floods, rain, winds/storm/typhoons) which is Unforeseeable or against which an experienced contractor could not reasonably have been expected to have taken adequate preventative precautions.

17.4 Consequences of Employer's Risks If and to the extent that any of the risks listed in Sub-Clause 17.3 above results in loss or damage to the Works, Goods or Contractor's Documents, the Contractor shall promptly give notice to the Engineer and shall rectify this loss or damage to the extent required by the Engineer.

If the Contractor suffers delay and/or incurs Cost from rectifying this loss or damage, the Contractor shall give a further notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 [Contractor's Claims] to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 [Extension of Time for Completion], and

(b) payment of any such Cost, which shall be included in the Contract Price. In the case of sub-paragraphs (f) and (g) of Sub-Clause 17.3 [Employer's Risks], Cost shall be payable.

After receiving this further notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine these matters.

17.5 Intellectual and Industrial Property Rights

In this Sub-Clause, "infringement" means an infringement (or alleged infringement) of any patent, registered design, copyright, trade mark, trade name, trade secret or other intellectual or industrial property right relating to the Works; and "claim" means a claim (or proceedings pursuing a claim) alleging an infringement.

Whenever a Party does not give notice to the other Party of any claim within 28 days of receiving the claim, the first Party shall be deemed to have waived any right to indemnity under this Sub-Clause.

The Employer shall indemnify and hold the Contractor harmless against and from any claim alleging an infringement which is or was:

(a) an unavoidable result of the Contractor's compliance with the Contract, or

(b) a result of any Works being used by the Employer:
  (i) for a purpose other than that indicated by, or reasonably to be inferred from, the Contract, or

  (ii) in conjunction with anything not supplied by the Contractor, unless such use was disclosed to the Contractor prior to the Base Date or is stated in the Contract.

The Contractor shall indemnify and hold the Employer harmless against and from any other claim which arises out of or in relation to (i) the manufacture, use, sale or import of any Goods, or (ii) any design for which the Contractor is responsible.

If a Party is entitled to be indemnified under this Sub-Clause, the indemnifying Party may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it. The other Party shall, at the request and cost of the indemnifying Party, assist in contesting the claim. This other Party (and its Personnel) shall not make any admission which might be prejudicial to the indemnifying Party, unless the indemnifying Party failed to take over the conduct of any negotiations, litigation or arbitration upon being requested to do so by such other Party.

17.6 Limitation of Liability

Neither Party shall be liable to the other Party for loss of use of any Works, loss of profit, loss of any contract or for any indirect or consequential loss or damage which may be suffered by the other Party in connection with the Contract, provided that this exclusion shall not apply to any obligation of the Contractor to pay Delay Damages to the Employer under Sub-Clause 8.7 [Delay Damages].

The total liability of the Contractor to the Employer, under or in connection

with the Contract other than under Sub-Clause 4.19 [Electricity, Water and Gas], Sub-Clause 4.20 [Employer's Equipment and Free-Issue Material], Sub-Clause 17.1 [Indemnities] and Sub-Clause 17.5 [Intellectual and Industrial Property Rights], shall not exceed the sum as specified in the Contract Data or if nothing is specified in the Contract Data, the accepted Contract Amount.

This Sub-Clause shall not limit liability in any case of fraud, deliberate default or reckless misconduct by the defaulting Party.

17.7 Use of Employer's Accommodation/ Facilities

The Contractor shall take full responsibility for the care of the Employer provided accommodation and facilities, if any, as detailed in the Specification, from the respective dates of hand-over to the Contractor until cessation of occupation (where hand-over or cessation of occupation may take place after the date stated in the Taking-Over Certificate for the Works).

If any loss or damage happens to any of the above items while the Contractor is responsible for their care arising from any cause whatsoever other than those for which the Employer is liable, the Contractor shall, at his own cost, rectify the loss or damage to the satisfaction of the Engineer.

18. Insurance

18.1 General Requirements for Insurances

In this Clause, "insuring Party" means, for each type of insurance, the Party responsible for effecting and maintaining the insurance specified in the relevant Sub-Clause.

Wherever the Contractor is the insuring Party, each insurance shall be effected with insurers and in terms approved by the Employer. These terms shall be consistent with any terms agreed by both Parties before the date of the Letter of Acceptance. This agreement of terms shall take precedence over the provisions of this Clause.

Wherever the Employer is the insuring Party, each insurance shall be effected with insurers and in terms consistent with the details annexed to the Special Conditions of Contract.

If a policy is required to indemnify joint insured, the cover shall apply separately to each insured as though a separate policy had been issued for each of the joint insured. If a policy indemnifies additional joint insured, namely in addition to the insured specified in this Clause, (i) the Contractor shall act under the policy on behalf of these additional joint insured except that the Employer shall act for Employer's Personnel, (ii) additional joint insured shall not be entitled to receive payments directly from the insurer or to have any other direct dealings with the insurer, and (iii) the insuring Party shall require all additional joint insured to comply with the conditions stipulated in the policy.

Each policy insuring against loss or damage shall provide for payments to be made in the currencies required to rectify the loss or damage. Payments received from insurers shall be used for the rectification of the loss or damage.

The relevant insuring Party shall, within the respective periods stated in the

Contract Data, submit to the other Party:

(a) evidence that the insurances described in this Clause have been effected, and

(b) copies of the policies for the insurances described in Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment] and Sub-Clause 18.3 [Insurance against Injury to Persons and Damage to Property].

(c) If the contractor fails to submit evidence and copies of the policies as mentioned in (a) & (b) above to prove that the policies have been obtained within the period specified in the contract data, and submits the same later on and from the submitted evidence it is found that the policies have not been obtained within the period specified, the Employer shall recover double the cost of the premium on pro rata basis for the period the policies have been delayed from the Contractor's Interim Payment.

When each premium is paid, the insuring Party shall submit evidence of payment to the other Party. Whenever evidence or policies are submitted, the insuring Party shall also give notice to the Engineer.

Each Party shall comply with the conditions stipulated in each of the insurance policies. The insuring Party shall keep the insurers informed of any relevant changes to the execution of the Works and ensure that insurance is maintained in accordance with this Clause.

Neither Party shall make any material alteration to the terms of any insurance without the prior approval of the other Party. If an insurer makes (or attempts to make) any alteration, the Party first notified by the insurer shall promptly give notice to the other Party.

If the insuring Party fails to effect and keep in force any of the insurances it is required to effect and maintain under the Contract, or fails to provide satisfactory evidence and copies of policies in accordance with this Sub-Clause, the other Party may (at its option and without prejudice to any other right or remedy) effect insurance for the relevant coverage and pay the premiums due. The insuring Party shall pay double the amount of these premiums to the other Party, and the Contract Price shall be adjusted accordingly. Additionally, the Employer shall recover double the cost of the premium on pro rata basis for the period the policies have been delayed from the Contractor's Interim Payment on pro rata basis.

Nothing in this Clause limits the obligations, liabilities or responsibilities of the Contractor or the Employer, under the other terms of the Contract or otherwise. Any amounts not insured or not recovered from the insurers shall be borne by the Contractor and/or the Employer in accordance with these obligations, liabilities or responsibilities. However, if the insuring Party fails to effect and keep in force an insurance which is available and which it is required to effect and maintain under the Contract, and the other Party neither approves the

omission nor effects insurance for the coverage relevant to this default, any moneys which should have been recoverable under this insurance shall be paid by the insuring Party.

Payments by one Party to the other Party shall be subject to Sub-Clause 2.5 [Employer's Claims] or Sub-Clause 20.1 [Contractor's Claims], as applicable.

The Contractor shall be entitled to place all insurance relating to the Contract (including, but not limited to the insurance referred to Clause 18) with insurers from any eligible source country.

The Contractor shall insure the Works, Plant, Materials, including those issued by the Employer and Contractor's Documents for not less than the full reinstatement cost including the costs of demolition, removal of debris and professional fees and profit, subject to a maximum value indicated in Contract Data**.** This insurance shall be effective from the date by which the evidence is to be submitted under sub-paragraph (a) of Sub-Clause 18.1 [General Requirements for Insurances], until the date of issue of the Taking-Over Certificate for the Works.

18.2 Insurance for Works and Contractor's Equipment

The insuring Party shall maintain this insurance to provide cover until the date of issue of the Performance Certificate, for loss or damage for which the Contractor is liable arising from a cause occurring prior to the issue of the Taking-Over Certificate, and for loss or damage caused by the Contractor in the course of any other operations (including those under Clause 11 [Defects Liability]).

The insuring Party shall insure the Contractor's Equipment for not less than the full replacement value, including delivery to Site. For each item of Contractor's Equipment, the insurance shall be effective while it is being transported to the Site and until it is no longer required as Contractor's Equipment.

Unless otherwise stated in the Special Conditions of Contract, insurances under this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties, who shall be jointly entitled to receive payments from the insurers, payments being held or allocated between the Parties for the sole purpose of rectifying the loss or damage,

(c) shall cover all loss and damage from any cause not listed in Sub-Clause 17.3 [Employer's Risks],

(d) shall also cover loss or damage to a part of the Works which is attributable to the use or occupation by the Employer of another part of the Works, and loss or damage from the risks listed in sub-paragraphs (c), (g) and (h) of Sub-Clause 17.3 [Employer's Risks], excluding (in each case) risks which are not insurable at commercially reasonable terms, with deductibles per occurrence of not more than the amount stated in the Contract Data (if an amount is not so stated, this sub-paragraph (d) shall not apply), and

(e) may however exclude loss of, damage to, and reinstatement of:

i) part of the Works which is in a defective condition due to a defect in its design, materials or workmanship (but cover shall include any other parts which are lost or damaged as a direct result of this defective condition and not as described in sub-paragraph (ii) below),

ii) a part of the Works which is lost or damaged in order to reinstate any other part of the Works if this other part is in a defective condition due to a defect in its design, materials or workmanship,

iii) a part of the Works which has been taken over by the Employer, except to the extent that the Contractor is liable for the loss or damage, and

iv) Goods while they are not in the Country, subject to Sub-Clause 14.5 [Plant and Materials intended for the Works].

If, more than one year after the Base Date, the cover described in sub-paragraph (d) above ceases to be available at commercially reasonable terms, the Contractor shall (as insuring Party) give notice to the Employer, with supporting particulars. The Employer shall then (i) be entitled subject to Sub-Clause 2.5 [Employer's Claims] to payment of an amount equivalent to such commercially reasonable terms as the Contractor should have expected to have paid for such cover, and (ii) be deemed, unless he obtains the cover at commercially reasonable terms, to have approved the omission under Sub-Clause 18.1 [General Requirements for Insurances].

18.3 Insurance against Injury to Persons and Damage to Property

The insuring Party shall insure against each Party's liability for any loss, damage, death or bodily injury which may occur to any physical property (except things insured under Sub-Clause 18.2 [Insurance for Works and Contractor's Equipment]) or to any person (except persons insured under Sub-Clause 18.4 [Insurance for Contractor's Personnel]), which may arise out of the Contractor's performance of the Contract and occurring before the issue of the Performance Certificate.

This insurance shall be for a limit per occurrence of not less than the amount stated in the Contract Data, with no limit on the number of occurrences. If an amount is not stated in the Contract Data, this Sub-Clause shall not apply.

Unless otherwise stated in the Special Conditions of Contract, the insurances specified in this Sub-Clause:

(a) shall be effected and maintained by the Contractor as insuring Party,

(b) shall be in the joint names of the Parties,

(c) shall be extended to cover liability for all loss and damage to the Employer's property including Railways Property (except things insured under Sub-Clause 18.2) arising out of the Contractor's performance of the Contract, and

(d) may however exclude liability to the extent that it arises from:

(i) the Employer's right to have the Permanent Works executed on, over, under, in or through any land, and to occupy this land for the Permanent Works,

(ii) damage which is an unavoidable result of the Contractor's obligations to execute the Works and remedy any defects, and

(iii) a cause listed in Sub-Clause 17.3 [Employer's Risks], except to the extent that cover is available at commercially reasonable terms.

18.4 **Insurance for Contractor's Personnel**

The Contractor shall abide by the provisions of ESIC Act, 1948 (extended from time to time) to take care of insurance against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness or disease. In addition the contractor shall also maintain insurance against liability for claim of death of any person employed by the Contractor or any other of the Contractor's Personnel.

The Employer and the Engineer shall also be indemnified under the policy of insurance, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel.

The insurance shall be maintained in full force and effect during the whole time that these personnel are assisting in the execution of the Works. For a Subcontractor's employees, the insurance may be effected by the Subcontractor,

but the Contractor shall be responsible for compliance with this Clause.

19. Force Majeure

If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics, strikes, lockouts or acts of God (hereinafter referred to 'events') provided, notice of the happening of any such event is given by either party to the other within 14 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance of delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and decision of the Engineer as to whether the works have been so resumed or not shall be final and conclusive, PROVIDED FURTHER that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a continuous period exceeding 84 days, either party may at its option terminate the contract by giving notice to the other party.

19.1 Payment and Release in case of Optional Termination

Upon such termination, the Engineer shall determine the value of the work done and issue a Payment Certificate which shall include :

(a) The amounts payable for any work carried out for which a price is stated in the Contract;

(b) The cost of Plant and Materials ordered for the Works which have been delivered to the Contractor, or of which the contractor is liable to accept delivery; this Plant and materials shall become the property of (and be at the risk of) the Employer when paid for by the Employer, the Contractor shall place the same at the Employer's disposal;

(c) Other costs or liabilities supported by necessary documentary evidence which in the circumstances were reasonably and necessarily incurred by the Contractor in the expectation of completing the Works as per mutually agreed programme.

(d) the Cost of removal of Temporary Works and Contractor's Equipment from the Site and the return of these items to the Contractor's works in his country (or to any other destination at no greater cost).

20. Claims, Disputes and Arbitration

20.1 Contractor's Claims

If the Contractor considers himself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give notice to the Engineer, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 28 days after the Contractor became aware, or should have become aware, of the event or circumstance.

If the Contractor fails to give notice of a claim within such period of 28 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Employer shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub-Clause shall apply.

The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.

The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Engineer. Without admitting the Employer's liability, the Engineer may, after receiving any notice under this Sub-Clause, monitor the record-keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Engineer to inspect all these records, and shall (if instructed) submit copies to the Engineer.

Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Engineer, the Contractor shall send to the Engineer a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:

(a) this fully detailed claim shall be considered as interim;

(b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Engineer may reasonably require; and

(c) the Contractor shall send a final claim within 28 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Engineer.

Within 42 days after receiving a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Engineer and approved by the Contractor, the Engineer shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within such time.

Each Payment Certificate shall include such amounts for any claim as have

been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

The Engineer shall proceed in accordance with Sub-Clause 3.5 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or after its expiry) in accordance with Sub-Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause.

20.2 Amicable Settlement

In case any dispute between the Engineer and the Contractor for which claim has already been made by the contractor, remains unresolved, the Contractor shall, then, give notice of dissatisfaction and intention to commence arbitration to the Employer duly specifying the subject of the dispute or difference as also the amount of claim item wise. The Parties shall make attempts to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, demand for arbitration may be made by the contractor after ninety days from the day on which a notice of dissatisfaction and intention to commence arbitration was given, even if no attempt at amicable settlement has been made.

20.3 Arbitration

Any dispute, in respect of which amicable settlement has not been reached, arising between the Employer and the Domestic or Foreign Contractor related to any matter arising out of or connected with this contract, then the contractor shall be entitled to demand in writing that the dispute or difference be referred to arbitration.

Only such dispute(s) or difference(s) in respect of which the demand had been made for amicable settlement under GCC 20.2 but could not be settled, shall be referred to arbitration subject to the condition that cumulative amount of claims in the contract is not exceeding 20% of the contract price. In case the cumulative amount of claims exceeds 20% of the contract price, arbitration clause will not be applicable.

The Arbitration proceedings shall commence from the day, a written and duly quantified demand for arbitration is received by Managing Director/HORCL (EMPLOYER).

The disputes so referred to arbitration shall be settled in accordance with the Indian Arbitration & Conciliation Act, 1996 and any statutory modification or re-enactment thereof.

Further, it is agreed between the parties as under:

20.3.1 **Number of Arbitrators:** The arbitral tribunal shall consist of three arbitrators.

20.3.2 **Procedure for Appointment of Arbitrators:** The arbitrators shall be appointed as per following procedure:

(a) The Contractor, while invoking demand for arbitration, shall submit to MD/EMPLOYER, claims duly quantified along with name and contact details of his nominee arbitrator. Thereafter, he Employer will nominate his nominee arbitrator within a period of 30 days from receipt of such demand from the Contractor and will issue letter of appointment to both the arbitrators appointed by the parties with a copy to the Contractor.

(b) The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties and shall act as Presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon consensus within a period of 30 days from the appointment of the Arbitrators subsequently appointed, then, upon the request of either or both parties, the Presiding Arbitrator shall be appointed by the Chairman and Managing Director, Haryana Orbital Rail Corporation Limited.

(c) If one or more of the arbitrators appointed as above refuses to act as arbitrator, withdraws from his office as arbitrator, or vacates his/their office/offices or is/are unable or unwilling to perform his functions as arbitrator for any reason whatsoever or dies or in the opinion of the MD/EMPLOYER fails to act without undue delay, the MD/EMPLOYER shall appoint new arbitrator/arbitrators to act in his/their place except in case of new Presiding Arbitrator who shall be chosen following the same procedure as mentioned in para (b) above. Such re-constituted Tribunal may, at its discretion, proceed with the reference from the stage at which it was left by the previous arbitrator(s).

20.3.3 **Qualification and Experience of Arbitrators (to be appointed as per sub-clause 20.3.2 above):** The contract being of specialized nature requiring knowledge and experience of dealing with construction contracts, the arbitrators to be appointed shall have minimum qualification and experience as under:

Arbitrator shall be;

a working/retired officer (not below E-9 grade and above in a PSU with which EMPLOYER has no business relationship) of any discipline of Engineering or Accounts/Finance department, having experience in Contract Management of construction contracts; or

a retired officer (retired not below the HAG level) of any Engineering/Accounts Services of Central Government, having experience in Contract Management of construction contracts; or a retired officer who should have retired more than 3 years previously from the date of appointment as Arbitrator (retired not below E-9 grade in EMPLOYER or a PSU with which EMPLOYER has a business relationship) of any Engineering discipline or Accounts department, having experience in Contract Management of construction contracts.

No person other than the persons appointed as per above procedure and having above qualification and experience shall act as Arbitrator. In case any person having the qualification and experience other than that mentioned above is nominated as arbitrator, the arbitration clause shall cease to exist and shall not be applicable.

20.3.4 No new claim, except as otherwise mutually agreed by the Parties, shall be added during proceedings by either party. However, a party may amend or supplement the original claim or defence thereof during the course of arbitration proceedings subject to acceptance by Tribunal having due regard to the delay in making it.

Neither party shall be limited in the proceedings before such arbitrators to the evidence nor did arguments previously put before during amicable settlement.

20.3.5 The reference to arbitration may proceed, notwithstanding that the Works shall not then be or be alleged to be complete, provided always that the obligations

20.3.6 of the Employer, the Engineer and the Contractor shall not be altered by the reason of the arbitration being conducted during the progress of the Works. Neither party shall be entitled to suspend the Works, nor shall payment to the Contractor be withheld on account of such proceedings

20.3.7 If the contractor(s) does/do not prefer his/their specific and final claims in writing, within a period of 90 days of receiving the intimation from the Employer/Engineer that the final bill is ready for signature of the contractor(s), he/they will be deemed to have waived his/their claim(s) and the Employer shall be discharged and released of all liabilities under the contract in respect of these claims.

20.3.8 Arbitration proceedings shall be held at Gurugram, India or at a place where EMPLOYER's (dealing the contract) office is located, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be in English.

The Arbitral Tribunal should record day to day proceedings. The proceedings

20.3.9 shall normally be conducted on the basis of documents and written statements.

All arbitration awards shall be in writing and shall state item wise, the sum and detailed reasons upon which it is based.

20.3.10 Any ruling on award shall be made by a majority of members of Tribunal. In the absence of such a majority, the views of the Presiding Arbitrator shall prevail.

A party may apply for correction of any computational errors, any typographical or clerical errors or any other error of similar nature occurring in the award of a tribunal and interpretation of specific point of award to tribunal within 60 days of the receipt of award.

A party may apply to tribunal within 60 days of receipt of award to make an additional award as to claims presented in the arbitral proceedings but omitted from the arbitral award.

20.3.11 Where the Arbitral award is for the payment of money, no interest shall be payable on whole or any part of the money for any period till the date on which the award is made.

20.3.12 The fees and other charges of the conciliator/arbitrators shall be as per the fee structure fixed by the Employer and as amended from time to time irrespective of the fact whether the Arbitrator(s) is/are appointed by the parties or by the Court of law unless specifically directed by Hon'ble Court otherwise on the matter, and shall be shared equally by the Employer and the Contractor. However, the expenses incurred by each party in connection with the preparation, presentation will be borne by itself.

21. Jurisdiction of Courts The Contract Agreement shall be subject to exclusive jurisdiction of Courts as indicated in the Contract Data.

APPENDIX 1

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK

(The laws as current on the date of bid opening will apply)

a) **Workmen Compensation Act 1923**: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) **Payment of Gratuity Act 1972**: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) **Employees P.F. and Miscellaneous Provision Act 1952 (since amended):** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are:

(i) Pension or family pension on retirement or death, as the case may be.
(ii) Deposit linked insurance on the death in harness of the worker.
(iii) payment of P.F. accumulation on retirement/death etc.

d) **Maternity Benefit Act 1951**: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) **Contract Labour (Regulation & Abolition) Act 1970**: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) **Minimum Wages Act 1948**: The Employer is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

g) **Payment of Wages Act 1936:** It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) **Equal Remuneration Act 1979**: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) **Payment of Bonus Act 1965**: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/- per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.

j) **Industrial Disputes Act 1947**: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) **Industrial Employment (Standing Orders) Act 1946**: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

l) **Trade Unions Act 1926:** The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

m) **Child Labour (Prohibition & Regulation) Act 1986**:The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

n) **Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979:** The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, travelling expenses from home upto the establishment and back, etc.

o) **The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996:** All the establishments who carry on any building or other construction work and employs 10 or more workers are

covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

As per Central Government's Notification No.S.O.2899 dated 26.09.1996 under this act, the cess shall be levied @1% of cost of construction works which shall be deducted from each bill of the payment due to the contractor.

p) **Factories Act 1948**: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

q) **The Employees State Insurance Act, 1948 (Act No. 34 of 1948) (Provisions as extended from time to time):**An Act to provide for certain benefits to employees in case of sickness, maternity and 'employment injury' and to make provision for certain other matters in relation thereto.

Section 7

Special Conditions of Contract

Part A: Contract Data

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Section 7 - Special Conditions of Contract

The following Special Conditions of Contract (SCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC

Part A - Contract Data

Conditions	Reference to GCC	**Data**
Contract Type	-	Composite Contract
Employer's name and address	1.1.2.2 & 1.3	Haryana Orbital Rail Corporation Limited (HORCL), IRCON Tower-2, Plot No. 16, Sector-32, Gurugram, Haryana-122018 E-mail: cpmwest@hridc.co.in
Employer's Representative	1.1.2.6	Chief Project Manager (West), Haryana Rail Infrastructure Development Corporation Limited (HRIDC), IRCON Tower-2, Plot No. 16, Sector-32, Gurugram, Haryana-122018 E-mail: cpmwest@hridc.co.in
Engineer's name and address	1.1.2.4 & 1.3 (b)	RITES Limited in Consortium with SMEC International Pty Ltd, 4th Floor, Plot No.144, RITES Limited, Sector-44, Gurugram, Haryana-122003
Time for Completion for the Works	1.1.3.3	548 days
Time for Completion for the Key Dates	1.1.3.3	As per Appendix 2 of Section 7: Works Requirements
Defects Notification Period	1.1.3.7	365 days
Sections	1.1.5.6; 1.1.3.3 & 8.2	NA
Electronic transmission systems	1.3 (a)	By Email
Address for Communication to Employer	1.3 (b)	Haryana Rail Infrastructure Development Corporation Limited (HRIDC), IRCON Tower-2,

Conditions	Reference to GCC	Data
		Plot No. 16, Sector-32 E-mail: gminfrahridc@gmail.com
Governing Law	1.4	The Laws of Republic of India
Ruling language	1.4	English
Language for communications	1.4	English
Time for access to Site	2.1	Within Seven (07) days of the Commencement Date.
Performance Security	4.2 & 11.9	The Performance Security shall be for an amount of 5% (Five percent) of the Accepted Contract Amount and in the same currency(ies) of the Accepted Contract amount in the prescribed form for the stated amount valid for a period of 28 days beyond issue of performance certificate.
Performance Security	4.2	Rate of addition or Reduction of Performance Security due to variation in contract price: 5%
Normal working hours	6.5	(i) Sunrise to Sunset. The Contractor, if required, shall take approval of the Engineer for carrying out work during night hours or in shifts subject to compliance with applicable Laws and shall be responsible for all necessary safety arrangements with respect to the work being undertaken. However, the Contractor shall not be entitled to any claim for increase in rates or any additional cost and the same shall be deemed to be included in the Contract Price.
Delay damages for the Works	8.7(a)	(i) 0.25% of the Contract Price per week or part thereof in the currencies and proportions in which the Contract Price is payable in case of delay in completion for entire Works.
	8.7(b)	NIL

Conditions	Reference to GCC	Data
Delay damages for the nonachievement of Key Dates when delay is fully attributable to the contractor	8.7.1	(i) 0.05% of the Contract Price per week or part thereof in the currencies and proportions in which the Contract Price is payable in case of delay in completion for entire works.
Maximum amount of delay damages	8.7	5% (five percent) of the Contract Price.
Provisional Sums	13.5	Not Applicable
Adjustment for Changes in Cost	13.8	Not Applicable
Mobilization advance payment	14.2.1	Not Applicable
Advance Payment against Plant and Machinery	14.2.2	Not Applicable
Interest on Advance Payment	14.2.1 & 14.2.2	Not Applicable
Repayment rate of Advance payment	14.2.4	Not Applicable
Percentage of Retention Money	14.3(c)	Retention money shall be deducted @ 5%
Limit of Retention Money	14.3 (c)	5% of the Contract Price
Plant and Materials intended for the Works	14.5 (b) (i)	Not applicable
	14.5(c) (i)	Not applicable
Maximum Total Liability of the Contractor	17.6	Accepted Contract Amount
Periods for submission of insurance: a) evidence of insurance b) relevant policies	18.1	a) 14 days of Notice of Commencement Date b) 28 days after Commencement Date
Maximum amount of deductibles for insurance of Employer's risks.	18.2 (d)	NIL

Conditions	Reference to GCC	Data
Minimum amount of insurance by the Contractor for Works and Contractor's Plant and Materials including loss or damage to equipment.	18.2	100 (hundred) percent of Contract price
Minimum amount of insurance by the Contractor for Third party insurance including damage to Other Property and personal injury or death insurance for: a) for other people, and b) for Contractor's Employees.	18.3	Rs.2 (two) crores per occurrence without any limit for number of occurrences.
Jurisdiction of Courts	21	Gurugram, Haryana

Section 8

Contract Forms

Section 8 - Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and Advance Payment Security, when required, shall only be completed by the successful Bidder after contract award.

All italicized text is for guidance how to prepare the various forms and shall be deleted from the final documents.

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FORM No. COF/1

Letter of Acceptance

[on letterhead paper of the Employer]

. . . . . *date*. . . . . .

To: . ...*[name and address of the Contractor]* . . . . . .

Subject:. . . . . [*Insert Name and Identification number]*……*[Notification of Award]*.....

This is to notify you that your Bid dated . . . . *[Insert Date]*. . . for execution of the . . . *[name of the contract and identification number, as given in the Contract Data]* . . . for the Accepted Contract Amount of the equivalent of INR . . . *[Insert amount in numbers and words and name of the currency]*. . , as corrected and modified in accordance with the Instructions to Bidders, is hereby accepted.

You are requested to furnish the Performance Security within 28 days in accordance with the Conditions of Contract, using for that purpose the of the Performance Security Form No. COF/3 included in Section 8 (Contract Forms) of the Bidding Document.

Authorized Signature: .....

Name and Title of Signatory: .....

FORM No. COF/2

Contract Agreement

THIS AGREEMENT made the . . . . . .day of . . . ., between . . . . . [N*ame of the Employer*. . .. . . . (hereinafter "the Employer"), of the one part, and . . . . . [*name of the Contractor***]**. . [1]. . .(hereinafter "the Contractor"), of the other part:

WHEREAS the *Employer* desires that the Works known as . . . . . [*name of the Contract***]**. . . . . .should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.

   (b) - the Letter of Acceptance

   (c) - the Letter of Technical Bid

   (d) - the Letter of Price Bid

   (e) - the Addenda Nos. . . . . [***insert addenda numbers if any]***. . . . .

   (f) - the Special Conditions of Contract

      (g) Part A : Contract Data

      (h) Part B : Specific Provisions

   (i) - the General Conditions of Contract;

   (j) - the Specification

   (k) - the Drawings*;*

   (l) - the Work's Requirements

   (m) - the completed Schedules including (priced Bill of Quantities)

   (n) - Any other documents

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price

[1] *In case Contractor is a Joint Venture the 'name of the contractor' shall be inserted as under :*
"the Joint Venture under the name and title of ……, comprising of ….[Lead Partner] ;……; and ….."

or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of . . . . . [*name of the borrowing country]*. . . . .on the day, month and year indicated above.

Signed by	Signed by .....
for and on behalf of the Employer	for and on behalf the Contractor
in the presence of	in the presence of
Witness, Name, Signature, Address, Date	Witness, Name, Signature, Address, Date

COF/3

FORM OF CONTRACT PERFORMANCE SECURITY
(BANK GUARANTEE)

[Refer Clause 41 of Instructions to Bidders]

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

Name and Address of the Bank…..

……..

To:

Haryana Orbital Rail Corporation Limited,

IRCON International Tower-2, Plot No.16

Sector – 32, Gurugram-122018, Haryana.

WHEREAS, Haryana Orbital Rail Corporation Limited, hereinafter called the Employer, acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the Contractor, for the work of [Insert Name of Work], vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ***[Insert Value of Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the Bank, acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the ***[Insert name of the JV partner]***, a JV partner on behalf of the contractor, agreed to give guarantee for performance security and additional performance security as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank]***, being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally

and irrevocably guarantee to pay the Employer the full amount in the sum of [Insert Value of Performance Security required] as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totalling up to the aforementioned full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee (s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……

Place…… [Signature of Authorised person of Bank]

…….

[Name in Block letters]

…….

[Designation]

…….

[P/Attorney] No.

…….

Bank's Seal

[P/Attorney] No.……

Witness:

1. *Signature*
   Name & Address & Seal

2. *Signature*
   Name & address & Seal

Notes:

1. All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.
2. In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.

FORM OF ADDITIONAL PERFORMANCE SECURITY
(BANK GUARANTEE)

[Refer Clause 35.5 of Instructions to Bidders]

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank)

From:

Name and Address of the Bank…..

……..

To:

Haryana Orbital Rail Corporation Limited,

IRCON International Tower-2, Plot No.16

Sector – 32, Gurugram-122018, Haryana.

WHEREAS, Haryana Orbital Rail Corporation Limited, hereinafter called the Employer, acting through ***[Insert Designation and address of the Employer's Representative]***, has accepted the bid of ***[Insert Name and address of the Contractor]***, hereinafter called the Contractor, for the work of [Insert Name of Work], vide Notification of Award No.***[Insert Notification of Award No.]***.

AND

WHEREAS, the contractor is required to furnish additional Performance Security for the sum of ***[Insert Value of additional Performance Security required]***, in the form of bank guarantee, being a condition precedent to the signing of the contract agreement.

WHEREAS, [Insert Name of the Bank], with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the Bank, acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the ***[Insert name of the JV partner]***, a JV partner on behalf of the contractor, agreed to give guarantee for additional performance security as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank]***,being fully authorized to sign and incur obligations for and on behalf of the Bank, confirm that the Bank, hereby, unconditionally and irrevocably guarantee to pay the Employer the full amount in the sum of ***[Insert Value of additional Performance Security required]***as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the Employer any amount up to and including aforementioned full amount without any demur, reservation or recourse. Any such demand made by the Employer on the Bank shall be final, conclusive and binding, absolute and unequivocal notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Employer of Bank.

3. On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount as demanded immediately on presentation of the demand by Employer without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The Bank Guarantee shall be unconditional and irrevocable.

6. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

7. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

8. This guarantee is valid and effective from the date of its issue, which is [insert date of issue]. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period]***. All demands for payment under the guarantee must be received by us on or before that date.

9. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totalling up to the aforementioned

full amount in several instances will be valid until either the aforementioned full amount is paid to the Employer or the guarantee is released by Employer before the Expiry date.

10. The Bank agrees that its obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

11. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

12. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 758.

13. The Guarantee shall be in addition to and without prejudice to any other security Guarantee(s) of the contractor in favour of the Employer available with the Employer. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the Employer.

Date ……

Place……. [Signature of Authorised person of Bank]

…….

[Name in Block letters]

…….

[Designation]

…….

[P/Attorney] No.

…….

Bank's Seal

[P/Attorney] No……

Witness:

1. *Signature*

Name & Address & Seal

2. *Signature*
   Name & address & Seal

Note:

1. All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.

2. In case the guarantee is issued by a foreign Bank, which does not have operations in India, the said bank shall have to provide a counter-guarantee by State Bank of India.

3. The Bank Guarantee should be duly attested by Notary public with notarial stamp of appropriate value affixed thereon.

4. In case the Contractor is a JV, the additional Performance Security is required to be furnished on behalf of the JV in favour of the Employer by the JV Partner(s) who is responsible for execution of schedule(s) (as per JV agreement) against which additional Performance Security is required to be submitted in terms of ITB 35.5. All the Bank Guarantee of JV Partners are liable to be encashed cumulatively.

Advance Payment Security

[Refer Clause 14.2 of GCC]

[Not Applicable]

INDEMNITY BOND FOR THE SAFE CUSTODY OF THE PLANT AND MATERIALS SUPPLIED BY THE CONTRACTOR

[Refer Clause 14.5 of GCC]

(To be executed on Non-Judicial Stamp Paper of Appropriate Value and notarised)

THIS INDEMNITY BOND made on this _____ day of _____ 20___ by _____(*insert the name of the Contractor and its registered address*) (hereinafter called "the Contractor") which expression shall where the context do admits or implies be deemed to include its executors, administrators and assigns, in favour of the Haryana Orbital Rail Corporation Limited, IRCON International Tower-2, Plot No. 16, Sector-32, Gurugram, Haryana-122018 (hereinafter called "Employer"/"HORCL") on the other part.

WHEREAS by an Agreement/Letter of Acceptance No._____dated _____ (hereinafter called "the said agreement"), the Contractor has agreed to execute the _____(*Name of Work*) (hereinafter called "the Works") .

AND WHEREAS the Contractor has submitted to HORCL/ the Engineer for payment on plants &materials procured by him and brought to the site of the Works or his workshop for use in the Works.

AND WHEREAS HORCL/ the Engineer has agreed to make advance/stage payment to the Contractor the total sum of Rs._____ (*in Figures*) [Rupees _____ (*in Words*) in Interim Payment Certificate (IPC) No._____, the quantities and other particulars of which are detailed in this IPC for the said works signed by the Contractor on _____ for the Plant and Materials brought by the Contractor to site of the works or his workshop. Brief details are also mentioned in schedule 1 appended hereto.

NOW THIS INDEMNITY BOND WITNESS that in pursuance of the said agreement and in consideration of the sum of Rs. _____ (*in Figures*) _____ (*in Words*) on or before the execution of these presents to be paid to the Contractor by HORCL so aforesaid, the Contractor doth hereby covenant and agree with HORCL and declare as follows: -

1. That the said sum of Rs. _____ (*In Figures*) _____ (*in Words*) to be paid by HORCL to the Contractor as aforesaid shall be utilized by the Contractor in or towards the execution of the said works and for no other purpose whatsoever.
2. That the Plant and Materials detailed in the said IPC which have been offered to and accepted by HORCL/ the Engineer, are absolutely the Contractor's own property and free from encumbrances of any kind and the Contractor will not make any application for or receive any further payment on the Plant and Materials which are not absolutely his own property and free from encumbrances of any kind, the Contractor indemnifies the HORCL against all claims on any Plant and Materials in respect of which payment is to be made to him as aforesaid.

3. That the Contractor undertakes that the Plant and Materials shall be used exclusively for the performance / execution of the Contract strictly in accordance with the terms and conditions of the Contract and no part of the Plant and Materials shall be utilized for any other work or purpose whatsoever.

4. That the Contractor is obliged and shall remain absolutely responsible for the safe transit / protection and custody of the Plant and Materials against all risks whatsoever including acts of the God till the Plant and Materials are duly incorporated in the works, commissioned and are taken over by HORCL/Railway (including surplus Plant and Materials, if required as instructed by HORCL/ the Engineer) in accordance with the terms of the Contract. The Contractor undertakes to keep HORCL harmless against any loss or damage that may be caused to the Plant and Materials.

5. That the said Plant and Materials shall not on any account be removed from the site of the works except with the written permission of HORCL/ the Engineer. Further, HORCL/ the Engineer shall always be free at all times to take possession of the materials in whatever form the materials may be in, if in its opinion, the Plant and Materials are likely to be endangered, mis-utilized or converted to uses other than those specified in the Contract, by any acts or omission or commission on the part of the Contractor or any other person or on account of any reason whatsoever and the Contractor binds himself and undertakes to comply with the directions of demand of HORCL to return the Plant and Materials without any demur or reservation.

6. That the said plant and materials shall, at all times, be open to inspection by HORCL/ the Engineer or any authorized representative. In the event of the said material or any part thereof at any time being found to be in lesser quantity than for which payment has been released or the same has been stolen, destroyed or damaged or becoming deteriorated, the Contractor will forthwith replace the same or repair and make good the same as required by HORCL/ the Engineer.

7. That making payment does not mean that Plant and Materials are of required specifications and quality or that whole of the quantity brought to site by Contractor will be used in the work. The Contractor is fully responsible for the materials to conform to required quality and specification and if at any time HORCL/ the Engineer do not find the material satisfactory, the Contractor at his own cost would replace these. HORCL/ the Engineer would be at liberty to recover cost of these from any dues of the Contractor. Also any Plant and Materials which are in excess of what is finally required under the contract would be the Contractor's property without any liability on HORCL/ the Engineer who would recover the cost of this from the Contractor.

8. That this Indemnity Bond is irrevocable. If at any time, any loss or damage occurs to the Plant and Materials or the same or any part thereof is mis-utilized in any manner whatsoever, then the Contractor hereby agrees that the decision of HORCL/ the Engineer as to assessment of loss or damage to the Plant and Materials shall be final and binding on the

Contractor. The Contractor binds itself and undertakes to replace the lost and/or damaged Plant and Materials at its own cost and/or shall pay the amount of loss to HORCL without any demur, reservation or protest. This is without prejudice to any other right or remedy that may be available to HORCL/ the Engineer against the Contractor under the Contract or under this Indemnity Bond.

9. That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of those presents, the total amount of the payment shall immediately on the happening of such default be recovered by HORCL/ the Engineer from any dues of Contractor. It is also clearly understood by the Contractor that non-observance of the obligations under this Indemnity Bond by the Contractor shall inter-alia constitute a criminal breach of trust on the part of the Contractor for all intents and purpose including legal / penal consequences.

10. IN WITNESS WHEREOF, the Contractor has hereunto set its hand through its authorized representative, the day, month and year first above mentioned.

11. SCHEDULE 1

Particulars of the Plant and Materials	**Quantity**	**Value of the Plant and Materials**

Signed, Sealed and Delivered by the said Contractor

(Contractor's Name)

Dated: ……. (AUTHORISED SIGNATORY)

Place: ……. SEAL OF COMPANY

IN THE PRESENCE OF:

WITNESS: SIGNATURE _____

NAME: _____

ADDRESS : _____

Note:

The contractor has the option to submit the Indemnity Bond to cover all the items and quantities of Plant and Materials of stage payment or to submit indemnity bond each time the stage payment is to be taken or Plant and Materials advance is to be taken.

FORM OF BANK GUARANTEE FOR RELEASE OF BALANCE RETENTION MONEY

(On non-judicial stamp paper of the appropriate value in accordance with stamp Act. The stamp paper to be in the name of Executing Bank).

From:

……..

…….*Name and Address of the Bank…..*

……..

To:

Haryana Orbital Rail Corporation Limited,

IRCON International Tower-2, Plot No.16

Sector – 32, Gurugram-122018, Haryana.

a) WHEREAS**,** Haryana Orbital Rail Corporation Limited, (hereinafter called the **Employer),** acting through ***[Insert Designation and address of the Employer's Representative]***, has entered into a contract with ***[Insert Name and address of the Contractor's Representative]***,, (hereinafter called the **Contractor),** for the work of ***[Insert Name of Work]***, vide Notification of Award No.***[Insert Notification of Award No.].***

b) WHEREAS as per conditions of contract Employer has deducted an amount of RS____***[Insert Amount deducted as retention money]***towards retention money till date, and WHEREAS now the contractor has requested the Employer for releasing the said amount on submission of a bank guarantee of equivalent amount which has been accepted by the Employer.****

OR

WHEREAS as per conditions of contract Employer has deducted an amount of RS____ ***[Insert Amount deducted as retention money]***towards retention money till date, out of a total amount of Rs____ [***Insert total Amount of retention money deductable as specified in the contract]***which is due to be deducted as retention money as per Contract agreement and WHEREAS now the Contractor has requested the Employer to accept a bank guarantee of the equivalent amount of the total retention money due as per contract agreement so that the amount already deducted may be released in favour of the contractor and that no further deduction towards retention money will be made in future which has been accepted by the Employer. ****

c) WHEREAS, ***[Insert Name of the Bank]***, with its Branch ***[Address]*** having its Headquarters office at ***[Address]***, hereinafter called the **Bank,** acting through ***[Designation(s) of the authorised person of the Bank]***, have, at the request of the contractor, agreed to give guarantee as hereinafter contained:

1. KNOW ALL MEN by these present that I/We the undersigned ***[Insert name(s) of authorized representatives of the Bank],***being fully authorized to sign and incur obligations for and on behalf of the Bank**,** confirm that the Bank, hereby, unconditionally and irrevocably guarantee the Employer to pay the full amount in the sum of ***[Insert Value of the Bank Guarantee being submitted]*** as above stated.

2.The Bank undertakes to immediately pay to the Employer any amount up to and including aforementioned full amount upon written order/orders from the Employer without any demur, reservation or recourse.

3.On payment of any amount less than aforementioned full amount, as per demand of the Employer, the guarantee shall remain valid for the balance amount i.e. the aforementioned full amount less the payment made to the Employer.

4. The Bank shall pay the amount so demanded without any reference to the contractor and without the Employer being required to show grounds or give reasons for its demand or the amount demanded.

5. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Contractor.

6. The Bank agrees that no change, addition, modifications to the terms of the Contract Agreement or to any documents, which have been or may be made between the Employer and the Contractor, will in any way release us from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification to the Bank.

7. This guarantee is valid and effective from the date of it's issue, which is ***[insert date of issue]***. The guarantee and our obligations under it will expire on ***[Insert the date twenty eight days after the expected end of defect liability period.]***. All demands for payment under the guarantee must be received by us on or before that date.

8. The Bank agrees that the Employers right to demand payment of aforementioned full amount in one instance or demand payments in parts totaling up to the aforementioned full amount in several instances will continue until either the aforementioned full amount is paid to the Employer or the guarantee expires.

9. The Bank agrees that it's obligation to pay any amount demanded by the Employer before the expiry of this guarantee will continue until the amount demanded has been paid in full.

10. The expressions Bank and Employer herein before used shall include their respective successors and assigns.

11. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the employer. This guarantee is subject to the Uniform Rules for Demand Guarantees (URDG), ICC Publication No. 758.

Date …… ……

Place……. [*Signature of Authorised person of Bank]*

[Name in Block letters] ……

[Designation] ……

Address ……..

…….

Witness :

1. *Signature*
   Name & Address & Seal

2. *Signature* *Bank's Seal*
   Name & address & Seal *Authorisation No……..*

Note :

1) *All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.*
2) *In case the guarantee is issued by a foreign Bank, the said bank shall have operations in India and should be countersigned by Indian operations branch of the said bank.*
3) *The Bank Guarantee should be duly attested by Notary public with notarial stamps of appropriate value affixed thereon.*
4) ***** strike out whichever is not applicable*