

**TENDER NO.: SMPA/KDS/CIV/T/3057/34**

***Dated 10.06.2026***



**श्यामा प्रसाद मुखर्जी पोर्ट, कोलकाता**  
**SYAMA PRASAD MOOKERJEE PORT, KOLKATA**  
*Formerly Kolkata Port Trust*

श्यामा प्रसाद मुखर्जी पोर्ट, कोलकाता

**SYAMA PRASAD MOOKERJEE PORT, KOLKATA**

**(Erstwhile KOLKATA PORT TRUST)**

**(AN AUTONOMOUS BODY UNDER THE MINISTRY OF PORTS, SHIPPING AND  
WATERWAYS, GOVERNMENT OF INDIA)**

**KOLKATA DOCK SYSTEM**

**विषय: "कोलकाता के श्यामा प्रसाद मुखर्जी बंदरगाह स्थित केडीएस के लोको शेड क्षेत्र में ऑफ-डॉक कंटेनर स्टैकिंग यार्ड के विकास हेतु इंजीनियरिंग, खरीद और निर्माण के लिए निविदा"**

**Sub: "Tender for Engineering, Procurement and Construction for Development of Off- Dock Container Stacking Yard at Loco Shed Area of KDS, Syama Prasad Mookerjee Port, Kolkata"**

**CIVIL ENGINEERING DEPARTMENT**  
**SYAMA PRASAD MOOKERJEE PORT, KOLKATA**

## 1. NOTICE INVITING TENDER (NIT)

Chief Engineer, SYAMA PRASAD MOOKERJEE PORT, KOLKATA, invites e-Tender under single stage Two packet system from resourceful, experienced and Bonafide agencies with sound technical and financial capabilities on fulfilling the required Pre- qualification Criteria stipulated in tender document for “Engineering, Procurement and Construction for Development of Off- Dock Container Stacking Yard at Loco Shed Area of KDS, Syama Prasad Mookerjee Port, Kolkata” as per bill of quantities. The bid document may be seen from the CPP portal <https://eprocure.gov.in/eprocure/app>. Corrigendum or clarifications, if any, shall be hoisted on the above-mentioned website only. The tender is also published on the SMPK website (<https://smp.smpportkolkata.in/smpk/en/>).

The Bidder should have successfully completed Engineering, Procurement and Construction (EPC) contract of Container Parking Facilities (Empty Container Yards/CFS etc.) or Terminals with allied facilities and <i>with or without</i> electrical works in the past 7 years.	
<b>Bidding Type</b>	Open (Single stage two packet system)
<b>Bid Call (Nos.)</b>	One
<b>Tender Currency Type</b>	Indian Rupees
<b>Joint Venture</b>	Allowed
<b>Bid Validity Period</b>	120 Days from date of opening of techno commercial part.
<b>Bid Document Downloading Start Date</b>	11.06.2026
<b>Bid Document Downloading End Date</b>	09.07.2026 up to 14:30 Hrs.
<b>Date &amp; Place of Pre- Bid Meeting</b>	19.06.2026 @ 11:30 Hrs., at the Office Of The Chief Engineer, 6, Strand Road, Kolkata – 700 001
<b>Last Date &amp; Time for Receipt of Bids</b>	09.07.2026 up to 15:00 Hrs.
<b>Estimated Cost</b>	Rs 33,83,42,016.00 (Rupees Thirty Three Crore Eighty Three Lakh Forty Two Thousand Sixteen Only)
<b>Earnest Money Deposit</b>	Rs. 43,83,420.00 (Rupees Forty Three Lakh Eighty Three Thousand Four Hundred Twenty Only). The Bid Security (EMD) may be accepted in the form of Insurance Surety Bond/ A/c payee DD/FD receipt/Banker's Cheque / Bank Guarantee from any of the commercial banks / online payment in an acceptable mode, copies of which should be uploaded. Physical copy to be submitted within three working days.
<b>Tender Fee</b>	Rs.5,900 (Rupees Five Thousand Nine Hundred Only) The Tender Cost may be accepted in the form of A/c payee DD/FD receipt/Banker's Cheque e from any of the commercial banks / online payment in an acceptable mode, copies of which should be uploaded. Physical copy to be submitted within three working days.  Micro & Small Enterprises (MSEs) registered with NSIC (under the single point registration scheme) or MSMEs are exempted from depositing Cost of Tender Document and Earnest Money, provided they are registered for the category of work conforming to the PQ criteria of NIT. If Micro & Small Enterprises (MSEs) registered with NSIC or MSME intend to participate in the tender, for the items they are not

	<p>registered with NSIC, then they will have to deposit the cost of Tender Document, the full amount of Earnest Money as per NIT. Otherwise, their offer will not be considered.</p> <p>A copy of a valid NSIC Certificate for MSEs has to be submitted along with the bid.</p> <p>E-Tenderers submitted without the requisite Earnest Money/Bid security are liable to be rejected, except in case of Micro &amp; Small Enterprises (MSEs) registered with NSIC (under the single point registration scheme) or MSME for items for which the tender is invited.</p>	
	<p>SPA Bank Details</p> <p>A/C: Syama Prasad Mookerjee Port, Kolkata</p> <p>A/c No: 067502000000491</p> <p>IFSC: IOBA0000675</p> <p>Bank Name: Indian Overseas Bank</p> <p>Branch Name: STRAND ROAD Branch</p>	

**Note: Work experience as a sub-contractor shall not be considered as the requisite qualification.**

## 2. SCHEDULE OF WORK

SL. NO	DESCRIPTION	QTY	UNIT
2.1	SITE GRADING: Site grading, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.2	OFF DOCK CONTAINER YARD DEVELOPMENT INCLUDING INTERNAL ROAD [30436 Sq.mtr]: Off-dock container yard development, including mobilization and demobilization, is ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.3	BUILDING WORK	LS	LS
2.3.1	OFFICE BUILDING INCLUDING CAR PARKING : Office building including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.3.2	REST SHELTER AND INFIRMARY : Rest shelter, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects. [250 Sq.Mtr]	LS	LS
2.3.3	EQUIPMENT SHED & REPAIRING YARD: Equipment shed & repairing yard, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects. [2000 Sq.Mtr]	LS	LS
2.3.4	COMMON TOILET BLOCK AND SHOWER FACILITIES: Common toilet block and shower facilities, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects. .[ 250 Sq.Mtr]	LS	LS
2.3.6	SECURITY OFFICE [ 20 Sq.Mtr] AND GATE: Security office and gate, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.4	WATER SUPPLY WORKS: Water supply works, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.5	STORM WATER DRAINAGE: Storm water drainage, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS
2.6	SEWERAGE SYSTEM: Sewerage system including mobilization and demobilization, and ready to use as per approved designs,	LS	LS

	drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
2.7	BOUNDARY WALL[1000 Mtr] : Boundary wall including mobilization and demobilization and ready to use as per approved designs, drawings and specifications, including testing, inspection, and defect rectifications, complete in all respects.	LS	LS

### 3. INTRODUCTION

#### 3.1 Background

3.1.1 Syama Prasad Mookerjee Port, Kolkata represented by the, Chief Engineer having its principal office at Kolkata, is engaged in the development of Kolkata Port and related infrastructure, and as part of this endeavour, the Authority has decided to undertake development of off Dock Container Stacking Yard at Loco Shed Area, Kolkata Dock System through an Engineering, Procurement and Construction (the “EPC”) Contract, and has decided to carry out an open, competitive bidding Process for selection of a Bidder to whom the Project may be awarded. A brief description of the Project may be seen in the Information Memorandum of the Project at the CPP portal <https://eprocure.gov.in/eprocure/app> as well as at the SMPK website (<https://smp.smpportkolkata.in/smpk/en/>). Brief particulars of the Project are as follows:

Name of the Project	Estimated Project Cost (In Rs. cr.)	Time Of completion of work
Engineering, Procurement and Construction for Development of Off-Dock Container Stacking Yard at Loco Shed Area of KDS, Syama Prasad Mookerjee Port, Kolkata.	Rs 33,83,42,016.00	540 Days.

3.1.2 The Selected Bidder (the “**Contractor**”) shall be responsible for Engineering, Procurement and Construction of the Project under and in accordance with the provisions of an Engineering, Procurement, and Construction agreement (the “**EPC Agreement**”) to be entered into between the Selected Bidder and the Authority in the form provided by the Authority as part of the Bidding Documents pursuant hereto. The scope of work will broadly include Civil Engineering works i.e. **SITE GRADING, CONTAINER YARD DEVELOPMENT, OFFICE BUILDING, REST SHELTER, EQUIPMENT SHED & REPAIRING YARD, DG ROOM, COMMON TOILET BLOCK AND SHOWER FACILITIES, SECURITY OFFICE AND GATE HOUSE COMPLEX, WATER SUPPLY WORKS, STORM WATER DRAINAGE, SEWERAGE SYSTEM, BOUNDARY WALL, FIRE FIGHTING SYSTEM, CCTV CAMERA, RFID, BOOM BARRIER AND COMMUNICATION FACILITIES, GREEN AREA DEVELOPMENT, WEIGH BRIDGE FACILITIES, POWER DISTRIBUTION LIGHTING AND COMMUNICATION WORKS, INTERNAL ROAD FACILITIES** and other allied & related incidental works.

3.1.3 The estimated cost of the Project (the “**Estimated Project Cost**”) has been specified above. The assessment of actual costs, however, will have to be made by the Bidders.

3.1.4 The draft EPC Agreement sets forth the detailed terms and conditions for award of the Project to the Contractor, including the scope of the Contractor’s services and obligations.

3.1.5 The Authority shall receive Bids pursuant to this Tender in accordance with the terms set forth in this Tender and other documents to be provided by the Authority pursuant to this Tender as modified, altered, amended and clarified from time to time by the Authority (collectively the “**Bidding Documents**”), and all Bids shall be prepared and submitted in accordance with such terms on or before the Bid Due Date specified for submission of Bids (the “**Bid Due Date**”).

#### 3.2 Brief description of Bidding Process:

3.2.1 The Authority has adopted a single-stage two-packet system (referred to as the “**Bidding Process**”) for the selection of the Bidder for the award of the Project. The 1st part (the “**Technical Bid**”) of the process involves qualification (the “**Qualification**”) of the interested parties/Consortium/Joint Venture who submits a Bid in accordance with the provisions of this Tender (the “**Bidder**”, which expression shall, unless repugnant to the context, include the members of the Consortium/Joint Venture). The 2nd part of the process involves opening of financial proposals (the “**Financial Bid**”) of the bidders qualified in the Technical Bid. The Technical and Financial Bid shall collectively be referred to as the Bid (the “**Bid**”). The Bidder would be required to furnish all information specified in this Tender. At the Qualification stage, the Technical Bids of Bidders would be evaluated, and only those Bidders that are qualified by the Authority shall be eligible for

the 2nd part of the Bidding Process, comprising opening and evaluation of their Financial Bids. Govt. of India has issued guidelines (see **Annexure I** of Tender) for the qualification of Bidders seeking to acquire stakes in any public sector enterprise through the process of disinvestment. These guidelines shall apply mutatis mutandis to this Bidding Process. The Authority shall be entitled to disqualify any Bidder in accordance with the aforesaid guidelines at any stage of the Bidding Process. Bidders must satisfy themselves that they are qualified to Bid, and should give an undertaking to this effect in the form at **Annexure-II**.

**3.2.2** The Bid shall be valid for a period of 120 days from the date of opening of Bids (the “Bid Due Date”).

**3.2.3.** A Bidder is required to submit, along with its Bid, a Bid Security/Earnest Money of Rs. 43,83,420 (Rupees. Forty Three Lakh Eighty Three Thousand Four Hundred Twenty only) (the "**Bid Security**"), refundable not earlier than 240 (Two hundred & Forty) days from the Bid Due Date, except in the case of the Selected Bidder, whose Bid Security/Earnest money shall be retained till it has provided a Performance Security as per the provision of this Tender and LOA. The Bidder will have to provide Bid Security physically deposited at the office of Chief Engineer at 6, Strand Road, Kolkata 700001 by vendors/contractors through Bank Draft/Banker’s Cheque/Demand Draft/Pay Order etc. on any scheduled/nationalized Bank, in favour of Syama Prasad Mookerjee Port, Kolkata, payable at Kolkata, within 3 working days after opening of tender. or submitted as a Bank Guarantee Bond from a scheduled Commercial Bank of India. The Bank Guarantee Bond shall be as per **Annexure-V** and shall be valid for a period of 90 days beyond the Bid Validity Period. The Bid shall be summarily rejected if it is not accompanied by the prescribed amount of Bid Security.

**3.2.4** Bidders are advised to examine the Project in greater detail, and to carry out, at their cost, such studies as may be required for submitting their respective Bids for award of the contract, including implementation of the Project.

**3.2.5** Bids will be evaluated for the Project based on the lowest cost required by a Bidder for implementing the Project (the "**Bid Price**"). The total time allowed for completion of construction under the Agreement (the "**Construction Period**") and the period during which the Contractor shall be liable for rectification of any defect or deficiency in the Project after completion of the Construction Period (the "**Defect Liability Period**") shall be pre-determined and are specified in the Bidding Documents. Any queries or requests for additional information concerning this Tender shall be submitted in writing by speed post/courier/special messenger or by e-mail to the following contact persons:

**Contact Persons (Syama Prasad Mookerjee Port, Kolkata):**

1. A Bagchi, Dy. Chief Engineer-IV  
Ph no. 03371012457  
Email: [a.bagchi@smpportkolkata.shipping.gov.in](mailto:a.bagchi@smpportkolkata.shipping.gov.in)
2. Swarup Nandy, Superintending Engineer (Contract),  
Ph no. 03371012224  
E-mail: [s.nandy@smpportkolkata.shipping.gov.in](mailto:s.nandy@smpportkolkata.shipping.gov.in)

**Contact (CPP Portal):**

Central helpline email IDs: - [support.etender@nic.in](mailto:support.etender@nic.in), [cphp-nic@nic.in](mailto:cphp-nic@nic.in)

WB helpline email IDs: - [helpdesk.eproc-wb@nic.in](mailto:helpdesk.eproc-wb@nic.in), [helpdesk2.eprocwb@nic.in](mailto:helpdesk2.eprocwb@nic.in).

### 3.3 Schedule of Bidding Process

The Authority shall endeavour to adhere to the following schedule:

<b>Sl. No.</b>	<b>Event Description</b>	<b>Date</b>
1.	Invitation of Tender (NIT)	10.06.2026
2.	Pre-Bid meeting at venue	19.06.2026 @ 11:30 Hrs., in the office of Chief Engineer, 6, Strand Road, Kolkata – 700 001
3.	Last date for receiving queries	Not applicable
4.	Authority response to queries latest by	Not applicable
5.	Last date of Request for Bid Document	09.07.2026 up to 14:30Hrs.
	Bid Due Date	09.07.2026 up to 15:00 Hrs.
7.	Physical Submission of all documents	15.07.2026 up to 17:00 Hrs.
8.	Opening of Technical Bids	10.07.2026, shortly after 15:00 Hrs., at the office of Chief Engineer, 6, Strand Road, Kolkata – 700 001
9.	Declaration of eligible / qualified Bidders	Will be intimated during bidding process
10.	Opening of Financial Bid	Will be intimated during bidding process
11.	Acknowledgement of LOA	Within 7 days of issue of LOA
12.	Validity of Bid	120 days from Bid Due Date
13.	Submission of Performance Security.	Within 30 days of issue of LOA.
14.	Signing of Agreement	Within 15 working days of issuance of LOA.

## 4. INSTRUCTIONS TO BIDDERS

### A. GENERAL

#### 4.1. General Terms of Bidding

4.1.1 No Bidder shall submit more than one Bid for the Project.

4.1.2 A Bidder bidding individually or as a member of a Consortium/Joint Venture shall not be entitled to submit another Bid either individually or as a member of any Consortium/Joint Venture, as the case may be.

4.1.3 Notwithstanding anything to the contrary contained in this Tender, the detailed terms specified in the Tender Document shall have overriding effect; provided, however, that any conditions or obligations imposed on the Bidder hereunder shall continue to have effect in addition to its obligations under the Agreement. Further, the statements and explanations contained in this Tender are intended to provide a better understanding to the Bidders about the subject matter of this Tender and should not be construed or interpreted as limiting in any way or manner the scope of services and obligations of the Contractor outlined in the Agreement or the Authority's rights to amend, alter, change, supplement or clarify the scope of work, the work to be awarded pursuant to this Tender or the terms thereof or herein contained. Consequently, any omissions, conflicts, or contradictions in the Bidding Documents, including this Tender, are to be noted, interpreted, and applied appropriately to give effect to this intent, and no claims on that account shall be entertained by the Authority.

4.1.4 The Bid shall be furnished in the format exactly as per **Annexure I, II, and III & VI** and it shall be signed by the Bidder's authorized signatory. The Bid Price shall be quoted online at the e-procurement platform of the Authority at the CPP portal <https://eprocure.gov.in/eprocure/app> as well as at the SMPA website (<https://smp.smporkolkata.in/smpk/en/>). In the event of any difference between figures and words, the amount indicated in words shall be taken into account.

4.1.5 The Bidder should submit a Power of Attorney as per the format at **Annexure VIII**, authorizing the signatory of the Bid to commit the Bidder.

4.1.6 In case the Bidder is a Consortium/Joint Venture, the Members thereof should furnish a Power of Attorney in favour of the Lead Member in the format at **Annexure IX** and a Joint Bidding Agreement in the format of **Annexure XI**.

4.1.7 Any condition or qualification, or any other stipulation contained in the Bid shall render the Bid liable to rejection as a non-responsive Bid.

4.1.8 The Bid and all communications in relation to or concerning the Bidding Documents and the Bid shall be in the English language.

4.1.9 This Tender is not transferable.

4.1.10 Any award of the Project pursuant to this Tender shall be subject to the terms of the Bidding Documents. The Bidding Documents and all attached documents, provided by the Authority, are and shall remain or become the property of the Authority and are transmitted to the Bidders solely for preparation and submission of the Bid in accordance with herewith. Bidders are to treat all information as strictly confidential and shall not use it for any purpose other than for the preparation and Submission of their Bid. The provision of this clause 4.1.10 shall also apply mutatis mutandis to Bids and all other documents submitted by the Bidders, and the Authority will not return to the Bidders any Bid, documents, or any information provided along with them.

4.1.11. In case the Bidder is a Consortium/Joint Venture, it shall comply with the following additional requirements:

(a) The number of members in a Consortium/Joint Venture shall not exceed 4 (Four);

(b) subject to the provisions of clause (a) above, the Bid should contain the information required for each member of the Consortium/Joint Venture;

(c) members of the Consortium/Joint Venture shall nominate one member as the Lead Member (the “**Lead Member**”). Lead Member shall have a minimum 51% shareholding in the Consortium/Joint Venture. Technical Capacity as per Clause 4.2.2.1 to be satisfied by any member of the Consortium/Joint Venture having a minimum 20% shareholding in the Consortium/Joint Venture. The nomination of Lead Member shall be supported by a Power of Attorney, as per the format at **Annexure-IX**, signed by all the other members of the Consortium/Joint Venture. Consortium/Joint Venture as a whole shall cumulatively/collectively fulfil the 100% Technical Capacity as per Clause 4.2.2.1 and 100% Financial Capacity as per Clause 4.2.2.2.

(d) The bid should include a brief description of the roles and responsibilities of individual members, particularly with reference to financial, technical, and defect liability obligations;

(e) The Lead Member shall carry out works directly under its own supervision and through its own personnel for at least 30% of the total value of the project in accordance with the provisions of the draft EPC Agreement.

(f) members of the Consortium/Joint Venture shall have entered into a binding Joint Bidding Agreement, substantially in the form specified at **Annexure- XI** (the “**Jt. Bidding Agreement**”), for the purpose of making the Bid. The Jt. Bidding Agreement, to be submitted along with the Bid, shall, *inter alia*:

(i) convey the commitment(s) of the Lead Member in accordance with this RFP, in case the contract to undertake the Project is awarded to the Consortium/Joint Venture; and clearly outline the proposed roles & responsibilities, if any, of each member.

(ii) include a statement to the effect that all members of the Consortium/Joint Venture shall be liable jointly and severally for all obligations of the Contractor in relation to the Project until the Defect Liability Period is achieved in accordance with the EPC agreement;

(g) Approval for change of constitution of the Consortium/Joint Venture shall be at the sole discretion of the Authority. The constitution of the Consortium/Joint Venture shall not be allowed to be modified after submission of the Bid by the Consortium/Joint Venture, except when modification becomes inevitable due to Succession laws, etc., **provided further that there is no change in qualification of minimum eligibility criteria by Consortium/JV**. However, the Lead member shall continue to be the Lead Member of the Consortium/Joint Venture. Failure to observe this requirement would render the offer invalid. Similarly, after the contract is awarded, the constitution of the Consortium/Joint Venture shall not be allowed to be altered during the currency of the contract except when modification becomes inevitable due to Succession laws, etc., provided further that it does not change the minimum eligibility criteria. Failure to observe this stipulation shall be deemed to be a breach of contract with all consequential penal action as per the contract condition.

4.1.12 While Bidding is open to persons from any country, the following provisions shall apply:

(a) Where, on the due date of the Bid, not less than 25% (twenty-five percent) of the aggregate issued, subscribed, and paid-up equity share capital/capital contribution/partnership contribution in the Lowest Bidder or its member is held by persons resident outside India, or where a Bidder or its member is controlled by persons resident outside India, then the eligibility and award of the project to such persons The Lowest Bidder shall be subject to the approval of the competent authority of the national security and public interest perspective, as per the instructions of the Government of India applicable at such time. The decision of the authority in this matter shall be Final and conclusive, and binding on the Bidder.

(b) Further, where the LOA of a project has been issued to an agency, not covered under the category mentioned above, and it subsequently wishes to transfer its share capital in favour of another entity that is a resident outside India, or where a Bidder or its member is controlled by persons resident outside India, and thereby the equity capital If the transferee entity exceeds 25% or above, any such transfer of equity capital shall be with the prior approval of the competent authority from the national security and public interest perspective as per the instructions of the Government of India applicable at such a point in time.

(c) The holding or acquisition of equity control, as above, shall include direct or indirect holding, acquisition, including by transfer of the direct or indirect legal or beneficial ownership or control, by persons acting for themselves or in concert, and in determining such holding or acquisition, the Authority shall be guided by the principles, precedents, and definitions contained in the Securities and Exchange Board of India (Substantial Acquisition of Shares and Takeovers) Regulations, 2011 or any substitute thereof, as in force on the date of such acquisition.

(d) The Bidder shall promptly inform the authority of any change in the shareholding, as above, and failure to do so shall render the Bidder liable for disqualification from the Bidding Process.

(e) In case the Lowest Bidder under (a) above is denied the security clearance, for whatever reasons, then the Bidders that emerged as the second Lowest, third lowest Eligible Bidders (in that order) may be given a counteroffer (one by one sequentially) to match the Bid of the Lowest Bidder. In the event of acceptance of a counteroffer is made by another eligible Bidder, the project may be awarded to such Bidder. In case no Bidder matches the Bid of the Lowest Bidder, the Bid Process shall be annulled and fresh Bids invited.

(f) "Any bidder from the countries sharing a land border with India will be eligible to bid in any procurement, whether of goods, services (including consultancy services and non-consultancy services) or works (including turnkey projects), only if the bidder is registered with the Competent Authority. The Competent Authority for registration will be the Registration Committee constituted by the Department for Promotion of Industry and Internal Trade (DPIIT), Government of India. For the interpretation of this clause, the Department of Expenditure, Ministry of Finance, Government of India, letter F.No.6/18/2019-PPD dated 23/07/2020 shall be referred to.

4.1.13 Notwithstanding anything to the contrary contained herein, if the Bid due date falls within three months of the closing of the latest Financial Year completed by a Bidder, it shall ignore such Financial Year for its Bid and furnish all its information and certification with reference to the 7 (seven) years or 1 (one) year, as the case may be, preceding its latest Financial Year. For the avoidance of doubt, Financial Year shall, for a Bid hereunder, mean the Accounting Year followed by the Bidder in the course of its normal business.

4.1.14 (a) Any entity that has been barred by the Central Government or any entity controlled by it, from participating in any project, and the bar subsists as on the date of Bid, would not be eligible to submit a Bid, either individually or as a member of a Consortium/Joint Venture.

(b) A Bidder, including any member or Associate, should, in the last 3 (three) years, have neither failed to perform on any contract, as evidenced by the imposition of a penalty or damages by a judicial authority or a judicial pronouncement against the Bidder, member or Associate, as the case may be, nor has been expelled from any project or contract by any public entity, nor have they had any contract terminated by any public entity for breach by such Bidder, member, or Associate.

(c) If Bidder's constituents are an entity incorporated in a country, where an entity incorporated in India does not have similar rights of bidding for contracts. The Authority reserves the right to reject an otherwise eligible Bidder based on the information provided under this clause 4.1.13. The decision of the Authority in this case shall be final.

## **4.2. Eligibility and qualification requirements of Bidder**

4.2.1 For determining the eligibility of the Bidder, the following shall apply:

(a) The Bidder may be a single entity or a group of entities (the "**Consortium**" or the "**Joint Venture**"), coming together to implement the Project. The term Bidder is used Herein would apply to both a single entity and a Consortium/Joint Venture.

(b) Bidder may be a natural person, private entity, or any combination of them, with a formal intent to enter into a Consortium/Joint Venture agreement, or under an existing agreement to form a Consortium/Joint Venture. A Consortium/Joint Venture shall be eligible for consideration, subject to the conditions set out in Clause 4.1.11 above.

(c) A Bidder shall not have a conflict of interest (**“Conflict of Interest”**) that affects the Bidding Process. Any Bidder found to have a Conflict of Interest shall be disqualified and liable for forfeiture of the Bid Security or Performance Security, as the case may be. A Bidder shall be deemed to have a Conflict of Interest affecting the Bidding Process, if:

(i) the Bidder, its Consortium/Joint Venture member (or any constituent thereof) and any other Bidder, its member, or any member of its Consortium/Joint Venture thereof (or any constituent thereof) has a common controlling shareholders or other ownership interest; provided that this disqualification shall not apply in cases where the direct or indirect shareholding of a Bidder, or its Consortium/Joint Venture member thereof (or any shareholder thereof having a shareholding of more than 5% (five percent) of the paid-up and subscribed shares capital of such Bidder, or its Consortium/Joint Venture member, as the case may be, in the other Bidder, its Consortium/Joint Venture member is less than 5% (five percent) of the subscribed and paid-up equity share capital thereof; provided further that this disqualification shall not apply to any ownership by a bank, insurance company, pension fund, or a public financial institution referred to in section 4A of The Companies Act 2013. For the purposes of this Clause 4.2.1(c), indirect Shareholding held through one or more intermediate persons shall be computed as follows:

(aa) where any intermediary is controlled by a person through management control or otherwise, the entire shareholding held by such controlled intermediary in any other person (the **“Subject Person”**) shall be taken into account for computing the shareholding of such controlling person in the Subject Person; and (bb) subject always to sub-clause (aa) above, where a person does not exercise control over an intermediary, which has a shareholding in the Subject Person, the computation of the indirect shareholding of such person in the Subject Person shall be undertaken on a proportionate basis; provided, however, that no such shareholding shall be reckoned under this sub-clause (bb) if the shareholding of such a person in the intermediary is less than 26% of the subscribed and paid up equity shareholding of such intermediary; or

(ii) A constituent of such Bidder is also a constituent of another Bidder;

or

(iii) Such Bidder, or any of its Consortium/Joint Venture member thereof, receives or has received any direct or indirect subsidy, grant, concessional loan, or subordinated debt from any other Bidder, or any of its Consortium/Joint Venture member thereof or has provided any such subsidy, grant, concessional loan or subordinated debt to any other Bidder, its member, or any of its Consortium/Joint Venture member thereof;

or

(iv) such Bidder has the same legal representative for purposes of this Tender as any other Bidder;

or

(v) such Bidder, or any of its Consortium/Joint Venture members thereof, has a relationship with another Bidder, or any of its Consortium/Joint Venture members thereof, directly or through common third party/parties, that puts either or both of them in a position to have access to each other’s information about, or to influence the Bid of either or each other;

or

(vi) such Bidder, or any of its Consortium/Joint Venture members thereof, has participated as a consultant to the Authority in the preparation of any documents, design, or technical specifications of the Project.

**4.2.2 Qualification requirements of Bidders:** To be eligible for Qualification, an individual Bidder or a Consortium/Joint Venture as a whole, as per clause 4.1.11(c), shall fulfil the following conditions of eligibility:

#### **4.2.2.1 Technical Eligibility Criteria:**

The tenderer must have completed any one of the following categories of work(s) during the last 07 (seven) years, ending last day of the month previous to the one in which the tender is invited

- (i) 03 (Three) completed works each costing<sup>#</sup> not less than 40 % of the estimated cost put to tender. Or
- (ii) 02 (Two) completed works each costing<sup>#</sup> not less than 50 % of the estimated cost put to tender. Or
- (iii) 01 (One) completed work costing<sup>#</sup> not less than 80 % of the estimated cost put to tender.

# Value of work without GST

Work experience as a sub-contractor shall not be considered as the requisite qualification.

**Similar Works:**

Construction or repairing of Yards/Pavements/ Hardstand/Roads/Runways/Bridges etc. with Standard Concrete (M25 grade or higher) and/or Pavement Quality Concrete (PQC) and / or with Heavy Duty interlocking concrete block pavement " with or without electrical works.

However, the total value of work excluding electrical work (if any) shall be considered to evaluate the compliance to PQ criteria.

**Satisfactory Performance:** For the above technical experience mentioned, the Tenderer shall submit the documentary proof for satisfactory performance from the firms where similar works were executed.

**Note:**

(i) In case the similar work has been executed for any private body in India, the bidder will be required to produce the tax deducted at source (TDS) certificate indicating the income tax deducted by the client for that work, which will form the basis for assessing the value of completed work.

**4.2.2.2 Financial Eligibility Criteria:**

The **Average Annual Financial Turnover of the bidding firm during the last three years**, ending on 31-03-2025, should be at least **30% of the Total quoted amount against this tender**.

**4.2.2.3 Bid Capacity:** The tender/technical bid will be evaluated based on the bid capacity formula detailed in **Annexure-III & XIX**.

**4.2.2.4 Capabilities and Resources:**

The Bidder should be in the business of Engineering, Procurement and Construction (EPC) of Container Parking Facilities (Container Yards/CFS /ICD/ICT etc.) including allied facilities *with 'or' without* electrical works in the past 7 years.

**4.3. JOINT VENTURE (JV) IN WORKS TENDERS**

This para shall be applicable for works tenders wherein tender documents provide for the same.

**4.3.1** A separate identity/name shall be given to the Joint Venture.

**4.3.2** Number of members in a JV shall not be more than three. One of the members of the JV shall be its Lead Member, who shall have a majority (at least 51%) share of interest in the JV. The other members shall have a share of not less than 20% each in the case of a JV with up to three members. In case of JV with foreign member(s), the Lead Member has to be an Indian firm/company with a minimum share of 51%.

**4.3.3** A member of JV shall not be permitted to participate either in an individual capacity or as a member of another JV in the same tender.

**4.3.4** The tender form shall be purchased and submitted only in the name of the JV and not in the name of any constituent member. The tender form can, however, be submitted by JV or any of its constituent members or any person authorized by JV through a Power of Attorney to submit a tender.

**4.3.5** Bid Security shall be submitted by JV or authorized person of JV either as: (i) Cash as mentioned in tender document, or (ii) Bank Guarantee bond either in the name of JV, or in the name of all members of JV as per MOU irrespective of their share in the JV if the JV has not been constituted legally till the date of submission of tender.

**4.3.6** A copy of the Memorandum of Understanding (MoU) duly executed by the JV members on stamp paper shall be submitted by the JV along with the tender. The complete details of the members of the JV, their share and responsibility in the JV, etc., particularly with reference to financial, technical, and other obligations, shall be furnished in the MoU.

**4.3.7** Once the tender is submitted, the MoU shall not normally be modified/alterd/terminated during the validity of the tender. In case the tenderer fails to observe/comply with this stipulation, the full Bid Security shall be forfeited.

**4.3.8** Approval for the change of the constitution of JV shall be at the sole discretion of the SMPA. The constitution of the JV shall not normally be allowed to be modified after submission of the bid by the JV, except when modification becomes inevitable due to succession laws, etc., provided further that there is no change in qualification of minimum eligibility criteria by the JV after a change of composition. However, the Lead Member shall continue to be the Lead Member of the JV. Failure to observe this requirement /would render the offer invalid.

**4.3.9** Similarly, after the contract is awarded, the constitution of JV shall not normally be allowed to be altered during the currency of the contract except when modification becomes inevitable due to succession laws, etc., and the minimum eligibility criteria should not be vitiated. Failure to observe this stipulation shall be deemed to be a breach of contract with all consequential penal action as per contract conditions.

**4.3.10** On award of contract to a JV, a single Performance Guarantee shall be submitted by the JV as per tender conditions. All the Guarantees, like Performance Guarantee, Bank Guarantee for Bid Security, Security Deposit, etc., shall be accepted only in the name of the JV, and no splitting of guarantees amongst the members of the JV shall be permitted.

**4.3.11** On issue of LOA (Letter of Acceptance), the JV entity to whom the work has been awarded, with the same shareholding pattern as was declared in the MOU/JV Agreement submitted along with the tender, shall be got registered before the Registrar of the Companies under 'The Companies Act -2013' (in case JV entity is to be registered as Company) or before the Registrar/Sub-Registrar under the 'The Indian Partnership Act, 1932' (in case JV entity is to be registered as Partnership Firm) or under 'The LLP Act 2008' (in case JV entity is to be registered as LLP). A separate PAN shall be obtained for this entity. The documents about this entity, including its PAN, shall be furnished to the Authority before signing the contract agreement for the work. In case the tenderer fails to observe/comply with this stipulation within 60 days of the issue of the LOA, the contract is liable to be terminated. In case the contract is terminated, the Authority shall be entitled to forfeit the full amount of the Bid Security and other dues payable to the Contractor under this contract. The entity so registered, in the registered documents, shall have, inter alia, the following Clauses:

**4.3.11.1** Joint and Several Liability - Members of the entity to which the contract is awarded shall be jointly and severally liable to the Authority for execution of the project in accordance with General and Special Conditions of Contract and others (if any). The members of the entity shall also be liable jointly and severally

for the loss, damages caused to the Authority during the course of execution of the contract or due to non-execution of the contract or part thereof.

**4.3.11.2** Duration of the Registered Entity - It shall be valid during the entire currency of the contract, including the period of extension, if any, and the maintenance period after the work is completed.

**4.3.11.3** Governing Laws - The Registered Entity shall, in all respects, be governed by and interpreted in accordance with Indian Laws.

**4.3.12** Authorized Member - Joint Venture members in the JV MoU shall authorize Lead member on behalf of the Joint Venture to deal with the contract, sign the agreement or enter into contract in respect of the said tender, to receive payment, to witness joint measurement of work done, to sign measurement books and similar such action in respect of the said tender/contract. All notices/correspondence with respect to the contract would be sent only to this authorized member of the JV.

**4.3.13** No member of the Joint Venture shall have the right to assign or transfer the interest, right, or liability in the contract without the written consent of the other members and that of the Authority in respect of the said tender/contract.

**4.3.14** Documents to be enclosed by the JV along with the tender:

**4.3.14.1** In case one or more of the members of the JV is/are partnership firm(s), the following documents shall be submitted:

- (i) A notarized copy of the Partnership Deed or a copy of the Partnership Deed registered with the Registrar.
- (ii) A copy of the consent of all the partners or an individual authorized by the partnership firm, to enter into the Joint Venture Agreement on stamp paper,
- (iii) A notarized or registered copy of the Power of Attorney in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm.
- (iv) An undertaking by all partners of the partnership firm that they are not blacklisted or debarred by SMPKs or any other Ministry/Department of the Govt. of India from participation in tenders/contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP in which they were/are partners/members. Any Concealment / wrong information regarding the above shall make the bid ineligible, or the contract shall be determined under Clause 62 of the Standard General Conditions of Contract.

**4.3.14.2** In case one or more members is/are Proprietary Firm or HUF, the following documents shall be enclosed:

- (i) A copy of notarized affidavit on Stamp Paper declaring that his Concern is a proprietary Concern and he is sole proprietor of the Concern OR he who is signing the affidavit on behalf of HUF is in the position of 'Karta' of Hindu Undivided Family (HUF) and he has the authority, power and consent given by other members to act on behalf of HUF.

**4.3.14.3** In case one or more members of the JV is/are companies, the following documents shall be submitted:

- (i) A copy of the resolutions of the Directors of the Company, permitting the Company to enter into a JV agreement,
- (ii) The copies of MOA (Memorandum of Association) / AOA (Articles of Association) of the company (iii) A copy of Certificate of Incorporation
- (iv) A copy of the Authorization/copy of Power of Attorney issued by the Company (backed by the resolution of the Board of Directors) in favour of the individual, to sign the tender, sign the MOU/JV Agreement on behalf of the company, and create liability against the company

**4.3.14.4** In case one or more members of the JV is/are LLP firm/s, the following documents shall be submitted:

- (i) A copy of the LLP Agreement
- (ii) A copy of the Certificate of Incorporation of LLP
- (iii) A copy of the resolution passed by the partners of the LLP firm, permitting the Firm to enter into a JV agreement
- (iv) A copy of the Authorization /copy of Power of Attorney issued by the LLP firm (backed by a resolution passed by the Partners) in favour of the individual, to sign the tender and/or sign the MOU/ JV agreement on behalf of the LLP and create liability against the LLP.
- (v) An undertaking by all partners of the LLP that they are not blacklisted or debarred by SMPKs or any other Ministry / Department of the Govt. of India from participation in tenders/contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP or JV in which they were/are partners/members. Any Concealment / wrong information regarding the above shall make the contract liable for determination with all consequential penal action as per the contract.

**4.3.14.5** In case one or more members of the JV is/are Society/s or Trust/s, the following documents shall be submitted: (i) A copy of the Certificate of Registration, (ii) A copy of the Memorandum of Association of the Society/Trust Deed

- (iii) A copy of the Rules & regulations of the Society
- (iv) A copy of power of Power of Attorney, in favour of the individual to sign the tender documents and create liability against the Society/Trust

**4.3.14.6** A power of Attorney executed and issued overseas, the document will also have to be legalized by the Indian Embassy and notarized in the jurisdiction where the power of Attorney is being issued. However, the power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 is not required to be legalized by the Indian Embassy if it carries a conforming Apostille certificate

**4.3.15** Credentials & Qualifying Criteria: Technical, financial eligibility, and Bid capacity of the JV shall be adjudged based on satisfactory fulfilment of the following criteria:

**4.3.15.1** Technical Eligibility Criteria:

The technical eligibility for the work as per para 4.2.2.1 above, shall be satisfied by either the 'JV in its own name & style' or 'Lead member of the JV'. Each other (non-lead) member(s) of JV, who is/ are not satisfying the technical eligibility for the work as per para 4.2.2.1 above, shall have a technical capacity of a minimum of 10 % of the cost of work, i.e., each non-lead member of JV must have satisfactorily completed or substantially completed during the last 07 (seven) years, ending last day of the month previous to the one in which a tender is invited, one similar single work for a minimum of 10 % of the Quoted value of the tender.

**4.3.15.2** Financial Eligibility Criteria

The JV shall satisfy the requirement of "Financial Eligibility" mentioned in para 4.2.2.2 above. The "financial capacity" of the lead member of the JV shall not be less than 51% of the financial eligibility criteria mentioned above. The arithmetic sum of the individual "financial capacity" of all the members shall be taken as JV's "financial capacity" to satisfy this requirement.

**Note:** Contractual payment received by a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for the purpose of satisfying the compliance of the above-mentioned financial eligibility criteria in the tender under consideration.

**4.3.15.3** Bid Capacity the JV shall satisfy the requirement of "Bid Capacity" mentioned in para 4.2.3 above. The arithmetic sum of the individual "Bid capacity" of all the members shall be taken as JV's "Bid capacity" to satisfy this requirement.

#### **4.4 Proprietary data**

All documents and other information supplied by the Authority or submitted by a Bidder to the Authority shall remain or become the property of the Authority and are transmitted to the Bidders solely for preparation and the submission of a Bid in accordance herewith. Bidders are to treat all information as strictly confidential and shall not use it for any purpose other than for the preparation and submission of their Bid. The provisions of this Clause 4.4 shall also apply *mutatis mutandis* to Bids and all other documents submitted by the Bidders, and the Authority will not return to the Bidders any Bid, document, or any information provided along therewith.

#### **4.5 Cost of Bidding**

The Bidders shall be responsible for all of the costs associated with the preparation of their Bids and their participation in the Bidding Process. The Authority will not be responsible or in any way liable for such costs, regardless of the conduct or outcome of the Bidding Process.

#### **4.6 Site visit and verification of information**

4.6.1 Bidders are encouraged to submit their respective Bids after visiting the Project site and ascertaining for themselves the site conditions, traffic, location, surroundings, climate, availability of power, water & other utilities for construction, access to the site, handling and storage of materials, weather data, applicable laws and regulations, and any other matter considered relevant by them. Bidders are advised to visit the site and familiarise themselves with the Project within the stipulated time of submission of the Bid. No extension of time is likely to be considered for submission of Bids.

4.6.2 It shall be deemed that by submitting a Bid, the Bidder has:

- (a) made a complete and careful examination of the Bidding Documents, Schedules of the Tender.
- (b) Received all relevant information requested from the Authority;
- (c) accepted the risk of inadequacy, error, or mistake in the information provided in the Bidding Documents or furnished by or on behalf of the Authority relating to any of the matters referred above. No claim shall be admissible at any stage on this account.
- (d) satisfied itself about all matters, things, and information, including matters referred to hereinabove, necessary and required for submitting an informed Bid, execution of the Project in accordance with the Bidding Documents, and performance of all of its obligations thereunder;
- (e) acknowledged and agreed that inadequacy, lack of completeness, or the incorrectness of information provided in the Bidding Documents or ignorance of any of the matters referred to hereinabove shall not be a basis for any claim for compensation, damages, or extension of time for performance of its obligations, loss of profits, etc., from the Authority, or a ground for termination of the Agreement by the Contractor;
- (f) acknowledged that it does not have a Conflict of Interest; and
- (g) agreed to be bound by the undertakings provided by it under and in terms hereof.

4.6.3 The Authority shall not be liable for any omission, mistake, or error in respect of any of the above or on account of any matter or thing arising out of or concerning or relating to the Tender/Contract, including any error or mistake therein or in any information or data given by the Authority.

#### **4.7 Verification and Disqualification**

4.7.1 The Authority reserves the right to verify all statements, information, and documents submitted by the Bidder in response to the Tender, and the Bidder shall, when so required by the Authority, make available all such information, evidence, and documents as may be necessary for such verification. Any such verification, or lack of such verification, by the Authority shall not relieve the Bidder of its obligations or liabilities hereunder, nor will it affect any rights of the Authority thereunder.

4.7.2 The Authority reserves the right to reject any Bid and appropriate the Bid Security if:

(a) at any time, a material misrepresentation is made or uncovered, or

(b) The Bidder does not provide, within the time specified by the Authority, the Supplemental information sought by the Authority for evaluation of the Bid. Such misrepresentation/ improper response shall lead to the disqualification of the Bidder. If the Bidder is a Consortium/Joint Venture, then the entire Consortium/Joint Venture and each member of the Consortium/Joint Venture may be disqualified/ rejected. If such disqualification/rejection occurs after the Bids have been opened and the lowest Bidder gets disqualified/rejected, then the Authority reserves the right to annul the Bidding Process and invite fresh Bids.

4.7.3 In case it is found during the evaluation or at any time before signing the EPC Agreement, or after its execution and during the period of defect liability subsistence thereof, that one or more of the eligibility and /or qualification requirements have not been met by the Bidder, or the Bidder has made material misrepresentation or has given any materially incorrect or false information, the Bidder shall be disqualified forthwith if not yet appointed as the contractor either by issue of the LOA or entering into the Agreement, and if the Selected Bidder has already been issued the LOA or has entered into the Agreement, as the case may be, the same shall, notwithstanding anything to the contrary contained therein, be liable to be terminated, by a communication in writing by the Authority to the Selected Bidder or the Contractor, as the case may be, without the Authority being liable in any manner whatsoever to the Selected Bidder or the Contractor. In such an event, the Authority shall be entitled to forfeit and appropriate the Bid Security or Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to the Authority under the Bidding Documents and/or EPC Agreement, or otherwise.

4.7.4. A Bidder shall be liable for disqualification and forfeiture of Bid Security, if any legal, financial or technical adviser of the Authority in relation to the Project is engaged by the Bidder, its member or any Associate thereof, as the case may be, in any manner for matters related to or incidental to such Project during the Bidding Process or after the (i) issue of the LOA or (ii) execution of the EPC Agreement. In the event any such adviser is engaged by the selected Bidder or Contractor, as the case may be, after issue of the LOA or execution of the Agreement for matters related or incidental to the project, then, notwithstanding anything to the contrary contained herein or in the LOA or the Agreement and without Prejudice to any other right or remedy or the Authority, including the forfeiture and appropriation of the Bid Security or Performance Security, as the case may be, which the Authority may have there under or otherwise, the LOA or the Agreement, as the case may be, shall be liable to be terminated without the Authority being liable in any manner whatsoever to the Selected Bidder or Contractor for the same. For the avoidance of doubt, this disqualification shall not apply where such adviser was engaged by the Bidder, its member, or Associate in the past, but its assignment expired or was terminated 6 (six) months before the date of issue of this Tender. Nor will this disqualification apply where such adviser is engaged after a period of 3 (three) years from the date of commercial operation of the Project.

#### **4.7.5. Rejection of Bids**

4.7.5.1 Notwithstanding anything contained in this RFP, the Authority reserves the right to reject any Bid and to annul the Bidding Process and reject all Bids at any time without any liability or any obligation for such acceptance, rejection, or annulment, and without assigning any reasons thereof. If the Authority rejects or annuls all the Bids, it may, in its discretion, invite all eligible Bidders to submit fresh Bids hereunder.

4.7.5.2 The Authority reserves the right not to proceed with the Bidding Process at any time, without notice or liability, and to reject any Bid without assigning any reasons.

**4.7.6. Performance Guarantee** The procedure for obtaining a Performance Guarantee is outlined below:

(a) The successful bidder shall have to submit a Performance Guarantee (PG), 5% of the contract value, within 21 (Twenty-one) days from the date of issue of the Letter of Acceptance (LOA). Extension of time for submission of PG beyond 21 (Twenty-one) days and up to 60 days from the date of issue of LOA may be given by the Authority that is competent to sign the contract agreement. However, a penal interest of 12% per

annum shall be charged for the delay beyond 21 (Twenty-one) days, i.e., from the 22nd day after the date of issue of the LOA. Further, if the 60th day happens to be a declared holiday in the concerned office of the SMPA, submission of PG can be accepted on the next working day. In all other cases, if the Contractor fails to submit the requisite PG even after 60 days from the date of issue of LOA, the contract is liable to be terminated. In case the contract is terminated by the SMPA shall be entitled to forfeit Bid Security and other dues payable to the contractor against that particular contract, subject to a maximum of PG amount. In case a tenderer has not submitted Bid Security on the strength of their registration as a Startup recognized by the Department of Industrial Policy and Promotion (DIPP) under the Ministry of Commerce and Industry, DIPP shall be informed to this effect.

The failed Contractor shall be debarred from participating in a re-tender for that work.

(b) The successful bidder shall submit the Performance Guarantee (PG) in any of the following forms, amounting to 5% of the original contract value: -

(i) A deposit of Cash;

(ii) Irrevocable Bank Guarantee;

(iii) Insurance Surety Bond as per Annexure-XII

(iv) Government Securities including State Loan Bonds at 5% below the market value;

(v) Pay Orders and Demand Drafts tendered by any Scheduled Commercial Bank of India;

(vi) Guarantee Bonds executed or Deposits Receipts tendered by any Scheduled Commercial Bank of India.

(vii) Deposit in the Post Office Savings Bank;

(viii) Deposit in the National Savings Certificates;

(ix) Twelve years of National Defence Certificates;

(x) Ten years Defence Deposits;

(xi) National Defence Bonds and

(xii) Unit Trust Certificates at 5% below market value or at the face value, whichever is less. Also, FDR in favour of FA&CAO (free from any encumbrance) may be accepted.

(c) The Performance Guarantee shall be submitted by the successful bidder after the Letter of Acceptance (LOA) has been issued, but before signing the contract agreement. This P.G. shall be initially valid up to the stipulated date of completion, plus 60 days beyond that. In case the time for completion of work gets extended, the Contractor shall get the validity of P.G. extended to cover such extended time for completion of work plus 60 days.

(d) The value of PG to be submitted by the Contractor is based on the original contract value and shall not change due to subsequent variation(s) in the original contract value.

(e) The Performance Guarantee (PG) shall be released after physical completion of the work based on the 'Completion Certificate' issued by the competent authority stating that the Contractor has completed the work in all respects satisfactorily.

(f) Whenever the contract is rescinded, the Performance Guarantee already submitted for the contract shall be encashed.

(g) The Engineer shall not make a claim under the Performance Guarantee except for amounts to which the SMPA is entitled under the contract (notwithstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

(i) Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer may claim the full amount of the Performance Guarantee.

(ii) Failure by the Contractor to pay SMPA any amount due, either as agreed by the Contractor or determined under any of the Clauses/Conditions of the Agreement, within 30 days of the service of notice to this effect by the Engineer.

(iii) The Contract being determined or rescinded due to any reason whatsoever.

**4.7.7. Security Deposit:** The Security Deposit shall be 5% of the contract value. The Bid Security submitted by the Contractor with his tender will be retained/encashed by the SMPA as part of security for the due and faithful fulfilment of the contract by the Contractor. Provided further that, if Contractor submits the Cash or Term Deposit Receipt issued from a Scheduled commercial bank of India or irrevocable Bank Guarantee Bond from a Scheduled commercial bank of India, either towards the Full Security Depositor, the Part Security Deposit equal to or more than Bid Security, the SMPA shall return the Bid Security to the Contractor. Balance of Security Deposit may be deposited by the Contractor in cash or Term Deposit Receipt issued from a Scheduled commercial bank of India or irrevocable Bank Guarantee bond issued from a Scheduled commercial bank of India, or may be recovered at the rate of 5% of the bill amount till the full Security Deposit is recovered. Provided also that in case of defaulting Contractor, the SMPA may retain any amount due for payment to the Contractor on the pending "on account bills" so that the amounts so retained (including amount guaranteed through Performance Guarantee) may not exceed 10% of the total value of the contract. The Irrevocable Bank Guarantee submitted towards the Security deposit shall be initially valid up to the stipulated date of the Maintenance period plus 60 days and shall be extended from time to time, if extension of contract period is granted by SMPA.

**Note:** Security Deposit deposited in cash by the Contractor or recovered from the running bills of a Contractor or submitted by the contractor as Term Deposit Receipt(s) can be refunded/returned to the contractor, instead of an irrevocable Bank Guarantee bond issued from a scheduled commercial bank of India, to be submitted by him, for an amount equal to or more than the already available Security Deposit, provided, however, that in a contract of value less than Rs. 50 Crore, such refund/ return of the already available Security Deposit is permitted up to two times and in a contract of value equal to or more than Rs. 50 Crore, such a refund/return of the already available Security Deposit is permitted up to three times.

**4.7.7 (i) Refund of Security Deposit:** Security Deposit mentioned in sub clause (1) above shall be returned to the Contractor along with or after the following:

(a) Final Payment of the Contract.

(b) Execution of Final Supplementary Agreement or Certification by Engineer that SMPA has No Claim on Contractor **and**

(c) Maintenance Certificate issued on expiry of the maintenance period.

**4.7.7 (ii) Forfeiture of Security Deposit:** Whenever the contract is rescinded as a whole or determined, the Security Deposit already with SMPA under the contract shall be forfeited.

**4.7.7 (iii) No** interest shall be payable upon the Bid Security and Security Deposit or amounts payable to the Contractor under the Contract, but Government Securities deposited in terms of Sub-Clause 4.7.6 (b) of this clause will be payable with interest accrued thereon.

#### **4.7.8 Accepted Programme of Work:**

The Contractor who has been awarded the work shall as soon as possible but not later than 30 days after the date of receipt of the acceptance letter have to submit the detailed programme of work indicating the time schedule of various items of works in the form of Bar Chart/PERT/CPM. He shall also submit the details of the organisation (in terms of labour and supervisors), plant and machinery that he intends to utilize (from time to time) for execution of the work within the stipulated date of completion. The programme of work amended as necessary by discussions with the Engineer, shall be treated as the agreed programme of the work for the purpose of this contract and the Contractor shall endeavour to fulfil this programme of work. The progress of work will be measured accordingly and the liquidated damages will be with reference to the overall completion date. Nothing stated herein shall preclude the Contractor in achieving earlier completion of item or whole of the works than indicated in the programme. The Contractor shall supply to the Engineer a 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. Each programme shall include a general description of the methods which the Contractor intends to adopt, and of the major stages, in the execution of the Works, and details showing the Contractor's reasonable estimate

for the number of each class of Contractor's Personnel & 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 Engineer shall be entitled to rely upon the programme when planning their activities. 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.

## 5. CHECK LIST FOR SUBMISSION OF TENDERS

List of the following documents (Scanned copy) which are to be submitted by the tenderer along with their offer, failing which the offer shall be summarily rejected.

Sl	Subject/Context	Required Documents/Form
1.	Earnest money/Bid security	Earnest money/Bid security. However, the original copy shall be physically deposited at the office of the Chief Engineer, Syama Prasad Mookerjee Port 6, Strand Road, Kolkata 700001, by the vendors/contractors within 3 working days after opening of the tender.
2.	Documents related to the Constitution of the Firm	
2(a)	In the case of a sole proprietorship concern	Undertaking may be given, if not given. If it is not mentioned in the submitted Tender is being submitted on behalf of a sole proprietorship firm/partnership firm/joint venture/registered company, etc., then the Tender shall be treated as having been submitted by the individual who has signed the tender.
2(b)	In case of a "Partnership Firm/Concern"	(i) A Notarized copy of the Partnership Deed or a copy of the Partnership Deed registered with the Registrar (ii) A notarized or registered copy of the Power of Attorney in favour of the individual to tender for the work, sign the agreement, etc., and create liability against the firm. An undertaking by all partners of the partnership firm that they are not blacklisted or debarred by the Port Authority or any other Ministry / Department of the Government of India from participation in tenders/contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP in which they were/are partners/members. Any Concealment / wrong information regarding the above shall make the bid ineligible, or the contract shall be determined.
2(c)	In case of a "Company"	Copies of the AOA / MOA (Article of Association/ Memorandum of Association) of the Company A copy of the certificate of incorporation. A copy of the Authorization/Power of Attorney issued by the Company (backed by the resolution of the Board of Directors) in favour of the individual to sign the tender on behalf of the company and create liability against the company.
2(d)	In case of a Registered Society & Registered Trust	A copy of the certificate of Registration. A copy of the Memorandum of Association of the Society/Trust Deed

		<p>A copy of the Power of Attorney in favour of the individual to sign the tender documents and create liability against the Society/ Trust.</p> <p>A copy of the Rules &amp; Regulations of the Society.</p>
2(e)	In the case of LLP	<p>A copy of the LLP Agreement,</p> <p>A copy of the certificate of incorporation; and</p> <p>(iii) A copy of the Power of Attorney/Authorization issued by the LLP in favour of the individual to sign the tender on behalf of the LLP and create liability against the LLP.</p> <p>(iv) An undertaking by all partners of the LLP that they are not blacklisted or debarred by the Port Authority or any other Ministry/Department of the Govt. of India from participation in tenders/contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP or JV in which they were/are partners/members. Concealment / wrong information regarding the above shall make the contract liable for determination.</p>
2(f)	In the case of a “JV firm”	<p>(i) A copy of the Memorandum of Understanding (MoU) duly executed by the JV members on a stamp paper shall be submitted by the JV along with the tender. The complete details of the members of the JV, their share and responsibility in the JV, etc., particularly with reference to financial, technical, and other obligations, shall be furnished in the MoU.</p> <p>(ii) Power of Attorney/authorization duly notarized by all JV constituents, in favour of the individual under whose digital signature key the tender document shall be uploaded on behalf of JV for signing the tender document on behalf of JV.</p>
2(f)(i)	In case one or more of the members of the JV Firm is/are Partnership Firm(s), the following documents shall be submitted:	<p>(i) A Notarized copy of the Partnership Deed or a copy of the Partnership Deed registered with the Registrar.</p> <p>(ii) A copy of the consent of all the partners or an individual authorized by the partnership firm, to enter into the Joint Venture Agreement on stamp paper.</p> <p>(iii) A notarized or registered copy of the Power of Attorney in favour of the individual to sign the MOU/JV Agreement on behalf of the partnership firm and create liability against the firm.</p> <p>(iv) An undertaking (as per format given in Annexure-X) by all partners of the partnership firm that they are not blacklisted or debarred by the Port Authority or any other Ministry/Department of the Govt. of India from participation in tenders/contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP in which they were/are partners/members. Any Concealment / wrong information regarding the above shall make the bid ineligible, or the contract shall be determined.</p>
2(f)(ii)	In case one or more of the members of the JV Firm is/are Proprietary Firm or HUF, the following documents shall be submitted:	<p>(i) A copy of notarized affidavit on Stamp Paper declaring that his Concern is a proprietary Concern and he is sole proprietor of the Concern OR he who is signing the affidavit on behalf of HUF is in the position of ‘Karta’ of Hindu Undivided Family (HUF) and he has the authority, power and consent given by other members to act on behalf of HUF.</p>

2(f)(iii)	In case one or more members of JV is/are Companies, the following documents shall be submitted:	<p>A copy of the resolutions of the Directors of the Company, permitting the company to enter into a JV agreement.</p> <p>The copies of the MOA (Memorandum of Association)/AOA (Articles of Association) of the company</p> <p>Copy of certificate of incorporation</p> <p>A copy of the Authorization/copy of Power of Attorney issued by the Company (backed by the resolution of the Board of Directors) in favour of the individual to sign the tender, sign the MOU/JV Agreement on behalf of the company, and create liability against the company.</p>
2(f)(iv)	In case one or more members of JV is/are LLP firm, the following documents shall be submitted/uploaded	<p>A copy of the LLP Agreement</p> <p>A copy of the Certificate of Incorporation of LLP</p> <p>A copy of resolution passed by partners of LLP firm, permitting the Firm to enter into a JV agreement</p> <p>A copy of Authorization /copy of Power of Attorney issued by the LLP firm (backed by resolution passed by the Partners) in favour of the individual, to sign the tender and/or sign the MOU/ JV agreement on behalf of the LLP and create liability against the LLP.</p> <p>An undertaking (as per format given in Annexure-13) by all partners of the LLP that they are not blacklisted or debarred by the Port Authority or any other Ministry/Department of the Govt. of India from participation in tenders / contracts as on the date of submission of bids, either in their individual capacity or in any firm/LLP or JV in which they were / are partners/members. Any Concealment / wrong information in regard to above shall make the contract liable for determination.</p>
3.	Power of attorney	<p>The tenderer whether sole proprietor/a company or a partnership firm / registered society / registered trust / HUF / LLP etc. if they want to act through agent or individual partner(s), should submit along with the tender, a copy of power of attorney duly stamped and authenticated by a Notary Public or by Magistrate in favour of the specific person whether he/they be partner(s) of the firm or any other person, specifically authorizing him/them to sign the tender, submit the tender and further to deal with the Tender/ Contract up to the stage of signing the agreement except in case where such specific person is authorized for above purposes through a provision made in the partnership deed / Memorandum of Understanding / Article of Association / Board resolution, failing which tender shall be summarily rejected.</p>
4.	<u>Technical Eligibility Criteria:</u>	All documents in support of the fulfilment of Technical Eligibility Criteria.
5.	<u>Financial Eligibility Criteria</u>	All documents in support of the fulfilment of Financial Eligibility Criteria, along with the Certificate issued by a Chartered Accountant.

6.	<b>Annexure-III &amp; XIX</b> of Tender Document. (Applicable for tender value more than Rs 20 crore)	All documents related to existing commitments and the balance amount of ongoing works, value of completed works/executed works, and payments received during the current and /or last three financial years immediately preceding the current financial year, up to the date of inviting of tender.
7.	<b>Annexure – XIV &amp; XV</b> of Chapter I of Tender Document (for partnership firm)	If tender submitted on behalf of a Partnership Firm.
8.	<b>Annexure- X &amp; XIII</b>	Certificate to be submitted by the tenderer along with the tender as per the proforma enclosed vide Annexure-X & XIII

In addition to above, scanned copy of the following documents are also to be enclosed along with the Tender:

- i) GST registration certificate.
- ii) Valid Trade License (applicable for the type of work). If this is not applicable, the bidder must submit an acceptable document in this regard.
- iii) Valid Professional Tax Clearance Certificate / Up-to-date tax payment challan. If this is not applicable, the bidder must submit an acceptable document in this regard.
- iv) Copy of EPF Registration Certificate.
- v) Copy of ESIC Registration Certificate.
- vi) Details of the firm as per **Annexure- XVI** of the tender document, duly filled up.
- vii) Last three years' balance sheet and profit & loss account in support of Annual Financial turnover (i.e., 2022 –2023, 2023-2024, and 2024-2025), the same should be audited as per relevant norms wherever required.
- viii) PAN Card.
- ix) Bank Draft/ Pay order, etc., regarding EMD & Cost of Tender documents/valid MSME NSIC certificate.
- x) A list of technically qualified and skilled persons would be engaged to supervise and execute the work, as per Annexure-XVII
- xi) Self-declaration of the bidder that the Bidding Firm has not been debarred/de-listed by any Govt/Quasi-Govt./Public Sector undertaking in India (to be submitted on the letterhead of the Firm) as per Annexure –XIII.
- xii) TDS certificate, including 26 AS, should essentially be submitted to validate the legitimacy of the work completion certificate.

**N.B.1:** The bidder will have to produce the original documents or any additional documents, if asked for, to satisfy the Authorities for clarification of their documents or credibility.

**N.B.-2:** Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements, and their EMD will be forfeited for such action.

## 6. Commercial Terms & Conditions

1	Mere participation in the e-tender will not mean that a particular bidder will be automatically considered qualified, and their bids will be entertained. Such a qualification will be reviewed at the time of techno-commercial evaluation of bids, also.
2	A copy of a valid NSIC Certificate or MSME Certificate under MSME has to be submitted along with the bid.
3	<b>Earnest Money/Bid Security and Security Deposit:</b> As per the tender Document
4	E-Tenderers submitted without the requisite Earnest Money/ Bid Security are liable to be rejected, except in case of Micro & Small Enterprises (MSEs) registered with NSIC (under the single point registration scheme) or MSME for items for which the tender is invited.
5	<b>Scope of Work:</b> As per E-Tender Document
6	The Terms and Conditions of E-Tender shall be read in conjunction with the General Conditions of Contract, Specifications, Bill of Quantities, and other documents forming part of this Contract wherever the Contract so requires.
7	The several documents forming the Contract shall be taken as mutually explanatory to each other, and in case of any discrepancies, the Bill of Quantities shall prevail over the Specifications and the Terms and Conditions over the General Conditions of Contract. In case of any dispute, question, or difference either during the execution of the Contract or any other time as to any matter or thing connected with or arising out of this Contract, the decision of the Chief Engineer, Syama Prasad Mookerjee Port, Kolkata, thereon shall be final and binding upon all parties.
8	The Contract will include the Client's Bid Documents with the General Conditions of Contract and the Bidder's Offer as finally accepted by the Client, together with Addenda, if there be any. The Board of SMPA's General Conditions of Contract is an integral part of the tender/contract. The above-mentioned General Conditions of Contract may be inspected at the office of the undersigned on any working day before quoting for the Tender.
9	The Board of SMPA is not bound to accept the lowest or any tender and reserves the right to accept a tender in full or in part and/or reject a tender in full or in part without assigning any reason thereof.
10	The contract shall be governed by all relevant Indian Acts applicable only within the jurisdiction of the High Court at Calcutta.
11	Intending bidders must take into account any cost or expense incurred by them in connection with the preparation and submission of their bids or for any other expenses incurred in connection with such bidding.
12	Bidders are advised to visit the site of work before submission of their bid. Bidder shall get himself thoroughly familiarized with the site conditions, existing road facilities, etc., before submission of the e-tender. He may contact the Chief Engineer/Superintending Engineer (NSD) or his authorized representative at his office at 6, Strand Road, Kolkata 700001 in this regard. Non-compliance with the same will in no way relieve the successful bidder of any of his obligations in performing the work in accordance with this Bid Document within the quoted price.
13	<b>Validity:</b> The tender shall remain open for acceptance for a period of <b>120 Days (4 Months)</b> from the date of opening the bid. If, before the expiry of this validity period, the Bidder amends his quoted rates or tender, making them unacceptable to the Board of SMPA and/or withdraws his tender, the Earnest Money/Bid Security deposited shall be liable to forfeiture at the option of the Board of SMPA / sanctioning Authority.

14	<b>Non-Responsive Bidder:</b> The offer/tender shall be treated as non-responsive if it:
	i) Is not accompanied by the requisite earnest money /valid NSIC Registration Certificate /MSME Registration Certificate.
	ii) Is not accompanied by the requisite tender paper cost / or valid NSIC/MSME Registration Certificate.
	iii) Validity of the offer is less than the tender stipulation,
	iv) Does not meet the Qualification Criteria as stipulated in the NIT.
	v) The bidder submits a conditional offer / imposes own terms and conditions / does not accept tender conditions completely, offer or tender if submitted with any deviation from the tender terms & conditions.
	In addition to the above, a bidder may be disqualified if –
	a) The bidder provides misleading or false information in the statements and documents submitted.
	b) Record of unsatisfactory performance during the last seven years, such as abandonment of work or rescinding of the contract, for which the reasons are attributable to the non-performance of the contractor or inordinate delays in completion, or financial bankruptcy, etc.
	The decision of Syama Prasad Mookerjee Port, Kolkata, in this regard shall be final and binding on the Bidder.
	Offer/tender is submitted with any deviation from the tender terms & conditions.
15	<b>Performance Guarantee:</b> 15.1. Within 30 (thirty) days of the issue of the LOA, the selected Bidder shall furnish to the Authority an irrevocable and unconditional guarantee from a Bank in the form set forth in the draft EPC Tender (the “Performance guarantee”) for an amount equal to 5% (five percent) of the accepted Bid value.
17	In the event of the successful bidder failing to execute the order within the stipulated delivery period without sufficient reasons acceptable to the Board of SMPA, the Performance guarantee as well as security deposit may be encashed and forfeited, and the order may be cancelled at the option of the Board of SMPA, apart from other actions.
18	<b>Prices:</b> As per the BOQ given in the tender document.
19	The bidder shall quote their price as per the Bill of Quantities in the Price bid
20	Orders may be placed in full or/part to the lowest bidder.
21	Prices (s) to be quoted should remain firm over the contract period.
22	The prices quoted shall include all statutory levies excluding GST, which shall be paid extra.
23	<b>Evaluation Criteria:</b> As per the relevant clause of the Tender document.
24	<b>Payment:</b> As per the Tender document.
25	<b>Location:</b> As per the Tender document.
26	<b>Time of Completion:</b> As per the Tender document.
27	Work is to be carried out as per the terms & conditions of the contract document.

28	<b>Price adjustment clause:</b> Not applicable.
29	<b>Technical capacity:</b> As stipulated in the Tender document.
30	<b>Financial capacity:</b> As stipulated in the Tender document.
31	<b>Dock Permits:</b> As per the tender document.
32	The bidder may offer a Bank Guarantee in the Board of SMPA' specified pro-forma from any Scheduled/ Nationalized Bank of India having Branch at Kolkata in lieu of Earnest Money /Security Deposit beyond Rupees 10 (Ten) lakhs.

**Besides the above conditions all other conditions as stated in the NIT, BOQ, Special Conditions of Contract, Instruction to the tenderers, and other components of the Tender Documents shall have to be agreed by the Bidders.**

Chief Engineer  
SYAMA PRASAD MOOKERJEE PORT, KOLKATA  
Tender Inviting Authority

## **7. EVALUATION OF TECHNICAL BIDS AND OPENING & EVALUATION OF FINANCIAL BIDS**

### **7.1. Evaluation of Technical Bids**

**7.1.1** The Authority shall open the Bids received online shortly after 15:00 hours. On 17.04.2026, at the place specified in the NIT, and in the presence of the Bidders who choose to attend. The Authority shall prepare minutes of the Bid opening, including information disclosed to those present at the time of Bid opening.

**7.1.2** Technical Bids of those Bidders who have not submitted their Bid online shall not be considered for opening and evaluation.

**7.1.3** If any information furnished by the Bidder is found to be incomplete or contained in formats other than those specified herein, the Authority may, in its sole discretion, exclude the relevant information for consideration of eligibility and Qualification of the Bidder.

**7.1.4** To facilitate the evaluation of Technical Bids, the Authority may, at its sole discretion, seek clarifications in writing from any Bidder regarding its Technical Bid. Such clarification(s) shall be provided within the time specified by the Authority for this purpose. Any request for clarification(s) and all clarification(s) in response thereto shall be in writing. The Bids will be examined and evaluated in accordance with the provisions set out in the Tender. The Authority will subsequently flag any issues with the data updated by the Bidders.

**7.1.5** If a Bidder does not provide clarifications sought above within the prescribed time, its Bid may be liable to be rejected. In case the Bid is not rejected, the Authority may proceed to evaluate the Bid by construing the particulars requiring clarification to the best of its understanding, and the Bidder shall be barred from subsequently questioning such interpretation of the Authority.

#### **7.1.6 Tests of responsiveness**

**7.1.6.1** As a first step towards evaluation of Technical Bids, the Authority shall determine whether each Technical Bid is responsive to the requirements of this Tender. A Technical Bid shall be considered responsive only if:

- (a) The Technical Bid is received online as per the Tender Documents, including all Annexures attached.
- (b) All Documents listed in the checklist are received physically within two weeks of the opening of the Tender.
- (c) The Technical Bid is accompanied by the Bid Security.
- (d) The Power of Attorney is uploaded on the e-procurement portal.
- (e) The Technical Bid is accompanied by a Power of Attorney for the Lead Member of the Consortium/Joint Venture and the Joint Bidding Agreement, as specified in Clause 4.1.6, if so required.
- (f) The Technical Bid contains all the information (complete in all respects).
- (g) The Technical Bid does not contain any condition or qualification. The Authority reserves the right to reject any Technical Bid which is non-responsive, and no request for alteration, modification, substitution, or withdrawal shall be entertained by the Authority in respect of such Bid.

**7.1.7** If a Bidder claims the Authority determines credit for an Eligible Project, and such a claim is incorrect, the Authority may reject/correct Such a claim for qualification requirements.

**7.1.8** The Authority will evaluate the Technical Bids for their compliance with the eligibility and qualification requirements pursuant to clause 2.2.1 of the Tender.

**7.1.9** After evaluation of Technical Bids, the Authority will publish a list of technically responsive Bidders whose Financial Bids shall be opened. The Authority shall notify other Bidders that they have not been technically responsive. The Authority will not entertain any query or clarification from Bidders who fail to qualify

### **7.2. Opening and Evaluation of Financial Bids**

The Authority shall inform the venue and time of the online opening of the Financial Bids to the technically responsive Bidders through the e-procurement portal and e-mail. The Authority shall open the online Financial Bids of the technically responsive Bidders only on the scheduled date and time in the presence of the authorised representatives of the Bidders who may choose to attend.

### **7.3. Selection of Bidder**

7.3.1. Subject to the provisions of Clause 4.7.5, the Bidder whose Bid is adjudged as responsive in terms of Clause 7.1.6, and who quotes the lowest price, shall be declared as the selected Bidder (the “**Selected Bidder**”).

7.3.2. If two or more Bidders quote the same Bid Price (the “**Tie Bids**”), the Authority shall identify the Selected Bidder by draw of lots, which shall be conducted, with prior notice, in the presence of the Tie Bidders who choose to attend.

7.3.3. If the Lowest Bidder is not selected for any reason except the reason mentioned in Clause 4.1.11 (e), the Authority shall annul the Bidding Process and invite Fresh Bids.

7.3.4. After selection, a Letter of Acceptance (the “**LOA**”) shall be issued by the Authority to the Selected Bidder, and the Selected Bidder shall, within 7 (seven) days after the issue of the LOA, acknowledge the receipt of the LOA. If the acknowledgement of the LOA is not received, and the original copy of the Joint Venture/Consortium Agreement is/or not received by the stipulated date, the Authority may, unless it consents to extension of time for submission thereof, appropriate the Bid Security of such Bidder as Damages on account of the failure of the Selected Bidder to acknowledge the LOA.

7.3.5. After acknowledgement of the LOA as aforesaid by the Selected Bidder, it shall cause the Bidder to submit Performance Security within the period prescribed/extended by Authority and then execute the Agreement within the period prescribed in Clause 3.3. The Selected Bidder shall not be entitled to seek any deviation, modification, or amendment in the Agreement.

7.3.6 The Bid security of other than selected Bidders shall be returned within 7 working days of the issue of the LOA. The Authority shall be responsible for returning the Bid Security, as above, and the Bidders shall not be required to ask for the same.

7.3.7 In case, Selected Bidder is a Consortium, then the Selected Bidder has to deposit the original copy of the Consortium Agreement duly registered as per the prevailing Law within 45 days of the receipt of the LOA.

7.3.8 In case, Selected Bidder is a Joint Venture, then on issue of LOA, the Joint Venture Agreement between members of the Joint Venture to whom work has been awarded, with the same shareholding pattern as was declared in the Joint bidding agreement document submitted along with the offer shall be registered before the Registrar/Sub-Registrar under “The Indian Companies Act-2013 (in case of the Company) or before the Registrar/Sub-Registrar under the “The Indian Partnership Act-1932 (in case of Partnership firm) or under LLP Act-2008 (in case of LLP) and deposit the original copy of the Joint Venture Agreement within 45 days of the receipt of the LOA to the Authority.

### **7.4. Contacts during Bid Evaluation**

Bids shall be deemed to be under consideration immediately after they are opened and until such time the Authority makes official intimation of award/ rejection to the Bidders. While the Bids are under consideration, Bidders and/ or their representatives or other interested parties are advised to refrain, save and except as required under the Bidding Documents, from contacting by any means the Authority and/ or their employees/ representatives on matters related to the Bids under consideration.

### **7.5. Correspondence with Bidder**

Save and except as provided in this Tender, the Authority shall not entertain any correspondence with any Bidder in relation to the acceptance or rejection of any Bid.

**7.6.** Any information contained in the Bid shall not in any way be construed as binding on the Authority, its agents, successors, or assigns, but shall be binding against the Bidder if the project is subsequently awarded to it based on such information.

## 7.7 Bid Security

7.7.1. The Bidder shall furnish as part of its Bid a Bid Security as specified in the Tender or submitted as a Bank Guarantee Bond from a scheduled commercial bank of India. A scanned copy of the paper security/ Bank Guarantee shall be uploaded on the specified portal while submitting the offer against the tender.

7.7.2. Any Bid not accompanied by the Bid Security shall be summarily rejected by the Authority as non-responsive.

7.7.3. The Selected Bidder's Bid Security will be returned, without any interest, upon the Bidder signing the Contract Agreement and furnishing the Performance Guarantee/ Security in accordance with the provisions thereof. The Authority may, at the Selected Bidder's option, adjust the amount of Bid Security in the amount of Performance Guarantee to be provided by him in accordance with the provisions of the Tender/Contract.

7.7.4. The Authority shall be entitled to forfeit and appropriate the Bid Security as damages inter alia in any of the events specified herein below. The Bidder, by submitting its Bid pursuant to this Tender, shall be deemed to have acknowledged and confirmed that the Authority will suffer loss and damage on account of withdrawal of its Bid or for any other default by the Bidder during the period of Bid validity as specified in this Tender. No relaxation of any kind on the Bid Security shall be given to any Bidder.

7.7.5. The Bid Security shall be forfeited and appropriated by the Authority as damages payable to the Authority for, inter alia, time cost and effort of the Authority without prejudice to any other right or remedy that may be available to the Authority under the Bidding documents and/or under the Agreement, or otherwise, under the following conditions:

- (a) If a Bidder engages in a corrupt practice, fraudulent practice, coercive practice, undesirable practice, or restrictive practice as specified in this Tender;
- (b) If a Bidder withdraws its Bid during the period of Bid validity as specified in this Tender and as extended by mutual consent of the respective Bidder(s) and the Authority;
- (c) In the case of the Selected Bidder, if it fails within the specified/extended time limit by the Authority
  - (i) to sign and acknowledge the receipt of the LOA.
  - (ii) to furnish the Performance Guarantee as specified in the Tender; or
  - (iii) to sign the EPC Agreement within 07 working Days on receipt of its readiness from The Authority;

7.7.6. In case, submission of Bid Security in the form of Bank Guarantee, the following shall be ensured:

I. A scanned copy of the Bank Guarantee shall be uploaded on the specified Portal while applying to the tender.

II. The original Bank Guarantee should be delivered in person to the official nominated as indicated in the tender document within 3 working days after the opening of bids.

III. non-submission of a scanned copy of the Bank Guarantee with the bid on the nominated portal and/or non-submission of the original Bank Guarantee within the specified period shall lead to summary rejection of the bid.

IV. The Bid Security shall remain valid for a period of 90 days beyond the Bid validity period for the Tender.

V. The details of the BG, physically submitted, should match the details available in the scanned copy and the data entered during the bid submission time, failing which the bid will be rejected.

VI. The Bank Guarantee shall be placed in an envelope, which shall be sealed. The envelope shall clearly bear the identification "Bid for the Project" and shall clearly indicate the name and address of the Bidder. In addition, the Bid Due Date should be indicated on the right-hand top corner of the envelope.

VII. The envelope shall be addressed to the officer, and the address as mentioned in the tender document.

VIII. If the envelope is not sealed and marked as instructed above. The Authority assumes no responsibility for the misplacement or premature opening of the contents of the Bid submitted and consequent losses, if any, suffered by the Bidder.

## 8. FRAUD AND CORRUPT PRACTICES

8.1. The Bidders and their respective officers, employees, agents, and advisers shall observe the highest standard of ethics during the Bidding Process and the issue of the LOA, and during the subsistence of the Agreement. Notwithstanding anything to the contrary contained herein, or in the LOA or the Agreement, the Authority may reject a Bid, withdraw the LOA, or terminate the Agreement, as the case may be, without being liable in any manner whatsoever to the Bidder, if it determines that the Bidder, directly or indirectly or through an agent, engaged in corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice in the Bidding Process. In such an event, the Authority shall be entitled to forfeit and appropriate the Bid Security or Performance Security, as the case may be, as Damages, without prejudice to any other right or remedy that may be available to the Authority under the Bidding Documents and/ or the Agreement, or otherwise.

8.2. Without prejudice to the rights of the Authority under Clause 8.1 hereinabove and the rights and remedies which the Authority may have under the LOA or the Agreement, or otherwise, if a Bidder or Contractor, as the case may be, is found by the Authority to have directly or indirectly, or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice, or restrictive practice during the Bidding Process, or after the issue of the LOA or the execution of the Agreement, such Bidder shall not be eligible to participate in any tender issued by the Authority during a period of 2 (two) years from the date such Bidder, or Contractor, as the case may be, is found by the Authority to have directly or indirectly, or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practices, as the case may be.

8.3. For this Section, the following terms shall have the meaning hereinafter respectively assigned to them:

- (a) "corrupt practice" means (i) the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the actions of any person connected with the Bidding Process (for avoidance of doubt, offering of employment to, or employing, or engaging in any manner whatsoever, directly or indirectly, any official of the Authority who is or has been associated in any manner, directly or indirectly, with the Bidding Process or the LOA, or has dealt with matters concerning the EPC Contract or arising therefrom, before or after the execution thereof, at any time before the expiry of one year from the date such official resigns or retires from or otherwise ceases to be in the service of the Authority, shall be deemed to constitute influencing the actions of a person connected with the Bidding Process); or (ii) save and except as permitted under Clause 4.7.4, engaging in any manner whatsoever, whether during the Bidding Process or after the issue of the LOA or after the execution of the EPC Contract, as the case may be, any person in respect of any matter relating to the Project or the LOA or the EPC Contract, who at any time has been or is a legal, financial or technical adviser of the Authority in relation to any matter concerning the Project;
- (b) "fraudulent practice" means a misrepresentation or omission of facts or suppression of facts or disclosure of incomplete facts, to influence the Bidding Process;
- (c) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any person or property to influence any person's participation or action in the Bidding Process;
- (d) "undesirable practice" means (i) establishing contact with any person connected with or employed or engaged by the Authority with the objective of canvassing, lobbying, or in any manner influencing or attempting to influence the Bidding Process; or (ii) having a Conflict of Interest; and
- (e) "restrictive practice" means forming a cartel or arriving at any understanding or arrangement among Bidders to restrict or manipulate a full and fair competition in the Bidding Process.

## **9. MISCELLANEOUS**

9.1. The Bidding Process shall be governed by, and construed in accordance with, the Laws of India shall have exclusive jurisdiction over all disputes arising under, pursuant to, and/ or in connection with the Bidding Process.

9.2. The Authority, in its sole discretion and without incurring any obligation or liability, reserves the right, at any time, to;

- (a) suspend and/ or cancel the Bidding Process and/ or amend and/ or supplement the Bidding Process or modify the dates or other terms and conditions relating thereto;
- (b) consult with any Bidder to receive clarification or further information;
- (c) retain any information and/ or evidence submitted to the Authority by, on behalf of, and/ or in relation to any Bidder; and/or
- (d) independently verify, disqualify, reject, and/or accept any submissions or other information and/ or evidence submitted by or on behalf of any Bidder.

9.3. It shall be deemed that by submitting the Bid, the Bidder agrees and releases the Authority, its employees, agents, and advisers, irrevocably, unconditionally, fully and finally, from any liability for claims, losses, damages, costs, expenses, or liabilities in any way related to or arising from the exercise of any rights and/ or performance of any obligations hereunder, pursuant to hereto and/ or in connection with the Bidding Process and waives, to the fullest extent permitted by applicable laws, any rights and/or claims it may have in this respect, whether actual or contingent, whether present or in the future.

## 10. Special Conditions of Contract (SCC)

### **Name of Work– FOR “Engineering, Procurement and Construction tender for Development of (off Dock) Container Stacking Yard at Loco Shed Area, Sonapore Road, Kolkata – Syama Prasad Mookerjee Port, Kolkata”**

#### **10.1. General:**

These provisions are part of the tender documents, which must be read as a whole, the various sections being complementary to one another and are to be taken as mutually explanatory. These provisions shall be read in conjunction with the other parts of the tender documents, viz., Notice Inviting Tenders, and Instructions to Bidder, Particular specifications, Drawings, Bill of Quantities, and other documents forming part of the Contract. In case of any discrepancy or ambiguity in the documents, the order of precedence of the documents as stated below will apply. In particular, these provisions will override those in the other Conditions, provided there is a discrepancy between them.

#### **10.2. Correlation and order of precedence of tender documents:**

If the stipulations in the various tender documents are found to be at variance in any respect, one will override others (but only to the extent these are at variance) in the order of precedence as given in the list below, i.e., any particular item in the list will take precedence over all those placed lower down in the list.

- a) Order letter/ Letter of Acceptance (LOA)
- b) Bill of Quantities.
- c) Specifications of work.
- d) Special Conditions of Contract.
- e) Specifications & Drawings.

In case of any dispute, question, or difference either during the execution of the work or any other time as to any matter or thing connected with or arising out of this Contract, the decision of the Chief Engineer, Syama Prasad Mookerjee Port, Kolkata, thereon shall be final and binding upon all parties.

The execution of work shall conform minutely to the approved & assigned drawings & specification & any other details drawings which shall be provided /duly approved by the Engineer during the progress of the work, as to such other drawings that have formed part of the contract documents.

#### **10.3. Deleted.**

#### **10.4. Scope of Work:**

The main scope of work is as follows:

- (i) Site Grading,
- (ii) Off-Dock Container Yard Development,
- (iii) Office Building, Rest Shelter, Equipment Shed, & Repairing Yard,
- (iv) DG Room,
- (v) Common Toilet Block and Shower Facilities.
- (vi) Security Office and Gate House Complex.
- (vii) Water Supply Works,
- (viii) Storm Water Drainage,
- (ix) Sewerage System,
- (x) Boundary Wall,
- (xi) Fire FIGHTING System,

- (xii) CCTV Camera, RFID, Boom Barrier, and COMMUNICATION,
- (xiii) Power Distribution, Lighting, and Communication work.
- (xiv) Internal Road Facilities and
- (xv) Required Design and Drawing as well as working drawings for all the above work.

**10.5. Location: Sonapore Road, Syama Prasad Mookerjee Port, Kolkata.**

**10.6. Access to the site:**

- (a) By Road: Hide Road , approachable from C.G.R. Road / Taratala Road.
- (b) By Rail: Khidderpore on Circular Railway and Bracebridge on Eastern Railway.

**10.7. Work Site: Locoshade area at Sonapore Road**

**10.8. Inspection of Site:**

The Bidder shall inspect the site of work and thoroughly familiarise himself with the nature of work, site conditions, and access to the site and location before submission of the tender. He should contact the Superintending Engineer (Contract) at his office at 6 , Strand Road for collecting information about the site before submission of the tender. No excuse will be entertained afterwards on the above ground. In case any part of the site cannot be handed over to the successful Bidder in time, no compensation for loss of labour or any other cause, nor any claim will be entertained by the Board. Suitable extension of time shall, however, be granted to the successful Bidder on that ground if applied for.

**10.9. Site conditions & Method of Work:**

As this is an EPC Contract, the bidder shall be responsible for thoroughly reviewing all requirements and ensuring execution of the same from Engineering to Commissioning within the stipulated time. Further, if so, required by the Engineer in the interests of normal working of the Port, if it is found necessary to shift/suspend some construction activity for some duration, this shall be done in compliance with the instructions of the Engineer and as per the prevailing rules in vogue. The bidder shall consider all the above points while quoting, as no separate claim for idle charges towards labour, material, Equipment, machinery, etc, will be considered for payment.

Proper care should be taken to provide adequate protection to the existing structures and cables (COMMUNICATION, computer, etc), all such installations against any damage at the Contractor's risk and expense. Any damage/defect to existing structures arising due to the faulty execution of the work shall have to be rectified forthwith as directed to the satisfaction of the Engineer, without charging any extra.

**10.10. Time of Completion:**

The work is to commence as per the instructions from the SE (NSD) on receipt of the work order/LOA and to be executed within a period of 18 (Eighteen) Months, (including mobilisation time) from the date of placement of the work order/LOA.

**10.11. Accessibility for Checking and Supervision:**

The engaged Contractor is to provide necessary arrangements for free access to the SMPK officers and personnel for supervision and checking of the subject work at his own cost.

**10.12. Responsibility of the Contractor for the methodology of works:**

As this is an EPC Contract, the bidder shall be responsible for thoroughly reviewing all requirements and ensuring execution of the same from Engineering to Commissioning within the stipulated time.

**10.13. Temporary Works:**

The successful tenderer shall be allowed space, if available, to provide shed for labour and materials required for the construction and removal of all temporary works, e.g. site office, site store, scaffolding, fencing lighting; watching, tube well and pipe lines etc. required for constructional purpose as well as for drinking water purpose of contractor's men, water supply, vats, platform, etc. as may be necessary for the successful execution, completion and maintenance of works without any extra cost to the Board of SMPA and the rates should be quoted accordingly. No rent shall, however, be charged to the contractor for the construction/erection of such temporary sheds and structures.

**10.14. Plant & Constructional Equipment:**

The contractor shall supply his tools, plants, and construction equipment within his quoted rates. A list of plants as intended to be employed by the tenderers in this construction must be furnished with full details along with the tender.

**10.15. Contract Price:**

The "Contract Price" for this contract means the sum agreed by both parties against the tender, subject to such additions thereto, deductions there from or reductions due to the supply of any materials by the Board of SMPA as provided for in the Contract.

**10.16. Particulars Of Existing Works:**

Such information as may be given in the specification as to the existing features and works other than those now under construction as part of "Syama Prasad Mookerjee Port, Kolkata" is given without warranty of accuracy, and neither the Board of SMPA nor the Engineer will be liable for any discrepancies therein.

**10.17. Safety Measures:**

The contractor shall adhere to safe construction practices, guard against hazardous and unsafe working conditions, and follow all safety precautions for the prevention of injury or accidents and safeguarding life and property. The contractor shall comply with relevant provisions of the Dock Workers (Safety, Health and Welfare) Act 1986 and Dock Workers (Safety, Health and Welfare) Regulation 1990, and the Safety Officer of the Board of SMPA or Safety Inspectors shall be afforded all facilities for inspection of the works, tools, plant, machinery, equipment, etc., wherever so required. The contractor shall further comply with any instruction issued by the Engineer, Board of SMPA's Safety Officer, Safety Inspector, regarding safety which may relate to temporary, enabling or permanent works, working of tools, plants, machinery, equipment, means of access or any other aspect. The contractor shall provide all necessary first aid measures, rescue, and lifesaving equipment to be available in proper condition.

The contractor shall provide PPE's (Personal Protective Equipment) such as, helmet, safety shoe etc. to all workers and shall also provide job specific PPE's e.g. safety belts for working at heights; protective face and eye shield, goggles, hand gloves for welding/gas cutting works; protective foot wear and gloves for hot works; facemasks, gloves and overalls for painting works, mixing and handling materials etc, as directed by the Engineer.

All safety rules shall be strictly followed while working on live electrical systems or installations as stipulated in the relevant safety codes. Use of hoisting machines and tackles, including their attachments, construction tools, machinery, and equipment, shall comply with the relevant safety codes.

The successful bidder shall also ensure that –

(i) No damage is caused to plants and vegetation unless the same is required for the execution of the project properly.

(ii) The work shall not pollute any source of water/land/air surrounding the work site to adversely affect the quality or appearance thereof or cause injury or death to animal and plant life. His office & labour hutment, etc., shall be maintained in a clean and hygienic condition throughout the period of their use, and different effluents of the labour hutment shall have to be disposed of suitably.

(III) Necessary clearance/NOC to be obtained by the Contractor from the Statutory Authorities for various activities like Fire protection, weigh bridge, pollution control Board, KMC, etc.

(iv) Handing over of all Manuals, guarantees, and warranty certificates issued by the manufacturers for all the equipment installed for the successful completion of the Project, etc, to the Engineer.

#### **10.18. Holiday or Sunday Work:**

Subject to provisions in local Acts and any statutes of the State, the Contractor shall arrange for working on Holidays and Sundays whenever so desired by the Engineer to expedite progress and complete the works in time.

The Contractor shall not be entitled to any additional payment for taking up work on Holidays and Sundays. The Contractor should be prepared to resort to round-the-clock working by following shift timings for labour.

#### **10.19. Power Supply:**

If available and if required, a suitable power supply may be arranged by the Board of SMPA at the nearest existing supply point of the site of work on receipt of a request letter from the Contractor to that effect. All necessary arrangements for the distribution at the site will have to be made by the Contractor at his own cost as approved by the Board of SMPA's Engineer or his representative. Charges for consumption of power shall be periodically recovered from the Contractor's Bill at the rates of SMPK as amended from time to time, including installation and hire charges for meters. The Board of SMPA does not guarantee uninterrupted power supply from the above sources, and Contractor shall not be compensated for any delay in providing / irregularity of power supply. The Contractor shall have to arrange for the supply of power at his own cost during such periods.

#### **10.20. Water:**

The Contractor will arrange for the supply of water both for drinking and for work purposes. However, on written request from the Contractor, water may be made available from the existing water line of the Board of SMPA at a point near the site of work. The contractor will have to arrange for laying temporary pipelines, as necessary, as per approval of the Engineer or his representative, for storing and distributing the same to the work point at his own cost. For such supply of water from the SMPK source, an amount @ 1.00 % (one percent) of the gross bill value shall be recovered from the contractor.

#### **10.21. Keeping the site and working area clear:**

The Contractor shall at all times keep the site and working areas free from all surplus materials, rubbish, and offensive matter, all of which shall be disposed of in a manner to be approved by the Engineer's Representative.

#### **10.22. Protection of existing services:**

The contractor must pay full attention to the fact that the existing service facilities for users are not disturbed at any time due to the storage of materials, rubbish, any other activities, etc, and take every precaution to keep the entrance passage clear if the same are being used by the labourers. The contractor shall be held liable for all damage and interference to the existing service caused by him in the execution of works. Should any damage be done to the existing services, in general, the contractor shall make good the same and any further work considered necessary by the Engineer's representative without any delay; otherwise, the cost of such repairing shall be recovered for his running bill, for which the Engineer's decision shall be final and binding.

**10.23. Cleaning during execution and after completion:**

On completion of the works, the contractor shall reinstate and make good at his own expense any property or land which might have been disturbed and/or damaged by his works. He should also clean the site as required during execution and fully clear the site after completion of all the works. The contractor shall forward any usable materials found during the course of construction at the work site or its vicinity to SMPK stores/yards, dispose off the debris beyond the port area all at his own expenses by his own transport and clean out all part of the work and leave everything clean and tidy to the entire satisfaction of the Engineer, failing which suitable deduction will be made from final bill as per discretion of the Engineer/Engineer's representative.

**10.24. Method of Measurement:**

Unless otherwise specified in the Bill of Quantities, the work shall be measured in accordance with the relevant IS Specification.

**10. 25. On account Payment:**

On account payment to the Contractor shall be arranged as and when required at the discretion of the Engineer based on measurements of completed works at the agreed rates in the Bill of Quantities. The terms of payment shall be in accordance with the Payment Schedule of the Tender. The Bills should be submitted by the contractor in quadruplicate to the Office of the respective Superintending Engineer (NSD) with the necessary documents in original. Subject to the availability and feasibility of the system, SMPK may make payment directly to the contractor's designated Bank account. For this purpose, the contractor will have to indicate (i) the name of the bank, (ii) the branch name, (iii) the branch code, and (iv) the designated account number, including ISFC Code as per the enclosed Format. In case payment is made directly through the bank, the contractor may be required to submit a pre-receipt as per the instructions of SMPK.

For any bill, the non-GST part of the bill shall be paid first, and after payment of the GST component, the same shall be reimbursed on compliance with the requirements as per the GST rule.

FORMAT FOR SUBMISSION OF DETAILS FOR DIRECT PAYMENT TO BANK

- (i) Name and Address of the contractor:
- (ii) MICR Code of Bank:
- (iii) Bank Name:
- (iv) Branch Name:
- (v) Bank Address:
- (vi) Bank Account No:
- (vii) Type of Account:
- (viii) ISFC Code:

A xerox copy of the cheque/cancelled cheque shall be attached

Enclosed: As stated above.

Confirmation by the Bank

**10.26. Labor, Tools & Plants:**

The Contractor shall arrange all necessary labour, tools, and plants required for satisfactory execution of the work to achieve steady progress of work.

**10.27. Escalation/ Variation on Prices:**

No price escalation/price variation on the quoted and accepted prices on any account will be considered for adjustment/payment, i.e, it is a fixed price contract

**10.28. Contract Labor Laws:**

The contractor shall be required to comply with the Minimum Wages Act 1948, the Employees Liability Act, 1938, Industrial Disputes Act, 1947, and the Contract Labour (Regulation and Abolition) Act, 1970, or statutory amendments and the modifications thereof, any other laws relating thereto, and the rules made thereunder from time to time. Payment to the labourers to be made as per the minimum wage rates fixed by the Chief Labour Commissioner (Central) and as per M.W.A. Govt. of W.B., whichever is higher, and revision from time to time.

It will be the duty of the contractor to abide by the provisions of the Act. Ordinances, Rules, Regulations, Byelaws, and Procedures as are lawfully necessary in the execution of the works. The contractor will be fully responsible for any delay/damage, etc., and keep the Engineer indemnified against all penalties and liabilities of any kind for noncompliance or infringement of such Acts, Ordinances, Rules, Regulations, By-laws and Procedures. The Contractor shall comply with the Employees' Bonus rules & pay Bonus once a year to his workmen accordingly, for which no extra payment shall be made to the Contractor.

The contractor shall indemnify the SMPK against payment to be made under or for the observance of the laws aforesaid, without prejudice to his right to claim indemnity from his subcontractor. The aforesaid regulations shall be deemed to be a part of this contract, and any breach thereof shall be deemed to be a Breach of Contract. It will be obligatory on the part of the Contractor to obtain the necessary Labour Licence from the Competent Authority for deploying the requisite Nos of labourers in the work and submit to the Engineer-In-Charge before commencement of the work. The contractor shall also be required to comply with the 'Workmen's Compensation Act, 1923, as amended by Amendment Act No.65 of 1976'

In addition to the above, the Personal Injuries (Compensation Insurance) Act, 1963, and any modifications thereof, and rules made thereunder from time to time. The contractor shall take into account all the above-mentioned financial liabilities in his quoted rates, and nothing extra, whatsoever, shall be payable to him on this account.

The Contractor shall indicate the maximum number of workmen to be engaged on any day for execution of the work in the appropriate place to the Engineer & he shall have to obtain a regular /permanent license as per Section 12 (1) of the Contract Labour Act. Further, whenever a contract work has commenced or completed, the contractor has to intimate the same to the Assistant Labour Commissioner (Central) /Labour Enforcement Officer (Central) in Form IV-A within 15 days of such commencement or completion. The contractor has to arrange for displaying the name of the Regional Labour Commissioner (Central), Asst. Labour Commissioner (Central) & Labour Enforcement Officer (Central) at his worksite(s). The contractor

shall inform the Principal Employer of the date, time & venue of disbursement to be made by him to his workers.

The successful bidder shall also be required to put up a notice at the site of work mentioning the date, time & venue of disbursement to be made by him to his workers, and he or his authorized representative shall have to be present during the period of disbursement.

**10.29. Compliance with EPF & MP ACT & ESI ACT 1948:**

The successful contractor will have to comply with the provisions of the EPF & MP Act 1952 and also with the Employees State Insurance Act 1948 (along with amendments, if any), issued from time to time as applicable. If asked for by the Employer, the contractor will be required to submit a photocopy of all payment challans and produce the original for verification to the representative of the principal employer, i.e., Superintending Engineer (NSD). The rate quoted by the bidder must include providing Minimum wage and Bonus as per the prevailing laws and provisions of EPF & ESI, as per the prevailing Laws to all the workers engaged through the contract within the stipulated date of disbursement as per applicable rules. The rates in the BOQ do not include EPF, ESI, and Bonus components, and the BOQ rates were estimated in 2022.

**10.30. Indemnification:** The successful bidder shall be deemed to indemnify and keep indemnified the Board of SMPA from and against all actions, claims, demands, and liabilities whatsoever under and in respect of the breach of any of the provisions of any law, rules, or regulations having the force of law, including but not limited to –

- a) The Minimum Wages Act, 1948.
- b) The Dock Workers (Regulation of Employment) Act, 1948
- c) The Building and Other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996
- d) The Dock Workers' Safety, Health & Welfare Act, 1986
- e) The Payment of Wages Act, 1936.
- f) The Workmen's Compensation Act, 1923.
- g) The Employees Provident Fund Act, 1952.
- h) The Contract Labor (Regulation and Abolition) Act, 1970; Rules 1971.
- i) The Equal Remuneration Act, 1976.
- j) The Employees' State Insurance Act, 1948 & Employees State Insurance (Amendment) Act, 1989
- k) Child Labor (Prohibition and Regulation) Act, 1986.
- l) The Maternity Benefits Act 1961
- m) Interstate Migrant Workmen (Regulation of Employment & Conditions of Service) Act, 1979.
- n) Motor Vehicle Act, latest revision.
- o) The payment of Bonus Act, 1965.

**10.31. Taxes & Duties:**

The prices quoted shall include all statutory levies excluding GST, which shall be paid extra. Supplier/service provider to confirm that the GST amount charged in the invoice is declared in its returns and that payment of taxes is also made.

The Supplier/ Service Provider agrees to comply with all applicable GST laws, including GST acts, rules, regulations, procedures, circulars & instructions thereunder applicable in India from time to time and to ensure that such compliance is done within the time prescribed under such laws.

Supplier/Service Provider should ensure that accurate transaction details, as required by GST laws, are timely uploaded to the GSTN. In case there is any mismatch between the details so uploaded in GSTN by

Supplier/ Service Provider and details available with Syama Prasad Mookerjee Port, Kolkata, then payments to Supplier/Service Provider to the extent of GST relating to the invoices/s under mismatch may be retained from due payments till such time Syama Prasad Mookerjee Port, Kolkata is not sure that accurate tax amount is finally reflected in the GSTN to SMPK's Account and is finally available to Syama Prasad Mookerjee Port, Kolkata in terms of GST laws and that the credit of GST so taken by Syama Prasad Mookerjee Port, Kolkata is not required to be reversed at a later date along with applicable interest.

Syama Prasad Mookerjee Port, Kolkata, has the right to recover monetary loss, including interest and penalty suffered by it due to any non-compliance of tax laws by the supplier/service provider. Any loss of input tax credit to Syama Prasad Mookerjee Port, Kolkata, for the fault of the supplier shall be recovered by Syama Prasad Mookerjee Port, Kolkata, by way of adjustment in the consideration payable.

Supplementary invoices/Debit note/credit note for price revisions to enable Syama Prasad Mookerjee Port, Kolkata, to claim tax benefit on the same shall be issued by the bidder for a particular year before September of the succeeding Financial Year.

The purchase order/ work order shall be void if at any point in time the bidder is found to be a blacklisted dealer as per the GSTN rating system, and further, no payment shall be entertained.

#### **10.32. Settlement of Disputes:**

If a dispute of any kind whatsoever arises between the Employer and the Contractor in connection with or arising out of the contract or the execution of the works, the same shall be dealt with as per the relevant provisions of the Arbitration and Conciliation Act.

#### **10.33. Contractor to execute Contract Agreement:**

The bidder, after acceptance of his tender, shall be required to enter into and execute a Contract Agreement to be prepared in the specified form together with such modifications as may be necessary within one month from the date of placement of the order. The contractor shall have to submit copies in quadruplicate of all documents, correspondence, connected papers, etc., as detailed in the above form of Contract Agreement/Tender, together with the instrument of Contract Agreement prepared on non-judicial stamped paper of requisite denomination, having three more copies made on plain paper, all at his own cost. The successful tenderer shall have to submit four sets of such Contract Agreement duly executed, sealed, signed, and witnessed for execution by the Board of SMPA. The other three sets shall be completed in all respects but not signed. If the successful tenderer or tenderers are a partnership concern, they will have to get the Agreement signed by all the partners or by the partner who is authorized to sign for and on behalf of the other partners. The contractor shall also comply with the requirements of the Security Deposit for the due fulfillment of the contract. The blank proforma of tender documents shall be supplied to the successful tenderer free of charge for preparing the documents of the aforesaid Contract Agreement. The successful tenderer shall have to copy out and prepare the documents of the Contract Agreement neatly and correctly. The necessary amendments, corrections, etc. (if any) have to be done at his own cost.

#### **10.34. Calcutta Port Trust / Kolkata Port Trust :**

The expression "Calcutta Port Trust/ KOLKATA PORT TRUST" appearing anywhere in the tender documents shall be construed to read as "SYAMA PRASAD MOOKERJEE PORT, KOLKATA".

**10.35. Clarification of Bids:**

To assist in the examination and comparison of Tenders, the Employer may, at his discretion, ask any Tenderer for clarification of his Tender, including breakup/analysis of unit rates. Any request for clarification by the SMPA and the correspondence thereon shall be made in writing. No change in the price or substance of the Tender shall be sought, offered, or permitted except to the extent necessary to correct arithmetic errors identified by the SMPA during the evaluation of the Tenders. No Tenderer shall contact the SMPA on any matter relating to their Tender from the time of the Tender opening to the time the contract is awarded. If the Tenderer wishes to bring additional information to the notice of the Employer, he should do so in writing.

Any effort by the Tenderer to influence the SMPA's Tender evaluation, Tender comparison, or contract award decisions may result in the rejection of his Tender.

**10.36. Disparity in quoted rate/amount.**

If there is any disparity between the quoted rate in percentage and the Tender Amount, the rate quoted in percentage shall prevail as the rate quoted by the tenderer, and the Tender Amount shall be derived by adding/subtracting (as the case may be) this percentage from the Estimated Value put to tender. Similarly, in case of disparity between the rate quoted in figures and in words, the rate quoted in words shall prevail.

**10.37. Dock Permit:**

For works inside the Docks, a Dock permit is required for men, materials, vehicles, and equipment, etc. are to be procured by the successful tenderer at the cost as per the recommendation of the executing departments/divisions, indicating the specific number of permits to be issued. But for the creation of individual IDs in the permit system, a charge as applicable will be levied per person (one time) even for companies/ Individuals who have been granted permission to obtain permits by SMPK. In case the work has to be carried out in an operational zone, the tenderer should keep in mind that the work is to be executed without hampering the operational activities and should complete the work within the stipulated time specified in the tender. All the costs, if any, are to be borne by the contractor for the above Permits & IDs.

**10.38. Working Period:**

Normally, the work will be carried out between 8 A.M. to 5 P.M. on the Board of SMPA's working days only. However, the tenderer should note that he might be required to carry out the job on Sundays, holidays, and after normal working hours, and at night, in addition to the normal working hours, to expedite the progress of the work if permitted by the Competent Authority. The tenderer should include in his rates the cost, if any, involved in those accounts.

**10.39. Bank Guarantee instead of Cash Security Deposit:**

Security deposit shall be recovered from the on A/C. Bill at the rate of 5% till it is fulfilled, 5% of the contract value. However, a Bank Guarantee may be considered instead of a Cash Security Deposit. In that case, the Contractor shall have to submit to the Engineer a performance Bond in the form of an irrevocable guarantee from any Nationalized Bank at Kolkata in the specified proforma.

**10.40. Workmen and Wages:**

The Contractor shall deliver, if ordered, a weekly return for all labour employed in writing in the requisite form as instructed by the Engineer or his representative. The contractor shall have to engage a sufficient number of technically qualified and skilled persons to supervise and execute the work, and this should be mentioned in the letterhead of the Firm.

**10.41. Measures against pollution:**

The contractor shall have to take proper measures against environmental pollution during the execution of work as directed by the Engineer. The contractor shall abide by all the regulations and rules of Syama Prasad Mookerjee Port, Kolkata, and those that may be issued from time to time without any extra cost to the SMPA.

**10.42. Defect Liability Period**

The defect liability period for the work is 02(Two) years from the date of handover after successful completion & installation. During this period, if any defect arises the contractor is bound to repair the same or take any other action as directed by the Engineer including replacement of the defective portion and redoing the same at his own cost within 7 days in case of repairing and 21 days in case of replacement and redoing from receipt of such instruction, failing which the work may be done by the Board by some other agencies and the cost of which including 19.25 % departmental charges plus GST will be recovered from the security deposit or any other dues of the contractor.

The warranty/guaranty provided by the OEM/Dealer/Supplier shall be extended to SMPA, connecting the agreement no. and invoices.

The Contractor, on completion of all works, shall inform the Engineer of its effect, and then the Engineer shall issue the Work Completion Certificate after due checking and satisfactory completion of works in all respects. The date of the Defect Liability Period will be reckoned from the date of completion of work as mentioned in the completion certificate issued by the Engineer.

**10.43. Port Area Obligations:**

The Dock area is custom-bounded and, as such, the contractor shall comply with all Regulations of the Port and Customs authorities and those that may be imposed from time to time in respect of the transit of all of the contractor's plants, vehicles, materials, and staff in the area. Whenever regulations so require, permits shall have to be obtained for such transit of Contractor's plants, vehicles, staff, and workmen. The contractor shall instruct his staff and Workmen to comply with all requirements in this "Restricted Area".

The contractor shall abide by all the regulations and rules of Syama Prasad Mookerjee Port, Kolkata, and those that may be issued from time to time without any extra cost to the KoPT.

**10.44. Errors in the B.O.Q:**

In case the rate of a particular item is printed erroneously in the BOQ, the rate stated in the Schedule of rates will prevail over the rate misprinted in the BOQ.

**10.45. Submission of Working Drawings:**

The Contractor has to submit all the relevant working drawings, as required and as directed by the Engineer. and the work will commence after obtaining the approval of the Engineer for the same.

**10.46 Certificate of Design Life of all structures:**

The Contractor has to furnish the certificate for the Design Life of all structures as specified in clause 15.1.2

## 11. PRICE BID

e-tendering For “Tender For Engineering, Procurement and Construction for Development of Off- Dock Container Stacking Yard at Loco Shed Area of KDS , Syama Prasad Mookerjee Port, Kolkata”

The Price Bid shall be submitted online , **Annexures XX & XXI to be submitted offline.**

### 1. Site Grading

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
1.1	Site grading, including mobilization and demobilization, is ready to use as per approved designs, drawings, and specifications. This includes testing, inspection, and defect rectification, being complete in all respects.		
	Total		

### 2. CONTAINER YARD DEVELOPMENT:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
2.1	Container yard development, including mobilization and demobilization, is ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

### 3. BUILDING:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
3.1	<b>Office Building:</b> Office Building with car parking , including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
3.2	<b>REST SHELTER AND INFIRMARY :</b> Rest shelter, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
3.3	<b>EQUIPMENT SHED &amp; REPAIRING YARD:</b> Equipment shed & repairing yard, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		

3.4	<b>DG ROOM:</b> DG room including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
3.5	<b>COMMON TOILET BLOCK AND SHOWER FACILITIES:</b> Common toilet block and shower facilities, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
3.6	<b>SECURITY OFFICE AND GATE HOUSE COMPLEX:</b> Security office and gate house complex, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		

#### 4. WATER SUPPLY WORKS:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
4.1	Water supply works, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

#### 5. STORM WATER DRAINAGE:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
5.1	Storm water drainage, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

**6. SEWERAGE SYSTEM:**

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
6.1	Sewerage system, including mobilization and demobilization, and ready to use as per approved designs, drawings, and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

**7. BOUNDARY WALL:**

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
7.1	Boundary wall including mobilization and demobilization and ready to use as per approved designs, drawings and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

**8. FIRE FIGHTING SYSTEM:**

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
8.1	Firefighting system including mobilization and demobilization and ready to use as per approved designs, drawings and specifications, including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

**9. CCTV CAMERA, RFID, BOOM BARRIER, AND COMMUNICATION FACILITIES:**

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
9.1	CCTV camera, RFID, boom barrier and COMMUNICATION facilities, including mobilization and demobilization and ready to use as per approved designs, drawings and specifications including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

### 10. POWER DISTRIBUTION, LIGHTING, AND COMMUNICATION WORKS:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
10.1	Power distribution, lighting and communication works, including mobilization and demobilization and ready to use as per approved designs, drawings and specifications including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

### 11. INTERNAL ROAD FACILITIES:

SL. No.	Description of Work	Value Quoted by the Bidder	
		In Figure	In Word
11.1	Internal road facilities, including mobilization and demobilization and ready to use as per approved designs, drawings and specifications including testing, inspection, and defect rectifications, complete in all respects.		
	Total		

### 12. Payment Schedule

#### Bill No. 01 – Site Grading

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
1.1.1	<b>DESIGN AND DOCUMENTATION</b>		
1.1.1. a	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	3	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA.
1.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance by SMPA.
1.1.2	<b>EXECUTION</b>		
1.1.2. a	Site Clearing & Grubbing	15	On satisfactory completion and acceptance by SMPA.
1.1.2. b	Excavation, Filling & Compaction	60	Pro-rata on Vol/Area
1.1.2.c	Disposal of Surplus Soil	20	On completion
	<b>subtotal</b>	<b>100</b>	

**Bill No. 02 – Off-Dock Container Yard Development**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
2.1.1	<b>DESIGN AND DOCUMENTATION</b>		
2.1.1. a	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	3	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
2.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance by SMPA.
2.1.2	<b>EXECUTION</b>		
2.1.1	Sub-grade Preparation	15	On satisfactory completion
2.1.2.	Granular Sub-base (GSB)	20	On satisfactory completion
2.1.3	Dry Lean Concrete (DLC)	20	On satisfactory completion
2.1.4	Pavement Quality Concrete (PQC) /Heavy Duty ICBP	30	On satisfactory completion
2.1.5	Testing and Inspection	05	After obtaining satisfactory test results and inspection
2.1.6	Defect rectification	05	After satisfactory rectification
	<b>Subtotal</b>	<b>100</b>	

**Bill No. 03 – Buildings & Ancillary Facilities**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
3.X	<b>DESIGN AND DOCUMENTATION</b>		
3.X. a(i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
3.X. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
3.X. b	As-Built Drawings & Documentation	2	On submission and approval by SMPA
3.x	<b>EXECUTION</b>		
3.x. a	Foundations – Excavation/ PCC, RCC	20	On satisfactory completion
3.x. b	Superstructure – RCC, Masonry	30	On satisfactory completion
3.x. c	Roofing & Finishes	15	On satisfactory completion
3.x. d	Electrical & Plumbing Works	10	On satisfactory completion
3.x. e	External Development Works	10	On satisfactory completion

3.x. f	Testing and Inspection	05	After obtaining satisfactory test results and inspection
3.x. g	Defect rectification	05	After satisfactory rectification
	Subtotal	100	

**Note: This schedule of payment shall apply to all priced items covered under Bill No. 3 (Items 3.1 to 3.6) individually. For each priced item, the placeholder “X” in the above table shall be substituted with the respective item number at the time of recording.**

#### **Bill No. 04 – Water Supply Works**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
4.1.1	<b>DESIGN AND DOCUMENTATION</b>		
4.1.1.a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
4.1.1.a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
4.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
4.1.2	<b>EXECUTION</b>		
4.1.2. a	Underground/Overhead Reservoirs	25	On satisfactory completion
4.1.2. b	Pumping Equipment & Piping	40	On satisfactory completion or proportionate
4.1.2. c	Internal Water Supply	20	On satisfactory completion
4.1.2. d	Testing and Inspection	05	After obtaining satisfactory test results and inspection
4.1.2. e	Defect rectification	05	After satisfactory rectification
	<b>Subtotal</b>	<b>100</b>	

#### **Bill No. 05 – Storm Water Drainage**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
5.1.1	<b>DESIGN AND DOCUMENTATION</b>		
5.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
5.1.1. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
5.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
5.1.2	<b>EXECUTION</b>		
5.1.2. a	Excavation & Bedding	20	On satisfactory completion
5.1.2. b	RCC/NP3 Pipes & Chambers	35	On satisfactory completion
5.1.2.c	Outfalls & Disposal Structures	30	On satisfactory completion
5.1.2. d	Testing and Inspection	05	After obtaining satisfactory test results and inspection
5.1.2. e	Defect rectification	05	After satisfactory rectification

	<b>Subtotal</b>	<b>100</b>	
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**Bill No. 06 – Sewerage System**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
6.1.1	<b>DESIGN AND DOCUMENTATION</b>		
6.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
6.1.1. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
6.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
6.1.2	<b>EXECUTION</b>		
6.1.2. a	Excavation & Bedding	20	On satisfactory completion
6.1.2. b	RCC/NP3 Pipes & Chambers	35	On satisfactory completion
6.1.2.c	Outfalls & Disposal Structures	30	On satisfactory completion
6.1.2. d	Testing and Inspection	05	After obtaining satisfactory test results and inspection
6.1.2. e	Defect rectification	05	After satisfactory rectification
	<b>Subtotal</b>	<b>100</b>	

**Bill No. 07 – Boundary Wall**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
7.1.1	<b>DESIGN AND DOCUMENTATION</b>		
7.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
7.1.1. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
7.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
7.1.2	<b>EXECUTION</b>		
7.1.2. a	Excavation & Bedding	20	On satisfactory completion
7.1.2. b	Completion of the boundary wall (RCC/Masonry as per design and drawing)	40	On satisfactory completion
7.1.2.c	Finishing as per the design and drawing	25	On satisfactory completion
7.1.2. d	Testing and Inspection	05	After obtaining satisfactory test results and inspection
7.1.2. e	Defect rectification	05	After satisfactory rectification

	<b>Subtotal</b>	<b>100</b>	
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**Bill No. 08 – Firefighting System**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
8.1.1	<b>DESIGN AND DOCUMENTATION</b>		
8.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
8.1.1. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
8.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
8.1.2	<b>EXECUTION</b>		
8.1.2. a	Laying of pipeline/procurement of firefighting equipment	50	On satisfactory completion
8.1.2. b	Completion of the assembly of all Equipment	25	On satisfactory completion
8.1.2.c	Finishing as per the design and drawing	10	On satisfactory completion
8.1.2. d	Testing , Inspection & certification by Competent Authority.	10	After obtaining satisfactory test results and inspection, certification.
	<b>Subtotal</b>	<b>100</b>	

**Bill No. 09 – CCTV Camera, RFID, Boom Barrier, and COMMUNICATION Facilities**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
9.1.1	<b>DESIGN AND DOCUMENTATION</b>		
9.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
9.1.1. a (ii)	Do	1	On approval of the design after due rectification/correction/re-design, etc. by SMPK
9.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
9.1.2	<b>EXECUTION</b>		
9.1.2. a	Procurement and installation of CCTV Camera at the nominated location	25	On satisfactory completion
9.1.2. b	Completion of all works of RFID in all respects	25	On satisfactory completion
9.1.2.c	Completion of all works of the Boom barrier in all respects	20	On satisfactory completion

9.1.2. d	Completion of all works of the COMMUNICATION facilities in all respects	15	On satisfactory completion
9.1.2. e	Testing and Inspection	05	After obtaining satisfactory test results and inspection
9.1.2. f	Defect rectification	05	After satisfactory rectification
	<b>subtotal</b>	<b>100</b>	

**Bill No. 10 – Power Distribution, Lighting, and Communication Works**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
10.1.1	<b>DESIGN AND DOCUMENTATION</b>		
10.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
10.1.1. a (ii)	Do	1	On approval of the design after due 9rectification/correction/re-design, etc. by SMPK
10.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
10.1.2	<b>EXECUTION</b>		
10.1.2. a	Laying of Cable/Wires, Erection of poles, hanger, etc. complete in all respects.	20	On satisfactory completion
10.1.2. b	Procurement and installation of all Electrical Gazettes	50	On a Pro-rata basis
10.1.2.c	Completion of all other ancillary works and power connection	15	On satisfactory completion
10.1.2. d	Testing and Inspection	05	After obtaining satisfactory test results and inspection
10.1.2. e	Defect rectification	05	After satisfactory rectification
	<b>subtotal</b>	<b>100</b>	

**Bill No. 11 – Internal Road Facilities**

Sub-item no	Payment items	% payable on item price	Remarks/payment basis
11.1.1	<b>DESIGN AND DOCUMENTATION</b>		
11.1.1. a (i)	Concept / Preliminary Design, Detailed Engineering & Calculations, and Good for Construction (GFC) Drawings	2	On submission of the detailed design and drawing duly proof checked by IIT/NIT, and after Approval by SMPA
11.1.1. a (ii)	Do	1	On approval of the design after due 9rectification/correction/re-design, etc. by SMPK
11.1.1. b	As-Built Drawings & Documentation	2	On submission and acceptance
11.1.2	<b>EXECUTION</b>		

11.1.2. a	Preparation of Sub-grade.	15	On satisfactory completion
11.1.2. b	Preparation of Granular Sub-base (GSB)	30	On a Pro-rata basis
11.1.2.c	Preparation of the base as per the approved design and drawing	30	On satisfactory completion
11.1.2. d	Completion of Pre-mix carpet/heavy-duty paver block	10	On satisfactory completion
11.1.2. e	Testing and Inspection	05	After obtaining satisfactory test results and inspection
11.1.2. f	Defect rectification.	05	After satisfactory rectification
	<b>Subtotal</b>	<b>100</b>	

**Notes to Price Schedule**

1. The Contract is on a lump sum EPC basis. This Price Schedule is provided solely as a payment mechanism for progressive release of amounts under the Lump Sum EPC Contract. It shall not be construed as a Bill of Quantities (BOQ) or as a re-measurement contract. Percentages indicated under each Bill and Sub-Head are for progressive payments only and do not alter the lump sum nature of the Contract.
2. Design & Drawing Submission sub-heads have been included under each Bill to recognise the EPC obligation. Full Payment under these sub-heads' payment items shall be released only upon acceptance of the design/drawings by the Engineer-in-Charge.
3. Payments under each Sub-Head shall be made progressively against certified completion of the respective activity. The above payment schedule is not exhaustive but only indicative, and the Engineer-in-Charge may further subdivide the sub-part/payment items into measurable activities (e.g., excavation, reinforcement, concreting) for certification. however, cumulative payment/percentage allocated for the subdivided activities shall not exceed the percentage allocation indicated for the subhead payment.
4. Cumulative payment under any Bill shall not exceed the percentage allocation indicated for that Bill.
5. The Contractor shall be deemed to have included in his price all costs for design, procurement, construction, testing, commissioning, maintenance during Defects Liability Period, and all incidental works, whether or not specifically mentioned in this schedule.

**13. Clause for Change Scope / Change Order Clause (EPC Lump-Sum Contract)**

**13.1. Right to Vary**

The Employer shall have the right to make changes in the scope, specifications, drawings, or schedule of the Works at any stage of the Contract through written Change Orders issued by the Engineer-in-Charge.

**13.2. Contractor's Obligation**

The Contractor shall execute such Change Orders diligently and expeditiously. No change shall be undertaken without the written instructions of the Engineer-in-Charge.

**13.3. Valuation of Change Orders**

- Since this is a Lump Sum EPC Contract, the Contract Price is fixed and not subject to remeasurement.
- Only where a Change Order involves additional works not contemplated in the original Employer's Requirements, or omission of part of the Works, shall the Contract Price be adjusted.

- The valuation of such changes shall be made as follows:
  - (a) By mutual agreement between the Employer and the Contractor; or
  - (b) In the absence of agreement, by the Engineer-in-Charge, who shall determine a fair and reasonable adjustment based on prevailing market rates, applicable standards, and principles of cost analysis.

#### **13.4. Adjustment of Time**

If a Change Order materially affects the Time for Completion, the Contractor shall submit justification for extension, which shall be decided by the Engineer-in-Charge.

#### **13.5. Limit of Variations**

The aggregate value of Change Orders shall not ordinarily exceed 10% of the Contract Price, unless specifically approved by the Competent Authority.

#### **13.6. No Claim for Loss of Profit**

The Contractor shall not be entitled to any claim for loss of profit, overheads, or consequential damages due to any Change Order. On account payment to the Contractor shall be On-account payments to the Contractor shall be released at the discretion of the Engineer, based on the **certified progress of works measured against the milestones, sub-heads, and percentage allocations indicated in the annexure to the respective**

## 14. Deliverables

### Deliverables Matrix

Deliverable Item	Responsible Party	Reference Clause	Timeline / Due Date	Remarks / Tracking	Sample Clause (Insertable)
Performance Security	Contractor	Clause 4.7.6	Within 21 days of LOA		The Contractor shall submit a Performance Security of 5% of the Contract Value in the form of a Bank Guarantee within 21 days from the date of issue of the Letter of Acceptance (LOA), valid up to 60 days beyond the Defects Liability Period.
Indemnity bond and labour-related licences of all types	Contractor	10.28, 10.29 & 10.30	Before commencement of work		The Contractor shall take out and maintain at his own cost adequate insurance policies for workmen, and works insurance before commencement, and shall submit copies to the Engineer. The contractor shall also indemnify and keep indemnified the SMPA for all actions, claims, liabilities, etc., for breach of any provisions of laws related to workers enforced.
Construction Programme	Contractor	4.7.8	Within 14 days of the LOA/Work Order	Bar chart for all activities to be furnished by the contractor	Within 14 days of the LOA/ Work Order, the Contractor shall submit a detailed Construction Programme showing methodology, milestones, and resource deployment for approval of the Engineer.
Shop Drawings / Working Drawings	Contractor	10.45	Before the start of the respective works	Schedule of work	The Contractor shall prepare and submit shop drawings/working drawings for approval before commencement of respective works. No work shall commence until drawings are approved.
Quality Test Reports (Concrete, Soil, Pavement)	Contractor	17	Monthly submission/ as per test cycle	To be provided as per Chapter 17	The Contractor shall conduct quality control tests as specified and submit certified reports to the Engineer on a monthly basis or as directed.
Statutory Approvals (PCB, Fire, Electrical Inspector)	Contractor	10.17	Before commissioning relevant works		The Contractor shall obtain and maintain at his cost all statutory approvals (Pollution Control Board, Fire, Electrical Inspector, etc.) and submit copies to the Engineer before commissioning.

As-Built Drawings	Contractor	12	At completion, before final payment		On completion, the Contractor shall prepare and submit as-built drawings in both hard copy and digital format, certified by the Engineer, before release of final payment.
O&M Manuals / Handing-Over Documentation	Contractor	10.17	Before final handover		The Contractor shall prepare and submit Operation & Maintenance Manuals for all installed systems and equipment before final handover of the works.
Completion Certificate Request	Contractor	10.42	On completion of works	Engineer to issue	The Contractor shall formally request the issue of the Completion Certificate upon completion of works. The Engineer shall verify and issue the certificate within 30 days if the works are satisfactory in all respects.
Defects Rectification Reports	Contractor	10.42	During DLP		During the Defects Liability Period, the Contractor shall rectify all notified defects and submit rectification reports to the Engineer for record.
Pavement Design Report (25-years Service Life)	Contractor	10.46	Before the commencement of pavement works	Ensure design is submitted & approved before execution	The Contractor shall design the pavement structure for a minimum service life of 20 years in accordance with latest IRC/IS codes, considering design traffic and soil conditions. The complete design report with calculations and drawings shall be submitted to the Engineer for approval prior to commencement of pavement works.

## 15. DESIGN CRITERIA

### 15.1 Design references:

#### 15.1.1 Codes and Standards:

The codes and standards stated below or elsewhere in these documents shall be the latest editions. All materials, testing, design, and execution shall conform with these codes and standards unless otherwise stated in these specifications. It is well understood that when a brand name is given for a material, the Contractor has the right to propose any equivalent material of any other brand for approval of the Employer / Engineer.

All works shall satisfy the requirements of the latest relevant codes, standards, and regulations for the works as per the Tender. Indian Standards shall generally be followed. In case any work or item is not covered by the Indian Standards, the following standards shall be adopted in order of preference.

- British Standards
- American Standards
- General Standards

Wherever details for part of the works are not defined adequately in Indian Standards, relevant acceptable International Standards shall be adopted. Codes and standards covering a major part of the works are included in the Tender Document, and some of them are listed below:

IS 4651 - Code of Practice for Planning and Design of Ports and Harbors

IS 1893 - Criteria for Earthquake Resistant Design of Structures

IS 875 - Code of Practice for Design Loads for Buildings and Structures – (Part 1 – 5)

IS 456 - Code of Practice for Plain and Reinforced Concrete

IS 800 - Code of Practice for General Construction in Steel

IS 2911 - Code of Practice for Design & Construction of Pile Foundations

IRC 37 - Guideline for the Design of Flexible Pavements

IS 15658: 2021 :- Concrete Paving Blocks.

IS 16777 : 2019 :- Laying Of Paver Blocks – Code Of Practice.

IS 13920 - Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice

IS 4326 - Earthquake Resistant Design & Construction of Buildings – Code of Practice

- National Building Code (2005)

IRC 58 - Guidelines for the Design of Plain Jointed Rigid Pavements for Highways

IRC 73 - Geometric Design Standards for Rural Highways

BS 449 - The use of Structural Steel in Building (Permissible Stress)

BS 648 - Schedule of Weights and Building Materials

BS 5493 - Protective Coating of Iron and Steel Structures against Corrosion

BS 5950 - Structural Use of Steel Work in Building (Limit State)

BS 6031 Earthworks

BS 6367 - Code of Practice for Drainage of Roads and Paved Areas

BS 6399 - Loading for Buildings

BS 8002 - Earth Retaining Structures

BS 8004 - Foundations

BS 8110 - Structural Use of Concrete

BS 5930 - Site Investigation

BS 8000 - Foundations

MJ Tomlinson - Pile Design and Construction Practice

Relevant codes for Utilities items like water supply, power supply, drainage, lighting as indicated in Specifications.

### **15.1.2 Design Life:**

The permanent works shall be designed and constructed to give the following design lives:

- Buildings - 50 years
- Pavements - 25 years

Lighting System- 30 years

Stormwater Drainage & Other Civil Structures- 20 years

- Equipment - as per manufacturer's Specification.

Above design lives are defined as a period within which the asset will continue to be serviceable for design loads without collapse, subject to regular inspection and preventive maintenance, but not major repairs and rebuilding.

### **15.1.3 Buildings:**

Required buildings shall be constructed as per Clause 2.2, Volume II of the Tender Document. All RCC framed buildings shall be designed satisfying the provisions of IS:456, and structural steel elements shall be designed as per IS:800. Loading shall be as per IS:875 & IS:1893. The buildings shall be provided with adequate arrangements for plumbing, sanitary, electrical fittings, illumination, air-conditioning, water distribution, etc. The following minimum considerations shall be followed:

- Grades of concrete: M-30 for all items as suggested in the relevant codes
- Grade of steel: Thermo-mechanically treated corrosion-resistant steel Fe500
- Grade of structural steel: As per IS:2062 (Grade-A) with minimum thickness of 10 mm
- Protective coating to structural steel: Minimum DFT of 240 microns after sand blasting to SA 2.5 grade
- Floor-to-floor height shall satisfy the bylaws of the National Building Code.
- A 750 mm wide plinth protection shall be provided around each building.
- The finished floor level of the building shall be 1500 mm above the finished ground level.

- All external walls shall be 230 mm thick; all partition walls shall be a minimum of 115 mm thick with 1:4 cement mortar.

#### **15.1.4 Water Supply System:**

The broad design parameters for the water supply system are given below:

- Hydraulic design of the pipeline shall use using Hazen-William's formula
- All pipelines shall be laid 1.2 m below ground
- The residual pressure in the pipeline at the farthest point shall be 2 kg/sq.cm
- The pumps shall be of centrifugal type.
- The ON/OFF system shall be provided for pumping potable water to the amenities room, shed, and vessels.

#### **15.1.5 Roads:**

Internal roads 11 m wide shall be provided at both . These roads shall be designed for the loads due to Trailers, reach stackers , forklifts etc.

Roads shall be designed with the provision of relevant IRC codes, with the following minimum requirement:

##### Geometric Parameter

- Maximum longitudinal grade: 3.0%
- Cross slope: Unidirectional 2.5% for All Roads
- Maximum super elevation: 5%
- Sight Distance: Intermediate sight distance
- Turning Radius at junction: Min. 25 m
- Design Speed: 50 km/hr

##### Pavement design:

- Traffic: 1 MSA for all Roads
- Pavement type: Rigid

##### Specification:

- Rigid Pavement
  - o Pavement Quality Concrete: Minimum M-40 grade / M-55 Grade ICBP
  - o Dry lean concrete: Minimum M-10 grade
  - o Sub-grade: Minimum CBR 8%
  - o Panel size: Minimum 4.50 m
  - o Axle load
    - Single Axle: 10.2 T

- Tandem Axle: 22.0 T

The culverts required for the cross-drainage works shall be designed as per the IRC codes. The length of the culvert shall be adequate to suit the size of the roadway. The overall clear width of the culvert shall be a minimum of 5 m.

#### **15.1.6 Stormwater Drainage:**

Stormwater drainage shall be designed with the following basic considerations:

- The design rainfall intensity shall be taken as 65 mm/hr.
- The drainage system shall be planned to carry storm run-off from the proposed areas shown in the scope drawings.
- No allowance for sullage shall be kept.
- A maximum velocity of 2.5 m per second shall be allowed for the RCC channel with a lined surface.
- Manning coefficient for different pipe materials shall be adopted as follows:
- Concrete surface in good condition - 0.015
- Masonry surface with cement plaster - 0.015

RCC channels shall be provided for carrying storm water, and all pipes shall be RCC NP4.

#### **15.1.7 Civil and Structural Works**

##### **15.1.7.1 Loads and Load Combinations**

Design loads shall comply with the requirements of IS: 875 & IS: 1893, as a minimum, unless more stringent requirements are specified herein. The following type of loads shall be considered in general for the analysis and design of structures and foundations.

##### **15.1.7.1.1 Dead Loads**

Dead loads shall include the weight of all structural and architectural components and other permanently applied external loads. Self-weight of materials shall be calculated based on unit weights given in IS: 875(Part I).

##### **15.1.7.1.2 Equipment Loads**

All structural components shall be designed to accommodate anticipated Static and dynamic loading from equipment. Where the uniform floor live load adequately accounts for the equipment weight, the weight of such equipment as a dead load need not be considered. Manufacturer's technical specifications shall be followed for any other equipment loading considerations during the detailed design stage.

##### **15.1.7.1.3 Live Loads**

Live loads shall consist of uniform live loads. Uniform live loads are unit loads, which are sufficient to provide for movable and transitory loads, such as the weight of people, portable equipment and tools, equipment, or parts, which may be moved over or placed on floors during maintenance operations. These uniform live loads shall not be considered on the floor area which are permanently covered with equipment. Foundations and fixing arrangements for items of equipment that generate vibration shall be designed to prevent transfer of such vibrations to the adjoining structures. Floors and supporting members, which are subject to heavy equipment loads, shall be designed based on the weight of the equipment in addition to a live load of 500 kg/sqm or a specifically designed live load, whichever is greater.

Flat Roof	150 kg/m <sup>2</sup> + Dust load of 50 kg/m <sup>2</sup> hanging load for pipe shall be considered as 100 Kg/m <sup>2</sup> and 50 Kg/m <sup>2</sup> for electrical, ventilation & air conditioning (wherever applicable)
Non-accessible roof	75 kg/m <sup>2</sup> + Dust load of 50 kg/m <sup>2</sup>
Inclined roof	In accordance with IS-875, for live load plus 25 kg/sqm, for dust load is to be considered on the plan area
MCC Floor	250 kg/m <sup>2</sup> + 1.2T/m of Pane
Ground floor	1500 kg/m <sup>2</sup>
Suspended floors	1500 kg/m <sup>2</sup>
Workshop	Loads due to a 10 T capacity crane shall be considered. Along with the vertical loads, lateral and longitudinal loads shall also be considered due to crane operations/movement.

#### **15.1.7.1.4 Wind Load:**

All structures will be designed for wind loads in accordance with IS: 875 (Part 3). A basic wind speed of 20 m/s and 55 m/s shall be considered in operating and storm conditions, respectively.

#### **15.1.7.1.5 Seismic Load:**

Seismic load shall be calculated considering the following parameters: Peak Ground acceleration (PGA) = 0.35g

As per clause 4.2.2.4, EN 1998-2, the earthquake effect shall be determined by applying to all node points the horizontal force given by Where,

T = Period of the fundamental mode of vibration for the direction under consideration

g = acceleration due to gravity

m<sub>i</sub> = mass of the concentrated at its point

d<sub>i</sub> = Displacement of its nodal point

S<sub>d</sub>(T) = Spectral acceleration of the design spectrum

#### **15.1.7.2 Load Combinations:**

Design load combinations shall comply with the requirements of IS: 875 & IS: 1893, as a minimum, unless more stringent requirements are specified herein in the Tender Document.

#### **15.1.7.3 Deflection Check**

The deflection for steel structures conforms to IS 800: 2007, Clause 5.6.1, Table 6, and that for reinforced concrete structures conforms to IS 456: 2000, Clause 23.2.

#### **15.2 Electrical Works**

For the design criteria of the following works/items, the respective clauses of Volume-II shall be referred to: Clause 7 (Power Distribution, Lighting and Communications)

## 16. GENERAL REQUIREMENTS

### 16.1 Site Acceptance and Mobilization/Demobilization

#### 16.1.1 Acceptance of Site

In accordance with these specifications, the Contractor shall have examined the site and familiarized himself with all existing conditions. He shall accept the site in its existing condition at the time of award of the contract.

#### 16.1.2 Mobilization:

Upon award of the Contract and within a reasonable time but not exceeding 2 months, the Contractor shall mobilize all such labour, equipment, and materials that are necessary to complete the project in due time.

#### 16.1.3 Demobilization:

Upon due performance of the contract and before the Taking Over Certificate is issued to the Contractor, he (the Contractor) shall demobilize all such labour, equipment, and materials that are necessary to clear the site within one (1) month to the Employer's satisfaction.

#### 16.1.4 Access:

The Contractor shall provide and maintain adequate access to the project site and all areas related to the works at his expense. If existing roads are to be used for access to the site, the Contractor shall maintain such roads for the duration of their use. Access to structures such as scaffolds, ladders, ramps, hoists, etc. shall be provided, maintained, and operated as necessary.

#### 16.1.5 Permits and Licenses:

Except as expressly stated in the Employer's Responsibilities, the Contractor shall obtain all permits and licenses necessary for the execution and completion of the Works. The Contractor shall pay all associated fees, including royalties. He shall also give the Employer a copy of all relevant correspondence and other documents relating to the Contractor's permits and licenses.

### 16.2 Facilities to Be Provided by the Contractor

#### 16.2.1 General

The Contractor shall arrange for, provide, install, construct, and maintain all buildings, services, site access roads, mooring and landing facilities, and the like which the Contractor and their principals, employees, and agents require on or near the Site directly or indirectly in connection with the Works as specified below. The Contractor shall fulfil his obligations under this Clause with the approval of the Engineer. As soon as practicable but in any case, not later than four (4) weeks after receipt by the Contractor of the notification in writing that the Contract is awarded to him, the Contractor shall submit all details of the location, the layout and the construction of the buildings, the site access roads, the services, the fittings, the furnishings and everything to be provided, installed and constructed under the provisions of this Clause for the approval of the competent authorities and of the Engineer (which approval shall not be unreasonably withheld) before materials, or other things are ordered or the works are put in hand.

#### 16.2.2 Offices, Workshops, etc. for the Contractor and Engineer

The Contractor shall provide, erect, construct, and equip all offices, workshops, stores, sheds, and the like required by him, employees, or agents, complete with all machines and tools and all services, access roads, and the like, required directly or indirectly for the execution or maintenance of the Works, in consultation with the Engineer. The costs incurred by the Contractor in complying with the provisions of this Sub-Clause shall be deemed to be included in the Contract Price.

### **16.3 Training**

All personnel shall be suitably qualified, experienced, and trained by the Contractor for the equipment or duty that they are engaged in. Before their employment, all labour and staff shall be given a health check as per the regulatory requirements, and the Contractor shall keep health certificates of all employees. Workers shall be screened for drug abuse, and persons addicted to drugs shall not be employed. A sufficient number of the Contractor's employees who speak the language of the State/region shall be fully qualified in first-aid so that first-aid will be immediately available in case of accident at any time and at any place throughout the Site and any off-site camps, housing, or other facility. The persons so designated shall be made known to all employees by the posting of their name, designation, and photograph in prominent positions on the Site. Such first-aiders or medical service providers shall be trained.

The costs incurred by the Contractor in complying with the provisions of this Sub-Clause shall be deemed to be included in the Contract Price.

#### **16.3.1 Site Induction and Safety Training**

The Contractor's personnel, including the personnel of any lower-tiered Contractors or suppliers, regular visitors of the Site, including Employer's staff and Engineer, shall undergo Site induction and safety training before commencement of duties on the Site.

The cost of all Contractor's personnel's time and expenses to attend the inductions is for the Contractor's account and shall be deemed to be included in the Contract price.

#### **16.3.2 Personal Protective Equipment**

The Contractor shall provide all employees and visitors to the site with Personnel Protective Equipment (PPE), which shall include but not be limited to, hard hats, personal self-inflating floatation devices during over-water transportation, construction work, and vessel to vessel transfers, safety glasses, safety boots, sun screen lotion, conspicuous work clothing or high visibility vests, and the like. Specific PPE shall be provided by the Contractor to all specialist trade employees, irrespective of whether they are direct employees or contract service providers. PPE to be provided as per the PPE Specification and PPE Matrix as approved by the Engineer. The Contractor shall ensure that PPE is used by all personnel on site as appropriate and in accordance with the requirements of the approved Health and Safety Management Plan. Failure of the Contractor to supply and/or ensure that PPE is used may give rise to an instruction from the Engineer, or his representative, to cease work in the affected areas of the Works until the situation is remedied to the satisfaction of the Engineer. In this event, the costs of all stoppages and any delays shall be to the account of the Contractor.

### **16.4 Site Laboratory**

#### **16.4.1 General**

The Contractor shall provide, erect, and equip, within 14 weeks after receipt by the Contractor of the notification in writing that the Contract is awarded to him, for the joint use of the Contractor, the Engineer and his principals, employees and agents at the Site in such a location and position as directed by the Engineer, accessible by motor vehicle from the adjacent Site roads along temporary all weather access ways and with adequate parking space nearby, a Laboratory complete with all plumbing, water services, drains, electrical installations, equipment, furnishing and the like, completely finished and ready for occupation. Before constructing the building, the Contractor shall submit drawings of its proposed construction and arrangement to the Engineer for approval. The Contractor shall maintain the building, services, furnishings, and equipment in good working order throughout the execution of the Contract Works.

#### **16.4.2 Laboratory:**

The Laboratory shall consist of:

- I. 1 office room with a floor area of at least 10 sq m.
- II. 1 store room with a floor area of at least 12 sq.m.
- III. 1 testing room with a floor area of at least 25 sq m.

- IV. 1 washroom
- V. a covered verandah
- VI. a covered car porch for at least 1 vehicle

The Laboratory shall be of a construction and design suitable for the climatic conditions prevailing. The Laboratory shall be properly ventilated and proof against weather, insects, and burglars. Each room shall be fitted with a false ceiling, provided with ceramic tile or equivalent flooring, and windows shall have openable glass panes and be fitted with adjustable blinds.

The Laboratory shall be provided with power and running water, sinks, drains, and all other facilities required to enable it to operate efficiently and shall be used exclusively for the purpose.

The office room shall be air-conditioned or fitted with water-pumped air coolers. Ceiling / Pedestal fans shall be installed in all rooms. Similar amenities are to be provided for the Site Office of the Engineer.

The Contractor shall provide all the testing equipment and tools and carry out all field and laboratory tests on dredged material and other materials and workmanship as specified in the Contract, including the Port works. Staffing of the laboratory shall be provided by the Contractor and shall be with engineers or technicians experienced in carrying out the specified testing and approved by the Engineer. The laboratory, equipment, samples, tests, and records shall be open to inspection by the Engineer 's Representative at any time and shall be available for the use of the Engineer's Representative to perform control tests on materials and workmanship related to the Works. No dredging or construction work shall commence until required test facilities are available and in good working order at the Site. All testing equipment shall be to the approval of the Engineer and shall be maintained in good working order at all times by the Contractor.

The costs incurred by the Contractor in complying with the provisions of this Sub-Clause shall be deemed to be included in the Contract Price.

#### **16.5 Power, water, sewerage, drainage, sanitary provisions:**

The contractor has to arrange electricity from CESC at his own cost. Similarly, arrangements for potable water shall also be made by the contractor himself.

Nevertheless, where required by the Engineer, the Contractor shall arrange for, provide, install and keep in running condition everything necessary to ensure adequate:

- I. The supply of potable or non-potable water, whichever is required, for testing, construction use, and all other purposes.
- II. The supply of electricity and other sources of power and light.
- III. The disposal of sewage,
- IV. The drainage.

The Contractor shall provide, install, and construct adequate sanitary conveniences on the Site till completion of all work activities as specified in the contract.

#### **16.6 Telecommunication**

**Deleted.**

#### **16.7 Assistance to the Engineer**

The Contractor shall allow for the provision of labourers to assist the Engineer, if and when required throughout the Works. The Contractor shall also provide such small hand tools and equipment as may be required by the Engineer.

### **16.8 Care for the Engineers' Facilities**

The Contractor shall be responsible for the cleaning, care, and maintenance of all facilities provided by the Engineer as per the requirements of this Specification, including all equipment, and shall provide all required utilities and consumables.

The costs incurred by the Contractor in complying with the provisions of this Sub-Clause shall be deemed to be included in the Contract price.

### **16.9 Temporary Works**

The Contractor shall design, install, and maintain all temporary facilities required for the construction of facilities under this contract package, which he requires on or at the site throughout the execution of the work, and remove the same on completion of the works. He shall provide all such buoying, fencing, watching, lighting, connections to public utilities, etc., as he needs or as required by authorities, and shall install and use his temporary facilities in accordance with all statutory regulations and the requirements of the relevant authorities.

The Contractor shall submit their plan for temporary works to the Employer for approval, within 30 days of the award of the contract.

Temporary construction shall be adequate for intended uses and for all loads imposed without excessive settlement, deflection, or deformation. All parts and members shall be properly strengthened to prevent displacement or failure.

Before or upon completion of work, unless otherwise required or directed, preparatory structures, installations, and utility services shall be disconnected and removed from the site within 30 days of expiry of the Defect Liability Period.

#### **16.9.1 Utilities**

Temporary utilities used for construction shall have to be adequate for the intended uses and not overloaded or otherwise used or arranged in any manner that endangers persons, premises, or works. Connections shall be properly made, lines and wiring securely anchored in place, and protected against accidents.

##### **a) Water**

The Contractor shall provide his own arrangements for sourcing and for distribution adequate supply of water for the Project, including:

- drinking water: providing and maintaining canisters, coolers, or connected drinking fountains of sufficient number to reasonably serve the Project.
- construction water: providing and maintaining temporary water service and distribution of adequate capacity for construction.

##### **b) Electricity**

The Contractor shall make his own arrangements for power supply.

If found necessary, the Contractor shall provide and maintain generators, including a stand-by generator of adequate capacity to meet their additional Project requirements.

The Contractor shall make his own arrangements as outlined hereunder:

- Distribution of adequate capacity for power, lighting, and other construction needs.
- As necessary to properly and safely perform work in enclosed spaces or under hazardous conditions. Likewise, providing lights for night work/protection as necessary.

Temporary electrical systems shall comply with the local codes and regulations.

#### **16.9.2 Waste and Rubbish**

The Contractor shall provide regular daily clean-up and removal of trash, waste, scraps, construction debris, etc. from the site and temporary work yard and shall arrange for disposal of waste and rubbish to disposal areas approved by the Employer.

### **16.9.3 First Aid and Fire Protection**

#### **a) Emergencies**

The Contractor shall maintain the lists of nearest available police, hospital, or medical services at the Contractor's Site Office, and the same are to be displayed at several locations & workplaces.

#### **b) Fire Protection**

The Contractor shall establish and submit the following measures to the Employer.

- maintain fire extinguishers, connected hoses, and other facilities necessary for reasonable firefighting action at the site and temporary work yard.

Provide and maintain a first aid kit containing bandages, medicines, and sterilized materials for first aid treatment of minor injuries at the Contractor's Site Office.

### **16.9.4 Construction Safeguards**

#### **a. Excavations**

Trenches intersecting roads shall have to be provided with crossings suitable to carry the type of traffic involved. Vehicular curbs and pedestrian railings shall be provided as necessary. Open pits and openings in floors and other accessible surfaces shall be protected by barricades or railings.

#### **b. Access**

Access to structures such as scaffolds, ladders, ramps, hoists, etc. shall be provided, maintained, and operated as necessary.

#### **c. Storage Areas**

Storage and shop areas shall be provided, arranged, and maintained at approved locations as necessary to properly store, handle, and fabricate the various materials and equipment required.

### **16.9.5 Protection of the Public:**

The Contractor shall provide barricades and enclosures as necessary for public protection.

### **16.10 Environmental Protection:**

The Contractor shall comply with all the conditions stipulated by the relevant statutory and regulatory organization of the Government of India.

#### **Fires**

Fires and burning of rubbish on the Site are not permitted except when authorized by the Employer. Where fires or burning are permitted, the Contractor shall prevent the structures that are to be preserved from staining and smoke damage. The Contractor shall restore, clean, and make good stained or damaged work to new condition.

#### **Disposal of Waste and Cleanliness**

The Contractor shall not bury rubbish and solid waste materials on the Site, and he shall not dispose of waste or volatile materials, such as mineral spirits, oil, or paint thinner, into the waterways, storm water drainage, or sanitary sewers.

The Contractor shall keep all pavements and areas leading to and from the site clean and free of mud, dirt, and debris at all times for the movement of vehicles and pedestrians.

#### **Drainage**

The Contractor shall provide temporary drainage and pumping facilities as necessary to keep the adjoining areas of the work site free from waterlogging and flooding.

#### **Pollution Control**

The Contractor shall cover or wet down dry materials and rubbish to prevent blowing dust and debris and provide dust control for temporary roads and yards.

The Contractor shall take all measures necessary to ensure that no pollution of the waterways or any land areas occurs as a result of his activities. He shall undertake at his own expense all measures necessary to clean up or otherwise rectify any pollution arising from his activities under this Contract to the satisfaction of the Employer.

### **Environment**

The Contractor, before the commencement of works, shall prepare and implement a Environmental Management Programme. The Contractor shall deploy most suitable construction equipment to minimize the suspension of fine sediments at the work site.

## **16.11 Submission of Documents during Project Execution**

### **16.11.1 Programme of Works**

The Contractor shall prepare and submit (both hard copy and soft copy) to the Employer within 30 days of receipt of the Letter of Award, the following:

- Detailed CPM Schedule showing the various activities of the Work using MS Project
- List of designs/drawings/documents along with their schedule of submission.
- List of Vendors / Suppliers of Bought-out items

The above shall be updated every month and submitted to the Employer.

### **16.11.2 Work Schedule, Survey Data & Drawings**

The Contractor shall prepare and submit construction schedules, survey data, and field drawings to illustrate the appropriate portion of work. The work items shall be described and related to responsibility, fabrication, layout, and setting or erection details as specified in appropriate Sections.

The Contractor shall keep allowance in the program of works for any stoppages during the monsoon period, and he has to take all necessary measures to protect his equipment and the partly completed structures. The Contractor is expected to build such stoppages of work during the monsoon into his overall schedule for completion. The Employer will not entertain any claims from the Contractor on this account.

Drawings shall be submitted in one reproducible transparency and two paper prints, maximum size 610 mm x 810 mm, and in soft copy (in AutoCAD format).

### **16.11.3 Maintenance Plan**

#### **16.11.3.1 General**

The Contractor shall prepare a maintenance plan covering all aspects of the works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full, and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life.

#### **16.11.3.2 Maintenance Document**

The Contractor shall provide six copies of the maintenance plan and manuals to the employer to retain by the Employer upon the request of the Employer or following receipt of attention to the Employer's comments.

### **16.11.4 Weekly and Monthly Progress Report**

The Contractor shall maintain a daily log describing the important events about the Works (the working hours, the number of laborers employed, the effective operation time of equipment, overtime hours),

progress made in the Works. Compilation of these logs and their summary shall be submitted to the Employer as a Weekly Progress Report in three (3) copies by the middle of the next week. The monthly progress reports shall include progress photographs taken at a fixed point and angle. The photographs shall be sufficient in numbers and locations to record the exact progress of works. The color photographs shall be in size 200 mm x 250 mm, and the soft copy containing the digital version of the same shall be provided.

The Contractor shall furnish the Employer with five (5) copies of the monthly progress reports within seven (7) days after the end of every month.

#### **16.11.5 As Built Drawings, Design and Final Construction Report**

Before submitting a request for a Taking Over Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents, including but not limited to two (2) sets of as-built drawings, final design supporting the as-built drawings, and a final construction report as a draft.

And within thirty (30) calendar days after receipt of comments from the Employer, the Contractor shall submit five (5) sets of the Final Construction Report and five (5) sets of Final As-built drawings & Design documents. As-built drawings of the works consist of two (2) sets of original size copies (white print) and six (6) sets of bound copies reduced to A3 size. All documents and drawings will also be delivered in soft copies (drawings in Auto-CAD format, documents in other required formats, and a soft copy of the file used in the software on which the design was carried out).

Before submitting a request for a Taking Over Certificate, the Contractor shall ensure that it has furnished to the Employer all required documents, including but not limited to five copies of manuals for installation, commissioning, operation, and maintenance, and the drawings/ documents, etc., covering all aspects of the Works for the review of the Employer. This plan shall be prepared to ensure that the design life periods stated are met in full, and where no design life periods are stated, the maintenance plan shall be prepared to maximize the serviceable life. In the event the Contractor makes any changes affecting such submission, the Contractor shall submit afresh such document, duly revising to that extent.

#### **16.11.6 Design and Drawing Submissions**

##### **16.11.6.1 Design Submissions - General**

All design submissions shall be made in triplicate. A further digital copy of the submission shall be given. This digital copy shall include the full submission with scanned copies of any documents prepared by hand.

##### **16.11.6.2 Submission of Calculations**

All calculations submitted for the Employer's approval shall comply with the following:

1. Each calculation page shall be uniquely numbered.
2. Each section of calculations shall have a cover sheet, listing the subject of the calculations, document number, and date of submission, name and qualifications of the Designer(s), the name and qualifications of the Design Verification engineer(s), and the relevant Indian/other Standards, books and drawings which are the basis of the calculations.
3. Each section of calculations shall have a Table of Contents, including page numbers.
4. Calculations shall be accompanied by all necessary sketches or extracts from drawings.
5. Calculations shall include introductions explaining the purpose of the calculations and the methods and design philosophies adopted. This shall clearly state the Standards on which the calculations are based.
6. Equations and values from Standards and Codes of Practice are to be clearly referenced. Extracts from publications other than Indian Standards or British Standards that are used in the design shall

be attached to the submission. The relevant Indian/other Standards forming the basis of the design shall be quoted.

7. Where values used in the calculations are brought forward from previous calculation pages, the page reference shall be included.
8. At the end of each section, there shall be a summary, listing the conclusions of the calculations, and referring to construction drawings.
9. If calculations are revised due to design changes or corrections, or comments of the Employer, the calculation sheets shall be clearly marked with a revision letter.
10. All calculations shall be signed/initialed by the designer and design verification engineer.

#### **16.11.6.3 Submission of Drawings**

All drawings submitted for the SMPA's approval shall comply with the following:

- a. All drawings shall be in metric millimeter dimensions and be finally prepared in ink with legible lettering on either A0 1189mm x 841mm using AutoCAD format compatible with AutoCAD 2026 or a lower version. The submitted prints shall be clearly legible throughout, and there shall be no ambiguity.
- b. All drawings shall be submitted in digital format on compact disc, as well as three paper prints.
- c. Drafting Standards employed in the preparation of all drawings shall be sufficient to produce legible 297mm x 420mm (A3) reduced drawings.
- d. Drawings from various sub-contracting services, specialist suppliers, etc., shall also be presented in a similar manner (identical title blocks/format, etc.) to provide a matched set of drawings.
- e. All drawings shall clearly show the status and revision of the drawings. Revised drawings shall clearly indicate the nature and details of the revision work, and also the revision cloud & revision mark shall be marked wherever revised.
- f. All drawings shall clearly identify the drafts-person responsible, together with the identity of the drawings checker.
- g. Each drawing shall show the scale(s) of the components illustrated by the drawing related to the original drawing size, A0, A1, A3, etc.
- h. All Drawings shall be submitted duly proof-checked from IIT/NIT /Any Government Institute.

### **16.12 Quality Control and Assurance**

#### **16.12.1 General**

The Contractor will be required to adopt a system of self-certification in accordance with their general quality plan and the appropriate detailed quality procedures. The quality system shall comply with the Standards of ISO 9001. The Contractor shall monitor his performance of executing his Works against two levels of Certification:

- the completion of individual work items and
- the completion of activities listed in the Programme.

In addition to the certification of the completion of work items and activities, the Contractor shall be required to issue the Quality Assurance (QA) certificates concerning the Quality Plan, Quality Procedures, and Construction Documents.

The Employer may monitor the Contractor's work against the Contractor's Quality Plan and Quality procedures. The Employer may do this by spot checks, and/or by continuous monitoring of the work. The Employer may also do this by carrying out compliance audits periodically against the Contractor's Quality Procedures. The frequency and intensity of such checks will depend on the proven reliability of the Contractor as work progresses. Each non-compliance with the Quality Plan shall be notified promptly to the Employer by the Contractor, together with proposals for the remedy of the non-compliance. The

absence of monitoring of or commenting on quality aspects as above by the Employer shall not absolve the Contractor from any of its contractual obligations and/or shall not entitle the Contractor to any claim.

#### **16.12.2 Improper Certification of Unsatisfactory Work**

If the Contractor or its personnel repeatedly confirms/declares work as being satisfactory when such work is not satisfactory, the Employer may reject such work at any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part without any implication to the Employer. In case of improper certification and/or Contractor's failure to rectify, the Employer may proceed as per the Contract, including terminating the Contract.

#### **16.12.3 Quality Plan and Quality Procedures**

The Contractor will be required to submit their complete General Quality Plan to the Employer within four weeks of the Commencement Date. A designer's quality plan will be accepted as an interim measure to permit design work to be started in advance of the preparation of the General Quality Plan.

Detailed Quality Procedures for each element or item of work must be submitted to the Employer for review at least four weeks before that work is due to commence. Detailed Quality Procedures are required for all items manufactured before delivery to the site.

#### **16.12.4 Submission and Certification of Construction Documents**

The Contractor shall submit a Design Certificate (in duplicate) and Design Check Certificate whenever he is submitting Construction Documents to the Employer for review. Construction Documents submitted without the relevant Design Certificate will not be reviewed.

The Contractor is to ensure that all Construction Documents submissions are in a form that enables the Employer to review the Construction Documents as required by the Contract without delaying completion of the Works.

#### **16.12.5 Certificates for Work Item Completion**

Readily identifiable Work Items must be certified as checked and found satisfactory by -

- Contractor's surveyor is responsible for checking and
- Contractor's supervisor is responsible for checking temporary works, material cleanliness, dimensions (not checked in (a) above), workmanship, and all other matters to enable him to certify that the item of work complies in every respect with the contract.

The Work Item Completion Certificate shall be checked and approved by the Contractor's Quality Manager. Each Work Item Completion Certificate must be identified by a unique and appropriate reference number. If the SMPA is not satisfied that the works have been carried out satisfactorily as certified, the SMPA shall raise a nonconformance report to which the Contractor shall respond, stating their proposals for rectifying the non-conforming item and what action will be taken to prevent recurrence. The SMPA may reject such work at any time during the currency of the Contract and instruct the Contractor to re-execute such work in full or a part thereof without any implication to the SMPA. In case of recurrence/failure of the Contractor to rectify, the Employer may adjust the Contract price by deducting the value of such work.

Any consequences in respect of any revisions arising out of Work Item Completion Certificates being returned with comments shall not be treated as a compensation event.

#### **16.12.6 Certificates for Activity Completion**

When a section of work has been completed satisfactorily, the Contractor shall certify that the activity has been completed in accordance with the Contract.

The Activity Completion Certificate shall be checked by the Contractor's Quality Manager and confirmed by the Contractor. The Designer's Representative shall also certify that the activity has been completed in conformance with the relevant Construction Documents and the Employer's Requirements.

The Activity Completion Certificate shall list the reference numbers and dates of Work Item Completion certificates that have been relied upon by the signatories to the Activity Completion Certificate.

Each Activity Completion Certificate shall have attached to it copies of any materials test certificates which were received after signing the relevant Work Item Completion Certificates and which have not been submitted to the Employer under separate cover during the period between the signing of the Work Item Completion Certificate and the preparation of the Activity Completion Certificate.

### **16.13 Field Surveys and Investigations**

#### **16.13.1 Topographic Surveys**

##### **16.13.1.1 Setting Out**

The Contractor shall establish working benchmarks related to the Reference Benchmark in the area soon after taking possession of the site. The Employer shall provide the Contractor with one Permanent Benchmark and its datum. It must then be accurately referenced in a manner satisfactory to the Employer. A schedule of reference dimensions shall be prepared and supplied by the Contractor to the Employer. These marks shall be maintained until the works reach the finished formation level and are accepted by the Employer.

The Contractor shall be solely responsible for safeguarding all survey monuments, benchmarks, etc. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the contract shall be verified by the Contractor on the site, and he shall immediately inform the Employer of any apparent errors or discrepancies in such dimensions and levels.

#### **16.13.2 Geotechnical Investigations**

The Contractor may carry out geotechnical investigations in the Works area if he so desires at his own cost and without any implications to the Employer.

#### **16.13.3 Post Construction Survey**

The completion of the works shall be examined by the Contractor in the presence of the Employer. During these examinations, the Contractor shall perform the survey, which shall be used to prepare a final drawing showing all dimensions, elevations, and cross sections of the "As Built" conditions of the structures. The Contractor shall be required to remove excess materials or place additional materials, as directed by the Employer, to comply with the Contract Documents.

### **16.14 Employer's Responsibilities**

#### **16.14.1 Datum Points and Levels**

The Employer will give the details of a reference Benchmark in the vicinity of the Project Site, and the Contractor shall establish working benchmarks linked to this and reduce them to Chart Datum (CD). The Contractor, before the start of works, shall confirm the location and details of datum points and levels. The Contractor shall convert all the levels accordingly with respect to CD.

#### **16.14.2 Contractor's Working Area**

The Contractor may use the part of area available during the construction work . He has to reduce his working area progressively during the development of the backup area and hand over the entire area after completion of the Works. If available , the Employer may allocate a suitable working area to the Contractor during execution of the Works, and his decision is binding on the Contractor in this regard.

## 17. SPECIFICATION (CIVIL WORKS)

### 17.1 Materials:-

#### 17.1.1 General:

The Contractor shall be responsible for furnishing all materials required for the execution of the Works. The Contractor shall submit the source and method of execution for the Employer's review before any execution. All materials used in the construction of permanent works required under this Contract shall be of 1st class quality as specified herein and comply with the latest IS Codes or equivalent. The material shall be tested before bringing it to the site.

This specification establishes and defines the requirements of various materials to be used in Civil and Structural works.

Whenever any reference to IS Codes is made, the same shall be taken as the latest revision (with all amendments issued thereto) as on the date of submission of the Tender.

Apart from the IS Codes mentioned in particular in various clauses of this specification, all other relevant codes related to a specific job under consideration regarding quality, tests, testing, and/or inspection procedures shall be applicable. Reference to some of the codes in various clauses of this specification does not limit or restrict the scope of applicability of other referred or relevant codes.

In case of any variation/contradiction between the provision of IS Codes and this specification, the provision given in this specification shall be followed, unless the Employer agrees/consents to follow IS codes or other proposal of the Contractor as provided in the Contract.

All materials shall be of standard quality and shall be procured from renowned sources/manufacturers approved by the Employer. It shall be the responsibility of the Contractor to get all materials/manufacturers approved by the Employer prior to procurement and placement of the order.

Wherever a brand is not mentioned, the Contractor can choose a brand complying with the tender specifications; however, mentioning the brand considered in the Bid submission for the approval of the Employer if required.

Whenever called for by the Employer, all tests of the materials as specified by the relevant IS Codes shall be carried out by the Contractor in an approved laboratory, and test reports duly authenticated by the laboratory shall be submitted to the Employer for his approval. If so desired by the Employer, tests shall be conducted in the presence of the Employer or his authorized nominee.

Quality and acceptability of materials not covered under this specification shall be governed by the relevant IS Codes. In case the IS code is not available for the particular material, other codes, e.g., B.S. or DIN, or API/ASTM, etc., shall be considered. The decision of SMPA in this regard shall be final and binding on the Contractor.

Whenever asked for, the Contractor shall submit representative samples of materials to the Employer for his inspection and approval. Approval of any samples does not necessarily exempt the Contractor from submitting necessary test reports for the approved material, as per the specification/relevant IS Codes. The Contractor shall submit manufacturer's test reports on the quality and suitability of any material procured from them and their recommendation on storage, application, workmanship, etc., for the intended use. Submission of manufacturer's test reports does not restrict the Employer from asking for fresh test results from an approved laboratory of the actual material supplied from an approved manufacturer/source at any stage of execution of work.

All costs relating to or arising out of the tests and submission of test reports and or samples to the Employer for his approval till the date of issuance of the Performance Certificate shall be borne by the Contractor.

Materials for approval shall be separately stored and marked, as directed by the Employer, and shall not be used in the Works till these are approved.

All rejected materials shall be immediately removed from the site by the Contractor at his own cost.

### **17.1.2 Water:**

Water used in construction for all civil & structural works shall be clean and free from injurious amount of oil, acids, alkalies, organic matters or other harmful substances, which may be deleterious to concrete, masonry or steel. The pH value of the water sample shall not be less than 6. Potable water shall be considered satisfactory.

Tests on water samples shall be carried out in accordance with IS:3025, and they shall fulfil all the guidelines and requirements given in IS:456.

The Employer may require the Contractor to prove that the concrete prepared with water, proposed to be used, shall not have an average 28-day compressive strength lower than 90% of the strength of concrete prepared with distilled water.

The Employer may require the Contractor to get the water tested from an approved laboratory before starting the construction work, and in case the water contains any oil/organic matter or an excess of acid, alkali, or any injurious amount of salts, etc., beyond the permissible maximum limits given in IS:456, the Employer may refuse to permit its use. In case there is any change in the source of water, water samples shall be tested again to meet the specified requirements.

Water shall be stored in tin barrels, steel tanks, or water-tight reservoirs made with bricks/stone or reinforced concrete. Brick/stone masonry reservoirs shall have an RCC base slab and shall be plastered inside, with 1 part of cement and 4 parts of sand, and finished with neat cement punning. These reservoirs shall be of sufficient capacity to meet the water requirements at any stage of construction.

Water for curing shall be of the same quality as used for concreting and masonry works. Sea water shall not be used for the preparation of cement mortar, concrete, as well as for the curing of plain/reinforced concrete and masonry works. Sea water shall not be used for hydrotesting and checking the leakage of liquid retaining structures, also.

### **17.1.3 Aggregate:**

#### **17.1.3.1 General:**

Coarse and fine aggregates for civil and structural Works shall conform in all respects to IS:383 (Specification for coarse and fine aggregates from natural sources for concrete). Aggregates shall be obtained from an approved source known to produce the same satisfactorily. Aggregates shall consist of naturally occurring (crushed or uncrushed) stones, gravel, and sand or a combination thereof. These shall be chemically inert, hard, strong, dense, durable, clean, and free from veins, adherent coatings, injurious amounts of alkalis, vegetable matter, and other deleterious substances such as iron pyrites, coal, lignite, mica, shale, seashells etc.

Source and type of aggregates shall be approved by the Employer prior to procurement. Change in source and type of aggregates, at a later stage, shall not be generally permitted; but under specific circumstances, the Employer subject to the Contract may accept the proposal to change. Contractor shall produce necessary test certificates from approved laboratories regarding the quality and suitability of the proposed aggregates and submit a fresh mix design for approval of the Employer. Aggregates, which may chemically act with alkalis of cement or might cause corrosion of the reinforcement, shall not be used. If so desired by the Employer, the Contractor shall carry out alkali reactivity tests and submit the results to him for approval.

The maximum quantities of deleterious materials in the aggregates as determined in accordance with IS:2386 – Part II (Methods of Test for aggregates for concrete), shall not exceed the limits defined in IS:383. No special test is required to prove the absence of such deleterious matters if the aggregates are from a known source with satisfactory prior data on the properties of concrete made with them. In case of newly developed quarry sites, the Contractor shall submit necessary test results as per IS:383 and IS:2386 to the Employer prior to his acceptance and approval. The method of Sampling shall be in accordance with the requirements given in IS:2430.

Coarse and fine aggregates shall be batched separately. All-in aggregates shall be used only where specifically permitted by the Employer. Separate sieve analysis and grading curves shall be prepared by the

Contractor for any/all batches of coarse and fine aggregates, and submitted to the Employer, whenever asked for, to ensure conformity with those submitted along with the mix design. Whenever required by the Employer, the aggregates (coarse/fine) shall be washed and/or sieved by the Contractor before use in the works to obtain clean and graded aggregate at no extra cost to the Employer. Aggregates not in conformity with the specifications shall be rejected and the Contractor shall immediately remove them from the site of work.

#### **17.1.3.2 Coarse Aggregates:**

Coarse aggregates are the aggregates that are retained on the 4.75 mm IS Sieve. It shall have a specific gravity not less than 2.6 (saturated surface dry basis).

These may be obtained from crushed or uncrushed gravel or stone as per Clause 5.1.3.1 and may be supplied as single-sized or graded. The grading of the aggregates shall be as per IS:383 or as required by the mix design. To obtain the densest possible concrete, the cost of such a mix design shall be borne by the contractor. For this purpose, the Contractor shall submit to SMPA at least three sets of mix design and test results, each with different gradings of coarse aggregates proposed to be used. The Employer may allow "All-in-aggregates" to be used, provided they satisfy the requirements of IS:383.

#### **17.1.3.3 Fine Aggregates:**

Fine aggregates are the aggregates that pass through a 4.75 mm IS sieve but not more than ten percent (10%) pass through a 150 micron IS sieve. These shall comply with the requirements of grading zones I, II, III, and IV of IS:383. Fine aggregates conforming to grade zone IV shall not be used for reinforced concrete works.

Fine aggregates shall consist of material resulting from the natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone, sand, or gravel. Sand from sea shores, creeks, or river banks affected by tides, dredged sand shall not be used for filling or concrete works.

#### **17.1.3.4 Sampling and Testing:**

Storage of all types of aggregates at the site of work shall be at the Contractor's expense and risk and shall be stored as specified in IS:4082. Aggregates shall in no case be stored near the excavated earth or directly over the ground surface.

Each type and grade of aggregate shall be stored separately on a hard, firm surface having an adequate slope for drainage of water.

Aggregates delivered at the site in wet condition or becoming wet due to rain or any other means shall not be used for at least 24 hours. The Contractor shall obtain prior approval of the Employer for the use of such aggregates and shall adjust the water content in accordance with IS:2386 to achieve the desired mix. In the absence of test results, and to allow variation in mass of aggregates and water content on account of moisture content, the Contractor can make suitable adjustments in the masses as per IS:456, for the preparation of nominal mix concrete only.

#### **17.1.4 Sand:**

##### **17.1.4.1 Sand for Masonry Mortars:**

The sand shall consist of natural sand, crushed stone sand or crushed gravel sand or a combination of any of these. The sand shall be hard, durable, clean, and free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS:2116.

The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft fragments, sea shells in such form or in such quantities as to adversely affect the hardening, strength or durability of the concrete.

Unless found satisfactory as a result of further tests as may be specified by the Employer, or unless evidence of such performance is offered which is satisfactory to him, the maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS:2386, shall not be

more than 5% by mass in natural sand, or crushed gravel sand or crushed stone sand. For organic impurities, when determined in accordance with IS:2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS:2386.

**17.1.4.2 Grading of Sand:**

The particle size grading of sand shall be within the limits as specified below:

Grading of Sand

IS Sieve Designation	Percentage	Method
IS:460 (Part I)	Passing by Mass	
4.75 mm	100	IS:2386 (Part I)
2.36 mm	90 – 100	
1.18 mm	70 – 100	
600 micron	40 – 100	
300 micron	5 to 70	
150 micron	0 to 15	

In case of a sand whose grading falls outside the specified limits due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings, which are by themselves unsuitable. Based on test results and in light of practical experience with the use of local materials, the Employer subject to the Contract may accept the proposal for a change in grading of sand. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

**17.1.4.3 Sampling and Testing:**

The method of sampling shall be in accordance with IS:2430. The amount of material required for each test shall be as specified in the relevant parts of IS:2386. Any test which the Employer may require in connection with this shall be carried out in accordance with the relevant parts of IS:2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) may be made in accordance with IS:2250 using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

**17.1.4.4 Sand for Filling:**

Sand for filling shall meet the requirements of IS:383 and shall be natural sand, hard, strong, free from any organic and deleterious materials. Any sand proposed for filling shall be used only after it is approved by the Employer. Sand obtained from seashores, creeks, or river banks affected by tides shall not be used for filling. Fine aggregates suitable for concreting works shall be suitable for filling also. No sand below grading zone-III as per IS-383 shall be allowed for filling.

**17.1.5 Cement:**

Cement to be used, for civil and structural works, shall be one of the following or in combination thereof, as per the relevant IS codes. For plain and reinforced concrete works minimum 43 grade ordinary Portland cement shall be used and the Contractor is required to quote on this basis only.

**17.1.5.1 Storage at Site:**

The storage of cement at the site of work shall be at the Contractor's expense and risk and shall meet the requirements of IS:4082. The cement shall be stored at least 30cm above ground/floor on a hard platform in a suitable weather-tight building or godown, and in such a manner as to permit easy access for proper inspection and also to prevent deterioration due to moisture.

All approved cement shall be arranged in batches with type, brand, and date of receipt flagged on them. A maximum of eight bags shall be stacked one over the other. Cement bags shall be used in the same order as received from the manufacturer i.e first cum first basis. The Contractor shall maintain a register, on a day-to-day basis, giving the details of the receipt/consumption, source of supply, and type of cement, etc. The register shall always be accessible to the SMPA for verification.

#### **17.1.5.2 Tests after Delivery:**

Each consignment of cement procured by the Contractor, along with the Manufacturer's test certificate, shall, after delivery at the Site and at the discretion of the SMPA, be subjected to any or all of the tests and analyses required by the relevant Indian Standard Codes.

#### **17.1.5.3 Rejection:**

The Employer may reject at his discretion any cement, notwithstanding the manufacturer's certificate, or failing to meet the requirements of the relevant IS Codes for testing of cement. He may similarly reject any cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or any other cause. Any cement that is considered defective shall not be used and shall be promptly removed from the site by the Contractor.

#### **17.1.6 Deleted.**

#### **17.1.7 Steel:**

##### **17.1.7.1 General:**

All steel bars, sections, plates, and other miscellaneous steel materials, etc. shall be free from loose mill scales, rust as well as oil, mud, paint or other coatings. The materials, construction specifications such as dimensions, shape, weight, tolerances, testing, etc. for all materials covered under this section, shall conform to respective IS Standards.

##### **17.1.7.2 Reinforcement Bars:**

Reinforcement bars, to be used for civil and structural works, shall be thermo-mechanically treated corrosion-resistant steel of grade equivalent to Fe-500, conforming to IS:1786. Reinforcement steel shall be purchased only from primary producers having an integrated Steel Plant(ISP) and using Iron Ore as the basic raw material, and having in-house Iron Rolling facilities followed by production of steel through the process of DRI-EAF, BF-BOF, and Corix-BOF only satisfying the provisions of IS:1786. The contractor shall produce the certificate issued by the cement manufacturers with documentary proof of process to establish that the cement is produced duly following the process as stated above, and that purchased from secondary suppliers shall not be accepted by The SMPA.

##### **17.1.7.3 Structural Steel:**

Structural steel to be used for general structural purposes shall be of grade A conforming to IS:2062. Structural steel sections shall conform to the following IS specifications.

Steel tubes for structural purposes	IS:1161
Mild Steel Tubes, tubulars, and other wrought steel fittings	IS:1239
Hollow steel sections for structural use	IS:4923

#### 17.1.7.4 Miscellaneous Steel Materials:

Miscellaneous steel materials shall conform to the following IS specifications.

Expanded Metal Steel Sheets for General Purposes	IS:412
Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement (grade I) (for mild steel bars of anchor bolts, rungs, metal inserts, grating etc.)	IS:432
Hexagonal head bolts, screws & nuts of product grade C	IS:1363
Cold formed light gauge structural steel sections	IS:811
Technical supply conditions for threaded steel fasteners	IS:1367
Plain washers	IS:2016
Steel wire ropes for general engineering purposes	IS:2266
Thimbles for wire ropes	IS:2315
Bulldog grips	IS:2361
Mild Steel Tubes, tubulars, and other wrought steel fillings. (for Handrail tubular sections).	IS:1239
Drop forged sockets for wire ropes for general engineering purposes	IS:2485
Steel chequered plates	IS:3502
Hexagonal bolts and nuts (M42 to M150)	IS:3138

#### Anchor Bolts:

Material for Anchor Bolts, such as MS bars, washers, nuts, pipe sleeves, and plates, etc., shall be as per the relevant IS Code 5624.

#### 17.1.7.5 Storage:

The storage of all materials at the site of work shall be at the Contractor's expense and risk and shall be done as per the requirements given in IS:4082. The Contractor shall maintain the proper records of receipt/consumption. The records shall always be accessible to the Employer for verification.

The reinforcement bars, structural steel sections, and other miscellaneous steel materials, etc., shall be stored in such a way as to avoid and prevent deterioration, corrosion, bending, twisting, and wrapping.

#### 17.1.7.6 Tests after Delivery:

Materials procured by the Contractor shall, after delivery at the site and at the discretion of the Employer, be subjected to any or all of the tests required by the relevant IS Codes. The Contractor shall carry out and bear the cost of such tests. The Contractor shall get himself satisfied regarding its quality before using the same in his works at his own expense.

#### 17.1.7.7 Rejection:

The Employer may reject at his direction any material, notwithstanding the manufacturer's certificate, failing to meet the requirements of relevant IS Codes for testing of materials. He may similarly reject any material, which has deteriorated or corroded etc., due to improper storage, handling or transport. Defective materials shall not be used and has to be removed from the site by the Contractor at his own expense.

#### 17.1.8 Bricks:

##### 17.1.8.1 General

Bricks for masonry works shall conform to IS:1077–Specification for common burnt clay building bricks and shall be of class 5.0 (with minimum compressive strength of 5.0N/mm<sup>2</sup>). Specific requirements for any other class of bricks shall be as shown in drawings or as described in the Contract for a particular site or

type of work. Physical requirements, quality, dimensions, tolerances, etc. of common burnt clay building bricks shall conform to the requirements of IS:1077.

Bricks shall be hand-moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough, and uniform in colour. These shall be free from cracks, chips, flaws, stone, or humps of any kind.

#### **17.1.8.2 Tests after Delivery:**

The Contractor shall make samples of each type of brick as directed by the Employer as per the requirements of IS: 5454, and tests shall be carried out as per IS: 3495. The cost for carrying out any or all the tests shall be borne by the Contractor. The bricks, when tested, as per IS: 3495, shall have a minimum average compressive strength, as given in the Code, for a particular class of brick. Water absorption shall not be more than 20% by its dry weight when soaked in cold water for 24 hours.

Brick samples so approved shall be deposited with the Employer. All subsequent deliveries shall be up to the standards of the approved samples.

#### **17.1.8.3 Stacking of Bricks:**

Bricks shall be stored at the site as per the requirements given in IS:4082 and shall not be dumped at the site. They shall be unloaded from trucks to a place on a levelled surface near the work site. They shall be stacked in regular tiers even as they are unloaded, to minimize breakages and defacement of bricks. The supply of bricks shall be so arranged that, as far as possible, at least two days' requirements of bricks are available at the site at any time. Bricks of different classes shall be stacked separately.

#### **17.1.8.4 Local Bricks:**

Where shown on drawings, locally available bricks of non-modular size (230 mm x 115 mm x 75 mm) in place of bricks of modular size (190 mm x 90 mm x 90 mm) can be used in case the bricks satisfy the other requirements of IS: 1077.

#### **17.1.9 Stones:**

**Deleted.**

#### **17.1.10 Admixtures:**

**17.1.10.1 General:** All concrete admixtures shall, in general, comply with the following Indian standards unless otherwise stipulated in this specification.

Specification for integral cement waterproofing compounds IS:2645

Specification for other admixtures for concrete IS:9103

Generally, admixtures shall have ISI certification marks. However, even in the case of BIS-certified admixtures, the Employer may require the Contractor to carry out and submit any or all the tests (as specified in relevant IS Codes), from approved laboratories, over and above the manufacturer's test certificate, before giving their final approval.

In case admixtures certified by BIS are not available, the Contractor shall submit to the Employer the type and/or proprietary brand of the admixture from only reputed manufacturers, along with necessary test certificates from recognized and approved laboratories or any other document directed by the Employer for the latter's final approval. In such cases, names of at least two manufacturers shall be submitted to the Employer for his selection. In case both names are rejected, the Contractor shall submit a fresh list of two manufacturers for approval by the Employer.

The Employer may direct the Contractor to submit test results as required by IS:2645 or IS:9103 for any admixture proposed to be used in the concrete in any approved laboratory at his discretion at any stage of the work. The cost of any/all tests required to satisfy compliance with this specification shall be borne by the Contractor.

In case of non-availability of any IS code for testing and acceptability criteria, the relevant British, American, or German Code shall be applicable in the order of preference.

Prior approval of the Employer shall be obtained while using water-reducing admixtures in the concrete (PCC/RCC) or mortar. Other types of admixtures, such as accelerating admixtures, retarding admixtures, or air-entraining admixtures, shall not be used unless prior approval is obtained from the Employer. Once approved, utmost care shall be taken at the site by the Contractor to maintain the consistency in the quality of admixture and the concrete/mortar so produced.

The suitability and effectiveness of any admixture shall be verified by trial with the designed concrete mixes using cement, aggregates, together with any other materials to be actually used in the works, as per the direction of the Employer. If two or more admixtures are to be used simultaneously in the same concrete mix, the Contractor must submit necessary test results from an approved laboratory to show their interaction and compatibility. Any/all tests specified in IS Codes shall be carried out only with the type of material and mix design, to be actually used in the work site.

No admixture shall impair the durability of the concrete, nor combine with the ingredients to form harmful compounds nor increase the risk of corrosion of reinforcement. Use of admixtures shall not reduce the dry density of concrete. Once the proportion of admixture has been established, strict checks shall be maintained not to alter the proportions of ingredients and water cement ratio of the Design Mix during execution. The chloride contents in admixtures shall not exceed 2% by mass of the admixture or 0.03% by mass of the cement. Admixtures which do not meet the requirements stipulated in this specification shall be rejected and shall not be used.

**17.1.10.2 Water Proofing Compounds:**

The permeability of the specimen with the admixture shall be less than half of the permeability with similar specimen without the use of these compounds. These compounds shall be used in such proportion as recommended by manufacturer but in no case it shall exceed 3% by weight of cement.

The initial setting time of the cement with the use of these compounds shall not be less than 30 minutes and final setting time shall not be more than 10 hours. Test shall be carried out in accordance with IS:4031.

Compressive strength of specimen at 3 days shall not be less than 270 kg/sq.cm. nor 90% of the 3 days compressive strength of mortar cubes prepared with same cement and sand only, whichever is higher. Similarly compressive strength at 7 days shall not be less than 370 kg/sq.cm. nor less than 90% of the 7 days compressive strength prepared with the same cement and sand only, whichever is higher. The test to determine the compressive strength shall conform to IS:4031.

**17.1.11 Water Bars (Water Stops):**

PVC water bars shall be used in reinforced concrete construction of liquid retaining structures or any other structure to safeguard them from hydrostatic pressure and water leakage and any relative movement between two parts of the structure due to thermal loading shrinkage or differential movement of foundations. These shall be pre-formed and shall provide a permanent watertight seal along the entire joint in the poured concrete structures. These shall also be flexible enough to withstand deflection/displacements at joints arising due to variation of temperatures or settlement of foundations. This shall be able to withstand a water head of at least 12 metres.

Performance requirements of PVC water bars shall meet the requirements of IS:12200. These shall be of approved make and of ribbed/serrated/plane type with a bulb at the centre. The thickness shall not be less than 5 mm and width less than 150 mm. The joining of the water bars shall be carried out by vulcanizing strictly as per the manufacturer’s specifications. Lapped joints shall not be allowed under any circumstances.

**17.1.12 Bitumen/Bituminous Materials:**

Bitumen to be used for various types of work shall meet all the requirements of relevant IS Codes as given below:

Specification of Paving Bitumen	IS:73
Specification for bitumen mastic for flooring	IS:1195

Specification for bitumen felts for water proofing and damp proofing	IS:1322
Specification for Bituminous compounds for water proofing and caulking purposes	IS:1834
Specification for preformed fillers for expansion joint in concrete pavements and structures	IS:1838
Specification for bitumen mastic for use in water proofing of roofs	IS:3037
Specification for bitumen primer for use in water proofing and damp proofing	IS:3384
Specification for Bitumen Mastic for Tanking and Damp proofing	IS:5871
Specification for Glass fibre base coal tar pitch & bitumen felts	IS:7193
Code of practice for damp proofing using bitumen mastic	IS:7198
Specification for bitumen Mastic, Anti Static and electrically conducting grade	IS:8374

The type and grade shall be as shown on the drawings or as directed by Employer. Tests and acceptable criteria shall be as per the relevant IS Codes.

#### **17.1.13 PVC Pipes:**

PVC Pipes shall conform to the requirements of IS:4985.

#### **17.1.14 Wood/Timber:**

Timber required to be used for formwork shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS:4082.

For proper identification and selection of suitable timber for formwork, following codes shall be referred.

Classification of commercial timbers and their zonal distribution IS:399.

Specification for ballies for general purposes IS:3337.

Specification for plywood for concrete shuttering work IS:4990.

#### **17.1.15 Paint:**

##### **17.1.15.1 General:**

All paints shall be of an approved quality and shall be obtained from only those suppliers and makers who have been in the market for a period of not less than 5 years. All paints shall conform to the appropriate Indian Standards for ready mixed paints where applicable. All paints, undercoats, primers, and finishing paint shall be supplied in sealed containers. The Engineer may, if he so wishes, take samples for analysis at the Contractor's expense. Wood preservative shall be of chemical type comprising copper-chrome-arsenic composition conforming to IS 401-1967. All paints shall be stored in cool and dry conditions and clear of other stores to the satisfaction of the Engineer.

##### **17.1.15.2 Painting:**

All structural steel work and metals, including handrails, brackets & exposed surfaces of steel inserts, shall be painted except if otherwise specified.

The operations, workmanship, schedules, and equipment for painting shall generally comply with the requirements of IS:1477 (Parts I & II) "Code of Practice for Painting of Ferrous Metals in Buildings." except insofar as this Specification modifies it.

All surfaces shall be thoroughly cleaned of all foreign matter adhering to the steel surface to Swedish Standard specification Sa 2 1/2 by means of blasting with sand. Use of a scraper, wire brush, and pig hammer is acceptable wherever blasting with sand is not possible due to a lack of access. All painting shall be carried out by brushing. Spray and roller application of paint shall not be allowed without the written permission of the Engineer. Painting shall generally be done immediately after cleaning. The cleaned surface shall not be allowed to stand overnight before painting. Where galvanized surfaces are to be

painted, they shall be cleaned and washed with a solution of copper sulphate before the application of the first coat of primer.

No painting shall commence until the cleaned surfaces have been approved by the Engineer. All steelwork unless specified otherwise, shall be painted as per the following schedule:

- a) Two coats of epoxy base zinc rich primer (92% zinc on dry film) shall be applied. The dry film thickness of two coats shall be 60 microns minimum.
- b) After the application of primer, all surfaces shall receive two coats of coal tar epoxy or any other high build epoxy compatible with the primer. The finish paint shall be applied to establish an enduring protection of the prime coat. It shall be resistant to atmospheric heat, reflect heat and rays and withstand mechanical stresses without crumbling. The total dry film thickness for these 2 coats shall be 200 microns minimum. The colours for the finishing coats shall be as approved by the Engineer.
- c) Total dry film thickness for the system shall be 260 microns minimum.
- d) For steel work intended to be painted only at Site, a primary coat of Red Oxide Zinc Chromate shall be given at the shop before dispatch.

#### **17.1.16 Polysulphide Sealants:**

All Polysulphide Sealants shall conform to IS:12118 and be of approved make. Test conditions and requirements shall be as given in the above referred IS code.

### **17.2 Plain and Reinforced Concrete Works:**

#### **17.2.1 General:**

The section of the specifications includes requirements for furnishing and placing all plain and reinforced cement concrete, including form work, reinforcement, and incidental works required for the completion of this Contract and herein specified.

This specification establishes the materials, mixing, placing, curing, etc. of all types of cast-in-situ and precast concrete used in rigid pavement, crown wall, underground and overground structures, floors etc. Any special requirements as shown shall supersede the provisions of these specifications.

Apart from this specification, construction of concrete works shall be in accordance with the Indian Standard Code of Practice for "Plain and Reinforced Concrete" IS:456 and other relevant codes mentioned therein.

In case of conflict between the clauses mentioned in this specification and those in the Indian Standards, this specification shall govern.

#### **17.2.2 Materials**

Materials for concrete viz cement, sand, coarse aggregate, water, etc. shall be as described in under specification of 'Materials'.

Materials for all reinforcements, embedment, inserts, water bars, etc. shall conform to specification of 'Materials'.

#### **17.2.3 Grades of Concrete:**

Unless otherwise noted, the grades of concrete shall generally be as per Table 17.1.

Table 17.1 Grades of Concrete

Grade Designation	Characteristic Compressive Strength of 15 cm cube at 28 days (N/mm <sup>2</sup> )
M 15	15
M20	20
M25	25
M30	30
M35	35
M40	40

The characteristic strength is defined as the strength of material, below which not more than five (5) percent of the test results are expected to fall.

**17.2.4 Type of Concrete Mix:**

Unless otherwise noted all lean and reinforced concrete shall be nominal mix and design mix types respectively.

**17.2.4.1 Nominal Mix Concrete:**

This concrete shall be made (without preliminary tests) by adopting nominal concrete mix with proportions of materials as specified in Table 17.2.

Table 17.2 Proportions for Nominal Mix Concrete

Nominal mix of concrete (by mass)	Quantity of water per 50 Kg of cement (max) / Liters
1:5:10	60
1:4:8	45
1:3:6	34
<p>Note:</p> <p>1. The proportions of the fine to coarse aggregates should be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregates becomes larger. Graded coarse aggregates shall be used.</p> <p>2. The cement content of the mix shall be proportionately increased if the quantity of water in a mix has to be increased to overcome the difficulties of placement and compaction, so that the watercement ratio, as specified, is not exceeded.</p>	

**17.2.4.2 Design Mix Concrete:**

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in Table 17.1 above.

As long as the quality of materials does not change, a mix design done earlier shall be considered adequate for later work. However, in case the quality of materials changes, the Employer may ask for a new design mix.

While designing the mix, the durability requirements as given in IS:456 shall also be taken into account.

**17.2.5 Concrete Mix Proportioning:**

Proportioning, as used in this specification, shall mean the process of determining the proportions of the various ingredients to be used to produce concrete of the required strength, workability, durability and other properties.

The Employer shall verify the strength of the concrete mix, before giving his sanction of its use. However, this does not absolve the Contractor of his responsibility as regards achieving the prescribed strength of the mix. If during the execution of the work, cube tests show lower strengths than required, the Employer shall order fresh trial mixes to be made by the Contractor. Any variation in cement consumption shall be taken into consideration for material reconciliation. Preliminary mix designs shall be established well ahead of start of work. The design mix shall conform to the guidelines of IS:10262.

**17.2.5.1 Maximum Density:**

Suitable proportions of sand and the different sizes of coarse aggregates for grade of concrete shall be selected to give as nearly as practicable the maximum density. This shall be determined by mathematical means, laboratory tests, field trials and suitable changes in aggregate gradation. The Contractor shall submit to the Employer at least three sets of mix design and corresponding test results after varying the

mix proportions and / or grading of aggregate so as to establish the maximum density of any particular grade of concrete.

**17.2.5.2 Water-Cement Ratio:**

Once a mix, including its water-cement ratio, has been determined and approved for use by the Employer, that water-cement ratio shall be maintained. The Contractor shall determine the water content of the aggregates frequently as the work progresses, and the amount of mixing water shall be adjusted so as to maintain the approved water-cement ratio. Maximum water-cement ratio shall never exceed the values given in IS:456 and IS:4651 for various exposures and sulphate attack conditions from durability considerations.

**5.2.5.3 Consistency:**

The concrete shall have a consistency such that it shall be workable in the required position and, when properly vibrated, it flows around reinforcing steel, all embedded fixtures, etc.

**5.2.5.4 Workability:**

The concrete mix proportion shall be such that the concrete is of adequate workability for the placing condition and can be properly compacted with the means available. Use of plasticiser/superplasticiser of approved make shall be taken recourse to where required for attaining proper workability as specified in the table below. However, prior written approval of the Employer shall be obtained for any such use of plasticiser/super-plasticiser before submitting the proposed design-mix for approval. Where adequate workability is difficult to obtain at the maximum permissible water-cement ratio, increased cement content shall also be alternatively considered while designing the mix proportions.

The suggested ranges of values of workability of concrete measured in accordance with IS: 1199 are indicated in Table 17.3 below. However, the actual values to be followed shall be established depending on aggregate sizing, mix proportions, placing conditions, etc. and shall be got approved by the Employer.

Table 17.3 Values of Workability

Placing conditions	Degree of workability	Values of workability
Concreting of shallow sections with vibration	Very low	20-10 seconds vee-bee time or 0.75-0.80 compacting factor
Concreting of lightly reinforced sections with vibration	Low	10-5 seconds vee-bee time or 0.80-0.85 compacting factor
Heavily reinforced sections with vibration	Medium	5-2 seconds vee-bee time or 0.89-0.92 compacting factor or 25-75mm slump for 20mm aggregate

**17.2.5.5 Durability:**

For achieving sufficiently durable concrete, strong, dense aggregates, low water-cement ratio and adequate cement content shall always be used. Workability of concrete shall be such that concrete can be completely compacted with the means available. Leak-proof formwork shall be used so as to ensure no loss of cement-slurry during pouring and compaction. Cover to reinforcement shall be uniform and as per standard codes. Concrete mix design shall always take into account the type of cement, minimum cement content irrespective of the type of cement and maximum water-cement ratio conforming to the exposure conditions as given in below table.

Table 5.4 Minimum Cement Content and Maximum Water Cement Ratio for Durability

Exposure	Type of Cement	Plain Concrete		Reinforced Concrete	
		Minimum Cement Content (Kg./m3)	Maximum Water Cement Ratio	Minimum Cement Content (Kg./m3)	Maximum Water Cement Ratio

Normal	OPC*PPC* PSC*	Nominal mix	0.6	300	0.55
Moderate	OPC* PPC* PSC	250	0.6	350	0.50
Severe	SSC* PSC* SRC	310	0.45	400	0.45

Note:

1: Severe exposure shall include structures exposed to sea or saline water (e.g. tidal rivers, brackish water, estuaries etc.), alternate wetting and drying, freezing whilst wet and subject to heavy condensation or corrosive environment. This shall also include structures exposed to sulphate and/or chloride attack due to presence of these chemicals in Soil and ground water. Total SO<sub>3</sub> content of 0.2% and above in Soil and 300 ppm in ground water shall be considered to constitute severe exposure. Similarly, chloride (as Cl) content exceeding 1500 ppm in ground water or soil shall be considered as severe exposure condition.

2: Structures subjected to aggressive environment below the minimum limits expressed in Note-1 above and/or those in industrial/chemical plants atmosphere shall be considered under moderate exposure. Also, any concrete structure in contact with water or retaining water or any other liquid not usually harmful to concrete shall be considered under moderate exposure.

3: All other environmental conditions not covered under Notes-1&2 shall be categorized under Normal exposure.

\* OPC - Ordinary low heat Portland Cement

\* PPC - Portland Pozzolana Cement

\* PSC - Portland Slag Cement

\* SRC - Sulphate Resistant Cement

\* SSC - Super Sulphated Cement

#### 17.2.6 Batching:

In proportioning concrete, the quantity of both cement and aggregate shall be determined by mass. Where the mass of cement is determined on the basis Of mass of cement per bag, a reasonable number of bags shall be weighed periodically to check the net mass. Where the cement is weighed at site and not in bags, it shall be weighed separately from the aggregates. Water shall be either measured by volume in calibrated tanks or weighed. Any solid admixtures that are to be added shall be measured by mass; liquid and paste admixtures shall be measured by volume or mass. Batching plant, where used, shall conform to IS:4925. All measuring equipment shall be maintained in a clean serviceable condition, and their accuracy periodically checked.

Except where it can be shown to the satisfaction of the Employer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, different sizes being stacked in separate stock piles. The grading of coarse and fine aggregates shall be checked frequently, the frequency for a given job being determined by the Employer to ensure that the approved grading is maintained.

Under special circumstances, change from weigh batching to appropriate volume batching may be permitted by Employer on specific request from the Contractor. However, in such cases all conversions from mass of ingredients to volume shall be based on actual and appropriate bulk densities physically measured at site and approved by the Employer.

The amount of added water shall be adjusted to compensate for any observed variations in the moisture contents in both fine and coarse aggregates. For the determination of moisture content in the aggregates, IS:2386 (Part-111) may be referred to. To allow for the variation in mass of aggregates due to variation in their moisture content, suitable adjustments in the mass of aggregate shall also be made. In the absence of exact data, only in the case of nominal mixes, the amount of surface water may be estimated from the values given below.

Table 17.5 Surface Water Carried by Aggregate

Aggregate	Approximate Quantity of Surface	
	Percent by mass	Litre / m3
Very wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist Gravel or Crushed Rock	1.25-2.5	20-40

No substitutions in materials used on the work or alterations in the established proportions, except as permitted shall be made without additional tests to show that the quality and strength of concrete are satisfactory. In case the Contractor proposes any change in the already approved mix design, a fresh mix design with supportive laboratory tests shall be submitted to the Employer, and his approval has to be obtained prior to using the revised mix proportion in the works. However, such proposals for revision shall only be entertained in case of successive failure of test cubes to achieve the required strength.

### 17.2.7 Concrete Mixing:

The mixing of concrete shall be strictly carried out in an approved type of mechanical concrete mixer. The mixing shall be continued until there is a uniform distribution of the material and the mass is uniform in colour and consistency. If there is segregation, after unloading from the mixer, the concrete shall be remixed.

#### 17.2.7.1 Mixer:

Mixers shall comply with IS: 1791 and shall be maintained in satisfactory operating condition. The mixer drum shall be kept free of hardened concrete, and blades shall be replaced when worn down more than ten percent (10%) of their depth. Should any mixer at any time produce unsatisfactory results, leak mortar or cause waste of materials, its use shall be promptly discontinued until it is repaired.

#### 17.2.7.2 Mixing Time:

Mixing time shall be as indicated in the following table. Excessive mixing requiring additions of water shall not be permitted. Time shall start when all solid materials are poured into the revolving mixer drum, provided that all of the mixing water shall be introduced before one-fourth of the mixing time has elapsed. The Employer may, however, direct a change in the mixing time if he considers such a change necessary.

Capacity of mixer	Minimum Mixing time
2 m3 or less	1½ minutes
3m3	2½ minutes
5m3	3 minutes

All records and charts for the batching and mixing operations shall be prepared and maintained by the Contractor as per the instructions of the Employer.

#### 17.2.7.3 Hand Mixing:

Hand mixing of concrete shall not be permitted. However, for non-critical structures located at faraway isolated places, this may be permitted by the Employer as a special case. Ten percent (10%) extra cement shall have to be added to the normal mix when mixed by hand. It shall be carried out on a watertight platform, and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. No extra payment shall be made to the Contractor for mixing by hand or for using extra cement due to hand mixing. However, extra cement consumed shall be considered for reconciliation purposes where such concreting is allowed by the Employer.

#### **17.2.7.4 Admixtures:**

Admixtures in concrete shall be used only with the prior approval of the Employer. Any admixture used for obtaining proper workability or leak-proofness of concrete or repair/rendering works of concrete due to non-conformance to the specifications shall not be measured and paid for.

#### **17.2.8 Transportation, Placing and Compaction:**

The entire concrete placing programme, including transportation arrangements, deployment of equipment, lay out, proposed procedures and methods, shall be submitted to the Employer 24 hours prior to concreting, for approval. No concreting shall be placed until his approval has been received. Approval of the Employer for pouring concrete shall be taken as 'conveyed', when the concrete pour card is signed by him.

##### **17.2.8.1 Chuting:**

The use of long troughs, chutes, and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization from the Employer. In case an inferior quality of concrete is produced by the use of such conveyors, the Employer may order discontinuance of their use and the substitution of a satisfactory method of placing the concrete. Open troughs and chutes shall be equipped with baffles and be in short lengths to avoid segregation. Chutes shall be designed so that the concrete is, to some extent, remixed at the lower end by passing down through a funnel-shaped pipe or drop chute. Alternatively, they shall discharge into a storage hopper from which the concrete shall be transported to the point of placing by wheelbarrows or other means. Where drop chutes are used, a sufficient number of these must be provided so that the concrete discharged from the chute is not required to flow laterally more than 1.0 metre. Where a drop chute is swung from the vertical, the bottom two sections must be maintained in a vertical position to avoid segregation. The addition of water at any point in the system of transportation, to facilitate the movement of concrete, shall not be permitted. All chutes, troughs, and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing them with water after each run; water used for flushing shall be discharged clear of the structure. Concrete shall not normally be permitted to fall freely from a height of more than 1.5 metres nor to strike the forms at an angle. However, a deviation from this normal practice may be allowed provided proper precaution is taken, while placing concrete into the forms to avoid segregation, to the satisfaction of the Employer.

##### **17.2.8.2 Vibrators:**

Concrete shall be compacted with mechanical vibrating equipment supplemented, if necessary, to obtain consolidation, by hand spreading, rodding, and tamping. The vibrators shall be of immersion type with operational frequency ranging between 8,000 and 12,000 revolutions per minute. All vibrators shall comply with IS:2505. Screed board concrete vibrators or concreting vibrating tables or form vibrators conforming to IS:2506, 2514, and 4656, respectively, shall be used where specifically required and directed by Employer. Immersion-type vibrators shall be inserted in a vertical position at intervals of about 600mm, depending upon the mix, the equipment used, and experience on work. The vibrators shall be withdrawn slowly. The spacing shall provide some overlapping of the area vibrated at each insertion. In no case shall vibrators be used to transport concrete inside the forms. Over vibration or under vibration shall not be permitted as both are harmful. Hand tamping, in some cases, may be allowed subject to the approval of the Employer.

In placing concrete in layers which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, bonding and moulding of the concrete between the succeeding batches.

The vibrator shall penetrate the layer being placed and also penetrate the layer below while the underlayer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

Care shall be taken to prevent contact of vibrators against all embedded reinforcing steel or inserts. Vibrators shall not be allowed to come in contact with forms.

The use of form vibrators shall not be permitted for compaction of in-situ concrete without specific authorization of the Employer.

The use of surface vibrators of screed board type shall not be permitted for consolidation of concrete under ordinary conditions. However, for thin slabs (of thickness less than 200mm) surface vibration by such vibrators may be permitted, upon approval of the Employer.

Whenever vibration has to be applied externally, the design of formwork and the disposition of vibrators shall be carefully planned to ensure efficient compaction and to avoid surface blemishes.

#### **17.2.8.3 Transportation:**

All concrete shall be conveyed from the mixer to the place of final deposit as rapidly as possible in suitable buckets, dumpers, containers, or conveyors, which shall be mortar leak-tight. Care shall be taken to prevent the segregation or loss of the ingredients and to maintain the required workability.

During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted. All equipment used for transporting and placing concrete shall be maintained in a clean condition. All buckets, hoppers, chutes, dumpers, and other equipment shall be thoroughly cleaned after each use.

#### **17.2.8.4 Placing and Compaction:**

Before placing concrete, all surfaces upon which or against which concrete is to be placed shall be well compacted and free from standing water, mud or debris. The surface of absorptive soil (against which concrete is to be placed) shall be moistened thoroughly so that moisture is not drawn from the freshly placed concrete.

Concrete shall not be placed until the formwork, the placement of reinforcing steel, embedded parts, pockets etc. have been inspected and approved by the Employer. Any accumulated water on the surface of the bedding layer shall be removed by suitable means before start of placement. No concrete shall be placed on a water-covered surface.

Concrete shall be discharged by vertical drop only and the drop height shall not normally exceed 1.5m throughout all stages of delivery until the concrete comes to rest in forms. For continuous concreting operation windows of suitable size shall be kept in the formwork or chutes shall be used to avoid segregation of concrete.

Concrete shall be deposited as near as practicable in its final position to avoid rehandling. Concrete shall be placed in successive horizontal layers. The bucket loads, or other units of deposit, shall be placed progressively along the face of the layer with such over-lap as will facilitate spreading the layer of uniform depth and texture with a minimum of hand shoveling. Any tendency to segregation shall be corrected by shoveling coarse aggregates into mortar rather than mortar on the coarse aggregates.

Such a tendency for segregation shall be corrected by redesign of mix, change in process or other means, as directed by the Employer.

All struts, stays and braces (serving temporarily to hold the forms in correct shape and alignment pending the placing of concrete at their locations) shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These shall not be buried in the concrete.

Concrete shall be thoroughly compacted with vibrators and fully worked around the reinforcement, embedded fixtures and into corners of formwork before setting commences and shall not be subsequently disturbed. Methods of placing shall be such as to preclude segregation. The formation of stone-pockets or mortar bondage in corners and against face forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding as directed by the Employer. Care shall be taken to avoid displacement of reinforcement and embedded inserts or movement of formwork.

Unless otherwise approved, concrete shall be placed in single operation to the full thickness of foundation rafts, slabs, beams and similar members. Concrete shall be placed continuously until completion of the part of the work between approved construction joints or as directed by the Employer.

The method of placing and compaction employed in any particular section of the work shall be to the entire satisfaction of the Employer.

During hot weather (atmospheric temperature above 40 degree Celsius) or cold weather (atmospheric temperature below 5 degree Celsius), the concreting shall be done as per the procedure set out in IS:7861. Concrete that has set standing and becomes stiffened shall not be used in the work.

#### **17.2.8.5 Items Embedded in Concrete :**

Concreting shall not be started unless the electrical conduits, pipes, fixtures etc., wherever required, are laid by the concerned agency. The Contractor shall afford all the facilities and maintain coordination of work with other agencies engaged in electrical and such other works as directed by the Employer.

Before concreting, the Contractor shall provide, fabricate and lay in proper position all metal inserts, anchor bolts, pipes etc. (which are required to be embedded in concrete members) as per relevant drawings and directions of Employer.

All embedment, inserts etc. shall be fully held and secured in their respective positions by the concerned agencies to the entire satisfaction of Employer so as to avoid any dislocation or displacement during the concreting operations. The Contractor shall take all possible care during concreting to maintain these embedment/inserts in their exact locations.

#### **17.2.9 Construction Joints:**

Construction joints shall be provided in position as described in the drawings or as directed by the Employer. Such joints shall be kept to the minimum. These shall be straight and at right angles to the direction of main reinforcement.

When the work has to be resumed on a surface, which has hardened, such surface shall be cleared of any foreign materials and roughened to expose the tips of the coarse aggregate. It shall then be swept clean and thoroughly washed and wetted before any new concrete is poured. Any set mortar or concrete sticking to the exposed reinforcing rods in and around such joints shall be thoroughly removed. The reinforcements shall be wire brushed and washed just before pouring any cement slurry or mortar. For vertical joints neat cement slurry shall be applied on the surface before it is dry.

For horizontal joints the surface shall be covered with a layer of mortar about 10 to 15mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry or mortar shall be freshly mixed and applied immediately before placing new concrete.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgment of particles of aggregate. The surface shall be thoroughly wetted, and all free water removed. The surface shall then be coated with neat cement slurry. On this surface, layer of concrete not exceeding 150mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots; work thereafter shall proceed in normal way.

#### **17.2.10 Separation Joint:**

Separation joint shall be obtained by using an approved alkathene sheet stuck on the surface against which concrete shall be placed. Adequate care shall be taken to cause no damage to the sheet.

#### **17.2.11 Expansion Joints/Isolation Joint:**

Expansion/Isolation joints in structures shall be formed in the positions and to the required shapes.

Isolation joints shall be provided around all equipment foundations, columns, pedestals, trenches, etc. on grade.

#### **17.2.12 Water Stops:**

PVC water stops as per specifications under 'Materials' shall be accurately cut, fitted and integrally joined as per manufacturer's specifications to provide a continuous, watertight diaphragm at all points.

The water stops shall be located and embedded at expansion/contraction/ construction joints.

Adequate provision shall be made for the support and protection of water stops during the progress of the work. Damaged water stops shall be replaced and/or repaired as directed.

**17.2.13 Protection of Freshly Laid Concrete:**

Newly placed concrete shall be protected by approved means from rain, sun, and wind.

**17.2.14 Curing:**

Concrete shall be cured by keeping it continuously moist wet for the specified period of time to ensure complete hydration of cement and its hardening. Curing shall be started after 8 hours of placement of concrete, and in hot weather after 4 hours. The water used for curing shall be of the same quality as that used for making of concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances such as hose, sprinklers etc. A layer of sacking, canvas, hessian, or other approved material, which will hold moisture for long periods and prevent loss of moisture from the concrete, shall be used as covering. Type of covering which would stain, disfigure, or damage the concrete, during and after the curing period, shall not be used. Only approved covering shall be used for curing.

Exposed surfaces of concrete shall be maintained continuously in a damp or wet condition for at least the first 7 days after placing of concrete, except that high early strength concrete shall be so maintained for at least the first 3 days.

The Contractor shall have all equipment and materials required for curing on hand and ready to use before concrete is placed.

For curing the concrete in pavements, the ponding method of curing is preferred after the expiry of the first 24 hours, during which (i.e., first 24 hours) the concrete shall be cured by use of wet sacking, canvas, hessian etc. The minimum water depth of 25mm for ponding shall be maintained. The method of containing the ponded water shall be approved by the Employer. The ponded areas shall be kept continuously filled with water, and leaks, if any, shall be promptly repaired. Areas cured by ponding method shall be cleared of all debris and foreign materials after curing is over.

Alternatively, membrane curing may be used in lieu of moist curing with the permission of the Employer. Such compounds shall be applied to all exposed surfaces of the concrete by spraying or brushing as soon as possible after the concrete has set. Minimum film thickness of such curing compounds shall be as per the recommendation of the manufacturer. This film of curing compound shall be fully removed from the concrete surface after the curing period specified earlier. Employer may not allow curing by curing compounds for those surfaces where use of curing compound may be detrimental to future finishes.

**17.2.15 Field Tests:**

**17.2.15.1 Grading Test:**

Grading test on fine and coarse aggregates shall be carried out as per IS:2386 at intervals specified by the Employer. The mandatory tests and their frequencies shall be done on sand and stone aggregates as given in table below.

Sl. No.	Material	Test	Field/Lab Test	Minimum Qty of Material/ Work for Carrying out the Test	Frequency of Testing
1	Sand	(a) Bulking of Sand	Field	20m <sup>3</sup>	Every 20 m <sup>3</sup> or part thereof or more frequently as decided by the Employer.

		(b) Silt content	Field	20m <sup>3</sup>	-DO-
		(c) Particle size distribution	Field or Lab as decided by the Employer	40 m <sup>3</sup>	1) Every 40 m <sup>3</sup> of fine aggregate/ sand required in RCC works only 2) Every 80 m <sup>3</sup> of fine aggregate/sand required for other items.
2	Store aggregate	a) Percentage of soft or deleterious materials	General visual inspection, laboratory test where required by the Employer or as specified	As required by Engineer	For all quantities
		b) Particle size distribution	Field or lab as required by Employer	45 m <sup>3</sup>	For every 45 m <sup>3</sup> or part thereof as decided by Employer
		Ten percent Fine value	Laboratory	45 m <sup>3</sup>	Initial test and subsequent test as & when required by Employer.

**Table 17.6 Mandatory Tests on Sand & Stone Aggregates**

**17.2.15.2 Vee-Bee Test/Slump Test of Concrete:**

At least one Vee-Bee Test/Slump Test shall be made for every compressive strength test carried out. More frequent tests shall be made if there is a distinct change in working conditions or if required by the Employer.

**17.2.15.3 Strength Test of Concrete:**

Samples from fresh concrete shall be taken as per IS: 1199, and cubes shall be made, cured, and tested at 28 days in accordance with IS:516. In order to get a relatively quicker idea of the quality of concrete, optional tests on beams for modulus of rupture at 72+2 hours or at 7 days, or compressive strength tests at 7 days, may be carried out in addition to 28-day compressive strength tests. For this purpose, the values given in Table 17.7 may be taken for general guidance in the case of concrete made with ordinary Portland cement. In all cases, the 28-day compressive strength specified in Table 17.1 shall alone be the criterion for acceptance or rejection of the concrete from strength consideration. If, however, from tests carried out in a particular work over a reasonably long period, it has been established to the satisfaction of Employer that a suitable ratio between 28 days compressive strength and the modulus of rupture at 72+2 hours or compressive strength at 7 days may be accepted, the Employer may suitably relax the frequency of 28 days compressive strength specified in Clause 17.2.3, provided the expected strength values at the specified early age are consistently met. However, a set of test cubes for a 28-day strength test shall always be taken and maintained to cater to any contingencies in the event of failure of the 7-day strength.

**Table 17.7 Test Requirement of Concrete**

Grade of Concrete	Compressive strength on 15 cm cubes, minimum at 7 days (N/mm <sup>2</sup> )	Compressive strength on 15 cm cubes, minimum at 28 days (N/mm <sup>2</sup> )	Modulus of Rupture by Beam Test, at minimum	
			72±2 hours (N/mm <sup>2</sup> )	7 days (N/mm <sup>2</sup> )
M15	10.0	15	1.5	2.1
M20	13.5	20	1.7	2.4
M25	17.0	25	1.9	2.7
M30	20.0	30	2.1	3.0
M35	23.5	35	2.3	3.2
M40	27.0	40	2.5	3.4

**17.2.15.4 Procedure:**

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested, that is the sampling should be spread over the entire period of concreting and cover all mixing units.

**17.2.15.5 Frequency of Sampling:**

The minimum frequency of sampling of concrete for each grade shall be in accordance with the following:

Quantity of concrete in the work in m <sup>3</sup>	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4
51 & above	4 plus one additional sample for each additional 50m <sup>3</sup> or part thereof

NOTE: At least one sample shall be taken from each shift.

**17.2.15.6. Test Specimen:**

Three test specimens shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes, such as to determine the strength of concrete at 7 days or at the time of striking the formwork, to determine the duration of curing, or to check the testing error.

Additional cubes may also be required for testing cubes cured by accelerated methods as described in IS:9013. The specimen shall be tested as described in IS:516.

### 17.2.15.7. Test Strength of Sample:

The test strength of the sample shall be the average of the strength of three specimens. The individual variation should not be more than 15 percent of the average.

### 17.2.15.8. Standard Deviation:

i) Standard deviation based on test results:

a) Number of test results: The total number of test results required to constitute an acceptable record for the calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results as early as possible, when a mix is used for the first time.

b) Standard deviation to be brought up to date: The calculation of the standard deviation shall be brought up to date after every change of mix design and at least once a month.

ii) Determination of Standard Deviation:

a) Concrete of each grade shall be analysed separately to determine its standard deviation.

b) The standard deviation of concrete of a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified in 2.15.7

$$\text{Estimated standard deviation}(s) = \sqrt{\frac{\sum \Delta^2}{n - 1}}$$

$\Delta$  = deviation of the individual test strength from the average strength of n samples

n = number of sample test results

c) When significant changes are made in the production of concrete | batches (for example, changes in the materials used, mix design, equipment or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

iii) Assumed Standard Deviation: Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table 5.8 may be assumed.

**Table 17.8 Assumed Standard Deviation**

Grade of Concrete	Assumed Standard Deviation (N/mm <sup>2</sup> )
M 15	3.5
M 20	4.6
M 25	5.3
M 30	6.0
M 35	6.3
M 40	6.6

However, when adequate past records for a similar grade exist and justify to the Employer, a value of standard deviation different from that shown in Table 5.8, it shall be permissible to use that value.

### 17.2.15.9 Acceptance Criteria:

The acceptance criteria for concrete shall be as per IS456:2000. Concrete shall be assessed daily for compliance.

Concrete is liable to be rejected if it is porous or honey-combed; its placing has been interrupted without providing a proper construction joint; the reinforcement has been displaced beyond the tolerances specified; or construction tolerances have not been met.

### **17.2.16 Inspection and Testing of Structures:**

#### **17.2.16.1 Inspection:**

Immediately after stripping the formwork, all concrete shall be carefully inspected, and defective work or small defects, if any, shall either be removed or made good before the concrete has thoroughly hardened.

#### **17.2.16.2 Testing of Structures or Parts of Structures:**

In case the results of work test cubes do not comply with the specified strength requirements or there is reasonable doubt regarding the strength of concrete used, either due to poor workmanship or materials, the Employer may instruct the Contractor to perform additional tests as felt necessary by SMPA and/or load test as specified in Clause 5.2.16.3 to ascertain the quality of concrete. These tests shall also be required to be carried out in the event the Employer is doubtful regarding the adequacy of the strength of the structure due to suspected overloading during construction, premature removal, and nonconformance to the specification of formwork, improper curing, or any other reason. The number and type of tests to be carried out shall be determined by the SMPA, whose decision shall be final and binding on the Contractor.

#### **17.2.16.3 Load Test:**

Load test, where directed by the Employer, shall be carried out as soon as possible after expiry of 28 days from the time of placing of concrete. The structure shall be subjected to a load equal to the full dead load of the structure (which shall include Self self-weight of Structural members plus the weight of finishes) plus 1.25 times the imposed load (for which the structure has been designed) for a period of 24 hours, and then the imposed load shall be removed. The deflection due to the imposed load only shall be recorded. If, within 24 hours of removal of the imposed load, the structure does not recover at least 75 percent of the deflection under imposed load, the test shall be repeated after a lapse of 72 hours. If the recovery is less than 80 percent, the structure shall be deemed to be unacceptable.

If the maximum deflection in mm, shown during 24 hours under load, is less than  $40 L^2/D$ , where L is the effective span in meters and D is the overall depth of the section in mm, the recovery doesn't need to be measured, and the recovery provision as given above shall not apply.

The Employer shall be the final authority for interpreting the results of all tests and shall decide upon the acceptance or otherwise. The decision of the Employer shall be final and binding on the Contractor. In case the results of the tests are unsatisfactory, the Employer may instruct the Contractor to demolish and reconstruct the structure.

### **17.2.17 Finishing of Concrete:**

On striking the form work, all surface defects such as bulges, ridges, and honey-combing, etc., observed shall be brought to the notice of the Employer. The Employer may, at his discretion allow rectification by necessary chipping and packing or grouting with concrete or cement mortar. However, if honey-combing or sagging is of such extent as being undesirable, the Employer may reject the work totally, and his decision shall be binding. No extra payment shall be made for rectifying these defects, demolishing, and reconstructing the structure. However, the quantity of cement actually used for this purpose may be considered for the reconciliation of materials. All burrs and uneven faces shall be rubbed smooth with the help of carborundum stone. The surface of non-shuttered faces shall be smoothed with a wooden float to give a finish similar to that of the rubbed-down shuttered faces. Concealed concrete faces shall be left as from the formwork, except that the honey-combed surface shall be made good as specified above.

#### **17.2.17.1 Repair and Replacement of Unsatisfactory Concrete:**

Repair shall be made as soon as possible after the forms are removed and before the concrete becomes too hard, with prior permission from the Employer, in writing. Stone pockets, segregation patches and damaged areas shall be chipped out and the edges undercut slightly to form a key. All loose material shall be washed out before patching. No excess water shall be left in the cavity, but the concrete shall be damp.

A good bond between the patch and parent concrete shall be obtained by sprinkling dry cement on the wet surface or by throwing mortar with force onto the wetted concrete, or by brushing a coat of thick cement grout of about 1:1 (1 cement: 1 Sand) just before applying the patching material. Before this has dried, the remainder of the patch shall be filled with mortar or concrete, depending on the extent of the repair.

Cement concrete/mortar used in the repair of exposed surfaces shall be made with cement from the same source as that used in concrete and blended with a sufficient amount of white Portland cement to produce the same colour as in the adjoining concrete. The proportions of ingredients shall be the same as those used in the parent concrete. The mortar shall be as dry as possible and well compacted into the cavity. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the filling has been cured and dried.

For larger repairs to hardened concrete, necessary formwork bearing tightly at the edges of the cavity shall be provided. Concrete shall be chipped out to a depth of at least 100mm and preferably 150mm. Mortar shall be scrubbed into all surfaces with a wire brush before placing the concrete. Damaged reinforcement shall be adequately spliced with new steel to maintain the original strength. Additional reinforcement, if required in the patch, shall be provided as per the instructions of the Employer.

In case, in the opinion of the Employer, defects in the concrete are excessive or beyond repair, the Contractor shall either redo the structure or take other remedial measures as instructed by the Employer. The decision of the Employer shall be final and binding on all in this respect.

Approved epoxy formulation for bonding fresh concrete used for repairs with already hardened concrete shall be used by the Contractor if asked by the Employer. Epoxy shall be applied in strict accordance with the manufacturer's specification and instructions. All repair works due to non-conformance or non-adherence to the specification shall be carried out.

#### **17.2.17.2 Curing of Patched Work:**

Immediately after patching is completed, the patched area shall be covered with an approved nonstaining water-saturated material, which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling for not less than 10 days.

#### **17.2.18 Cement Wash:**

If instructed by the Employer, the Contractor shall provide one coat of cement wash over the exposed concrete surfaces of foundations, beams, columns, walls, lintels, soffit of slabs etc. which are not plastered and appearance-wise not up to acceptable standard, as per the sole direction of Employer due to bad workmanship, defective shuttering, honey-combing and other repair works subsequently undertaken by the Contractor. No extra amount shall be paid to the Contractor on this account. However, the cement used by the Contractor for providing the cement wash shall be taken into account for material reconciliation purposes.

#### **17.2.19 Form Work:**

##### **17.2.19.1 General:**

Forms for concrete shall be of plywood conforming to IS:6461 or steel or as directed by the Employer and shall give smooth and even surface after removal thereof.

If it is desired by the Employer, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Employer.

Form work and its supports shall maintain their correct position and be to correct shape and profile so that the final concrete structure is within the limits of dimensional tolerances specified below, unless required otherwise, for functional/aesthetic reasons. The decision of the Employer shall be final and binding in this regard.

(a) Deviation from specified dimensions - 6mm to + 12mm of cross-section of columns and beams.

(b) Deviation from dimensions of footings (see Note below)

(i) Dimensions in plan: -12mm to +50mm

(ii) Eccentricity: 0.02 times the width of the footing in the direction of deviation, but not more than 50 mm.

(iii) Thickness:  $\pm 0.05$  times the specified thickness. Note: Tolerances apply to Cast-in-situ concrete dimensions only, not to the positioning of vertical reinforcing steel or dowels.

(c) Deviation in length (major dimension of single unit)

(i) up to 3m:  $\pm 6$ mm (

ii) 3m to 4.5m:  $\pm 9$ mm

(iii) 4.5m to 6m:  $\pm 12$ mm Additional deviation for every subsequent 6m  $\pm 6$ mm

(d) Deviation in straightness or bow (deviation from the specified line) for a single or continuous member) e.g., beam, column, or slab edge.

(i) up to 3m: 6mm

(ii) 3m to 6m: 9mm

(iii) 6m to 12m: 12mm Additional for every subsequent 6m: 6mm

(e) Deviation in squareness shall be measured taking the longer of two adjacent sides as the baseline.

The shorter side shall not vary in its distance from a perpendicular so that the difference between the greatest and shortest dimensions exceeds 6mm. For this purpose, any error due to a lack of straightness shall be ignored. Squareness shall be checked with respect to the straight lines that are most nearly parallel with the features being checked. When the nominal angle is other than 90 degrees, the included angle between check lines shall be varied accordingly.

(f) Deviation in twist shall be within a limit such that any corner shall not be more than the limit given below from the plane containing the other three corners:

- up to 600mm wide and up to 6m in length - 6mm

- over 600mm wide and for any length - 12mm

Maximum deviation in flatness from a 1.5m straight edge placed in any position on a nominally plain surface shall not exceed 6mm.

#### **17.2.19.2 Form Requirement :**

The formwork shall be true, rigid, and adequately braced both horizontally as well as diagonally. The forms shall have a smooth and even surface and be sufficiently strong to carry, without deformation, the dead weight of the green concrete working load, wind load, and also the side pressure exerted by the green concrete. As far as practicable, clamps shall be used to hold the forms together. Where the use of nails is unavoidable minimum number of nails shall be used. The projected part of the nail shall not be bent or twisted for easy withdrawal.

Where through tie rods are required to be put to hold the formwork and maintain accurate dimensions, they shall always be inserted through a precast concrete block (of the same mix proportion as is to be used for concreting) with a through hole of a bigger diameter. The precast block shall tightly fit against in inner faces of formwork. The holes left after the withdrawal of tie rods shall be fully grouted with cement-sand mortar of the same proportion as that used for concrete. However, use of such precast blocks shall in no case impair the desired appearance or durability of the structure. No such tie rods shall be used in any liquid retaining or basement structure.

Tie wires shall be permitted only upon approval of the Employer and shall be cut off flush with the face of the concrete or counter sunk, filled, and finished in the manner specified in Clause 5.2.17.

Form joints shall not permit any leakage. The formwork shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion, or loosening of its components.

Forms for beams and slabs (span more than 6.0m) shall have a camber of 1 in 500 so as to offset the deflection and assume the correct shape and line after deposition of concrete. For cantilevers, the camber at the free end shall be 1/100th of the projected length. Where architectural considerations and adjunctive work are critical, smaller form cambers shall be adopted as decided by the Employer. All vertical wall forms may be designed and constructed for the following minimum pressure. The pressures listed in Table 5.9 are intended as a guide only, and the Contractor shall ensure that the formwork is adequately strong and sturdy.

**Table 17.9 Minimum Design Pressure for Wall Formwork**

Rate of pour in meters/hour	Pressure in KN/m <sup>2</sup>	
	at 10° (in Celsius)	at 24° (in Celsius)
0.6	36	29
0.9	40	32
1.2	44	35
1.5	46	37

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement, equipment, material, embedment, and a minimum live load of 2.0 KN/Sqm.

**17.2.19.3 Inspection of Forms:**

Temporary openings shall be provided at the base of column and wall forms, and other places necessary to facilitate cleaning and inspection. Before concrete is placed, all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated, and free from foreign material. The complete form work shall be inspected and approved by the Employer before the reinforcement bars are placed in position. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected as per the instructions of the Employer.

**17.2.19.4 Treatment of Forms:**

The surfaces of forms that would come in contact with concrete shall be well-treated with approved non-staining release agents such as soft soap, oil, emulsions, etc. Care shall be taken that such releasing agents are kept out of contact with the reinforcement.

**17.2.19.5 Chamfers and Fillets:**

All comers and angles shall be formed with 45-degree mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfer and fillets, unless otherwise detailed or specified, shall be 25x25mm. For heavier work, chamfers or fillets shall be 50x50mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

**17.2.19.6 Reuse of Forms:**

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined, and when necessary, repaired and retreated, before resetting. Formwork shall not be reused if declared unfit or unserviceable by the Employer.

**17.2.19.7 Removal of Forms / Stripping Time:**

In the determination of time for removal of forms, consideration shall be given to the location and character of the structures, the weather, and other conditions, including the setting and curing of the concrete and material used in the mix.

Forms and their supports shall not be removed without the approval of the Employer. The formwork shall be removed without shock, and methods of form removal likely to cause over-stressing or damage to the concrete shall not be adopted. Supports shall be removed in such a manner as to permit the concrete to uniformly and gradually take the stresses due to its own weight.

In normal circumstances, when the average air temperature exceeds 16 degrees Celsius during the period under consideration after pouring of concrete and where ordinary Portland cement is used, forms may generally be removed after expiry of the following periods.

(a) Walls, columns, and vertical: 24 to 48 hours, as may faces of all structural members may be decided by the Employer.

(b) Slabs (props left under): 3 days.

(c) Beam Soffits (props left under): 7 days.

(d) Removal of props under slabs: Spanning up to 4.5m.: 7 days. Spanning over 4.5m.: 14 days.

(e) Removal of props under beams and arches: Spanning up to 6m.: 14 days. Spanning over 6m and up to 9m.: 21 days. Spanning over 9m.: 28 days.

(f) Cantilever Construction: Formwork shall remain till structures for counteracting or bearing down have been erected & have attained sufficient strength (minimum 14 days).

#### **Notes:**

1. For rapid hardening cement, 3/7 of the above-mentioned periods shall be considered, subject to a minimum of 24 hours.

2. For other cements, the stripping time recommended for ordinary Portland cement shall be suitably modified as per the instructions of the Employer.

3. The number of props left under, their sizes, supporting arrangement, and disposition shall be such as to be able to safely carry the full dead load of the slab, beam, or arch, as the case may be, together with any live load likely to occur during curing or further construction.

4. Where the shape of the element is such that the formwork has re-entrant angles, the formwork shall be removed as soon as possible after the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

#### **17.2.19.8 Staging/Scaffolding:**

Staging / Scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. The Contractor shall get it reviewed by the Employer before commencement of work. While designing and during the erection of scaffolding/staging, the following measures shall be considered:

(a) Sufficient sills or underpinning in addition to base plates shall be provided, particularly where scaffolding is erected on soft grounds.

(b) Adjustable bases to compensate for uneven ground shall be used.

(c) Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure, wherever available.

(d) Horizontal braces shall be provided to prevent the scaffolding/staging from rocking.

(e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.

(f) The scaffolding/staging shall be checked at every stage for plumb line.

(g) Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected afresh, and effort shall not be made to bring it in line with a physical force.

(h) All nuts and bolts shall be properly tightened, and care shall be taken that all clamps/couplings are firmly tightened to avoid slippage

(i) Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall be carried out under the supervision of a technically qualified civil Engineer of

the Contractor. For smaller works or works in remote areas, wooden ballies may be permitted for scaffolding/staging by the Employer at his sole discretion. The Contractor must ensure the safety and suitability of such works as described above.

#### **17.2.20 Exposed Concrete Work:**

##### **17.2.20.1 Form Work:**

Other things remaining the same as per Clause 5.2.19, formwork shall be of high quality. Care shall be taken to arrange the forms so that the joints between forms correspond with the pattern indicated in the Contractor's drawings. The forms shall be butting with each other in straight lines, the comers of the boards being truly at right angles. The joints between the forms shall cross in the two directions at right angles. The size of forms shall be so selected as to exactly match the pattern of forms impression on the concrete face indicated in the Contractor's drawings. Maximum care shall be taken to make the formwork watertight. Burnt oil shall not be used for the treatment of forms. The Contractor shall be permitted to reuse forms brought new to the work for exposed concrete work as specified below.

Such reuses shall be permitted only if forms are properly cared for, stored, repaired, and treated after each use.

- a) Plywood Forms 6 Reuses (Max.)
- b) Steel Forms 10 Reuses (Max.)

However, in the case of steel formwork higher number of reuses could be permitted as long as casting tolerance levels are within acceptable limits.

The Employer may, at his absolute discretion, order removal of any forms considered unfit for use in the work, irrespective of the number of uses specified above.

##### **17.2.20.2 Finishing:**

Repairing exposed concrete work shall be avoided. Rendering and plastering shall not be done. Minor repairing, if unavoidable, shall be done as specified in Clause 5.2.17.1 with the written permission of the Employer.

##### **17.2.20.3 Reinforcement:**

###### **General:**

Reinforcement shall be cut, bent to shape and dimensions as shown in the Contractor's bar bending schedules/drawings. In the normal course, the bar bending schedule of selected structures/structural parts shall be supplied to the Contractor.

###### **Straightening, Cutting, and Bending:**

Procedure for cutting and bending shall be as given in IS: 2502. In case bars are supplied in coils, they shall be smoothly straightened without any kinks.

Cold twisted deformed bars shall be bent cold. Bars larger than 25mm in size (except cold twisted deformed bars) may be bent hot at cherry red heat to a temperature not exceeding 850° Celsius as per the instructions of the Employer. The bars shall be allowed to cool gradually without quenching.

Bars shall be bent in a slow and regular movement to avoid fractures. Bars that develop cracks or splits after bending shall be rejected. A second bending of reinforcement bars shall be avoided, but when reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 times bar diameter for plain mild steel or 6 times bar diameter for high-strength deformed bars. Care shall also be taken when bending back bars to ensure that concrete around the bars is not damaged. All bars shall be properly tagged for easy identification.

#### **17.2.20.4 Placing and Fixing:**

All reinforcement shall be cleaned to ensure freedom from loose mill scale, loose rust, oil, grease or any other harmful material before placing them in position. Reinforcement shall not be surrounded by concrete unless it is free from all such materials.

All reinforcement shall be fixed in the correct position and shall be properly supported to ensure that displacement will not occur when the concrete is placed and compacted.

The reinforcement bars shall be tied at every intersection by two strands of 16 SWG black soft annealed binding wire. Crossing bars shall not be tack-welded for assembly of reinforcement. The reinforcement bars shall be kept in position by using the following methods:

a) In case of beam and slab construction, precast cover blocks (having the same cement sand contents as the concrete which shall be placed) of size 40 x 40 mm and thickness equal to the specified covers shall be placed firmly in between the bars and forms to secure and maintain the specified covers over the reinforcement.

When reinforcement bars are placed in two or more layers in beams, the vertical distance between the horizontal bars shall be maintained by introducing spacer bars at 1 to 1.2m centre to centre.

b) In case of thick rafts & pile caps having two or multiple layers of reinforcement, the vertical distance between the horizontal bars shall be maintained by introducing suitable chairs, spacers, etc.

c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them. The templates shall be removed after the concreting has been done below it.

d) Exposed portions of reinforcement bars shall not be subjected to impact or rough handling and workmen will not be permitted to climb on extending bars until the concrete has attained sufficient strength so that no movement of the bars in the concrete is possible.

#### **17.2.20.5 Splicing / Overlapping:**

Only bars of full length shall be used. But where this cannot be done, overlapping of bars shall be done as directed by the Employer. Where practicable, the overlapping bars shall not touch each other, but these shall be kept apart by 25mm or 1.25 times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be tied with two strands of 16 SWG black soft annealed binding wire. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

#### **17.2.20.6 Welded Joints:**

Welding of reinforcing bars shall not be permitted without the written permission of the Employer. Where welding is permitted, it shall be in accordance with the recommendations of IS:2751 and IS:9417. Welded joints shall be located at suitable staggered positions. Tests shall be made as directed by the Employer to prove that the joints are of the full strength of the bars. Maximum one welded joint shall be allowed per bar.

#### **17.2.20.7 Mechanical Connections:**

The mechanical splices in reinforcement by means of couplers, clamps etc. shall be used (as per manufacturer's specifications) with the written approval of the Employer. However, tests shall be made as directed by the Employer to prove that such connections are of the full strength of the bars on trial joints.

#### **17.2.20.8 Tolerances:**

Unless otherwise directed by the Employer, reinforcement shall be placed within the following tolerances:

a) For effective depth 200mm or less:  $\pm 10$ mm

b) For effective depth more than 200mm:  $\pm 15$ mm

The cover shall in no case be reduced by more than one third of specified cover or 5mm, whichever is less.

#### **17.2.20.9 Substitution:**

When the indicated diameter of reinforcement bar is not available, the Contractor shall use other diameter of reinforcement bars with the written approval of the Employer.

**17.2.20.10 Cover:**

Cover to reinforcement shall be as per standard codes / as directed by the Employer.

**17.2.20.11 Precast Concrete:**

Specifications contained in the above regarding concrete, formwork, and reinforcement shall apply in addition to the specifications given as under. The Contractor shall get the pre-casting bed approved by the Employer.

Necessary lifting hooks of suitable (but not less than 12mm Dia) M.S. rounds shall be provided for handling.

Unless otherwise specified, the exposed surfaces of precast members shall be integrally finished smooth. For precast slabs or planks, the top surface shall be finished with 1:3 (1 cement: 3 sand) cement mortar. Surface used as walkways shall be given a non-skid finish.

The precast concrete units shall be marked clearly on the top surface with the letter "T" for identification of surfaces at the time of erection and shall be stored properly until required for erection. The precast units shall be handled and erected by methods approved by the Employer to protect them from damage. The Contractor shall take all necessary precautions for safe handling during the course of erection. The Contractor shall replace all such units that are damaged during the course of erection.

**17.2.21 Concrete Underwater:**

Where concrete is to be deposited underwater, the greatest care shall be taken to prevent the cement from being washed out. The concrete shall be placed through a tremie pipe with suitable hopper and plunger arrangements. Great care shall be taken to ensure that no segregation of concrete takes place, and the Employer shall approve the method of placing. The discharge end of the tremie tube shall be plugged at the start of the work so as to minimize the entry of water into the tube, and it shall be entirely sealed at all times and kept full of concrete up to the bottom of the hopper. Concreting operations once commenced are to be completed in full without break; otherwise, the structure shall be considered as rejected.

**17.2.22 Underground Concrete Work:**

All reinforced concrete work below ground level or other filled areas shall be protected from the aggressive action of salts and other chemicals contained in all types of earth and rocks, groundwater water or other materials as follows:

Except where otherwise agreed by the Employer, the underside of all concrete foundations, beams, slabs, ducts, and manholes shall have a layer of at least 75 mm of blinding concrete of an approved mix using sulphate-resistant cement. The top face is to be finished to take the polythene sheeting material.

A layer of polythene sheeting material shall be laid prior to concreting under the foundations, beams, slabs, ducts, manholes, etc., and carried up the sides of such members to ground level or other level as defined by the Employer. Laps in the polythene sheeting material shall not be less than 300 mm and securely taped as specified.

Care shall be taken to avoid puncturing or tearing the sheeting, and should this occur, the puncture or tear shall be repaired to the satisfaction of the Employer, or the sheeting replaced.

The surfaces of concrete exposed after the removal of form, including top faces of buried members, shall be painted with one coat of primer (Bituminous solvent) and two coats of Bituminous (blended with non-asbestos reinforcing fabric and solvent) applied as manufacturer's instructions and to the satisfaction of the Employer.

The external surfaces of manholes, cable pits, and service pits shall be coated with two coats of a rubber-reinforced bitumen emulsion, brush applied. The coatings shall be applied strictly in accordance with the manufacturer's instructions.

**17.2.23 Concreting in Inclement Weather:**

In the event of a rainstorm or any other severe conditions arising, concreting shall be stopped, and appropriate temporary stop ends, vee grooves, etc. placed as may be necessary. During wet weather, the concrete shall be adequately protected as soon as put into position.

The Contractor shall always have in readiness approved framed sheeting, tarpaulin, etc., for the protection of newly placed concrete during inclement weather. Should any concrete be damaged due to rainstorms or other weather conditions, the Employer may order the cutting out and replacement of the damaged concrete.

**17.2.24 Grouting:**

The base plates of all the steel structures shall be grouted to a thickness as shown on the relevant structural drawings of the Contractor, after the alignment and approval of the Employer. The grout shall consist of either

a) 1:2 (1 Cement: 2 Sand) mortar for operating platforms (not supporting Equipment), pipe supports up to 2.5m in height (above concrete top), cross-overs, staircases, and ladders. Or

b) Free-flow non-shrinking Grout (Pre-mix type) of compressive strength not less than 40/mm<sup>2</sup> for all structures other than those covered in (a) above, as per the instructions/recommendations of the manufacturer.

**17.2.25 Continuous Concreting:**

Continuous concreting shall be done in a single operation as per the requirements of IS:456 and IS:2974. It shall be ensured that Clause 17.2.8.4 of these specifications is not violated in case of continuous concreting. Sufficient "Windows" shall be left in the formwork for walls, columns and other thin sections of significant height for pouring & compaction of concrete and inspection. The concrete to be placed in a manner that will prevent segregation and accumulation of hardened concrete on the formwork or reinforcement above the level of the placed concrete. These windows shall be fixed tight once the level of concrete reaches their levels.

**17.4 Site Grading:****17.4.1 General:**

The Contractor shall first clear the area of any obstructions or old structures and carry out a detailed topographic survey of the whole area. Formation level shall be such that there shall be no flooding of the site.

**5.4.2 Material:****5.4.2.1 Acceptable Fill Material:**

Fill material shall be granular, non-cohesive, naturally occurring and shall be free from organic and deleterious matter and shall have the following properties:

- Maximum particle size 200mm
- Percentage maximum particle size 10%
- Percentage passing 63-micron sieves 10% maximum
- Liquid limit 35% maximum
- Plasticity index 6% maximum
- Chloride content (top 150mm only) 3.3% maximum
- Sulphate content (top 150mm only) 2.0% maximum

**17.4.2.2 Unsuitable Material:**

Material, which has been deposited in reclamation areas and does not comply with the specification requirements for filling, shall be removed by the Contractor and replaced with suitable fill.

#### **17.4.2.3 Testing:**

Contractor shall carry out testing in the reclamation fill to determine whether or not the materials placed conform to the requirement of the specification. The results shall be in a form and give such information as the Employer may direct.

#### **17.4.2.4 Sampling:**

Unless directed otherwise by the Employer, sampling shall be carried out as follows:

(i) Bag samples (large) (25kg)

Every day during the progress of filling, the Contractor shall take two bag samples of the materials placed in reclamation at locations directed by the Employer. Samples shall be taken at a maximum depth of 0.5m.

The Contractor shall carry out all of the following tests on each of the bag samples:

(a) Sieve analysis (BS1377 Part 2 - Section 9.2)

(b) Particle size distribution by hydrometer (BS1377 Part 2 - Section 9.5)

(c) Specific gravity (BS1377 Part 2 - Section 8)

(d) Bulk density (BS1377 Part 2 - Section 7)

#### **17.4.2.5 Standards:**

Unless stated otherwise, testing of fill materials shall be carried out in accordance with BS812 and BS1377. The Relative Density of the reclamation fill shall be as defined in ASTM D4253 and the Contractor's attention is drawn to the requirement for both wet and dry methods of compaction to establish the maximum dry density. Alternative methods of assessing relative density, or density index as defined in Clause 4.6 of BS1377: Part 4: 1990, will be considered provided the Contractor undertakes comparative tests.

### **17.4.3 Compaction:**

#### **17.4.3.1 General:**

During the reclamation process the Contractor shall place approved material within the reclamation area to achieve an in-situ density not less than 90% of the Maximum Dry Density (MDD) throughout the full thickness and lateral extent of the fill. The latter is defined in Clauses 3.5 & 3.6 of BS1377: Part 4: 1990 - Determination of the dry density/moisture content relationship using the 4.5kg rammer.

The uppermost zone of fill shall be placed and treated to ensure that the top 900mm of the fill has an in-situ density not less than 95% MDD.

The in-situ density shall be measured using the appropriate method described in Clause 2.1 of BS1377: Part 9: 1990 or similar approved.

#### **17.4.3.2 Testing:**

The presence of pockets and layers of fine material and the degree of compaction achieved from placing fill shall be established by drilling boreholes through the fill. Boreholes shall be carried out to the required depth on an average of one in every 1,000 m<sup>2</sup> or as directed by the Employer. In each borehole continuous undisturbed sampling shall be performed using a good quality sampler that will ensure a high recovery ratio. The Contractor shall propose a sampler and shall seek approval from the Employer prior to its use. Immediately upon extraction, each sample shall be subjected to a bulk density determination.

Around each borehole position three static cone penetrometer soundings shall be made, approximately 1.5m away from the borehole. The cone penetrometer soundings shall be made before the drilling of boreholes. The penetrometer equipment shall record data electronically and the data shall be made available to the Employer in approved format.

Each sample shall be subjected to minimum and maximum density determinations in accordance with ASTM D4254 and ASTM D4253 standard tests respectively and to Maximum Dry Density testing in accordance with Clause 3.5 and 3.6 of BS1377 : Part : 1990. When available quantities of fill material from individual samples are less than specified for the particular tests, mixing from immediately adjacent samples shall be permitted with the specific approval of the Employer. From the above tests the relative density, as defined in ASTM D4254, corresponding to 90% MDD shall be established for each sample. At each borehole location the Contractor shall establish a correlation between cone resistance and relative density and shall prepare a relationship between cone resistance and depth for fill having a Relative Density corresponding to 90% MDD. Once this relationship has been agreed with the Employer the cone resistance depth profile shall be used to monitor the density of the whole fill. The Contractor shall perform static cone penetrometer soundings on a square grid of 25m for the whole extent and depth of the reclamation that has been filled with dredged material. There shall be an agreed time interval between filling and sounding to allow for the equilibration of in situ water pressures. Where the soundings show cone resistance values less than the agreed profile the Contractor shall submit his proposals for improving the density of the fill. Repeat soundings shall be undertaken following any ground improvement.

The Contractor may wish to submit alternative methods for demonstrating that the Fill has achieved the specified density; these shall be submitted as an alternative and he shall submit a detailed method statement for evaluation.

In situ density testing shall be carried out on the upper 900mm of fill in reclamation area to determine the degree of compaction achieved. The rate of testing shall be one test per nominal 2,500m<sup>2</sup> and the Employer shall select any depth within the upper 900mm of Fill.

The in-situ density of the upper 900 mm shall be determined in accordance with the method described in BS1377: Part 9 - Section 2.1 or 2.2.

Laboratory tests to determine the moisture content/dry density relationship shall be performed on a representative sample of the fill material for each 1,000 m<sup>2</sup> of fill placed in the reclamation area. The location and depth of the test sample shall be determined on-site by the Employer.

Additional testing shall be carried out on the top 300 mm of fill in the reclamation area as follows:

<b>Test</b>	<b>Test Frequency (Not less than one test per)</b>
Dry density	600 m <sup>2</sup>
Moisture content/maximum dry density relationship	1000 m <sup>2</sup>
Particle size distribution	1000 m <sup>2</sup>
Atterberg limits	1000 m <sup>2</sup>
Linear shrinkage	1000 m <sup>2</sup>
CBR	1000 m <sup>2</sup>
Sulphate content	1000 m <sup>2</sup>
Chloride content	1000 m <sup>2</sup>

#### **17.4.4 Acceptance of Works:**

The Contractor shall undertake a post-construction survey of the entire site, so graded to confirm that the area has been developed to the required levels. The Employer shall not accept the Work unless the Contractor has carried out all the required tests with satisfactory results. The entire area of the graded site shall be taken over completely by the Employer upon completion. The Employer shall not take over part of the area.

Interim payment for reclamation fill shall be based on quantities measured net using the calculated difference between the agreed ground levels from the surveys and up-to-date ground levels from interim surveys. Simpson's formula shall be used for computing fill volumes.

## **17.5 Road & Pavement Works:**

### **17.5.1 General:**

This section covers the specification for the construction of 2-lane / single-lane roads and paved open areas.

These specifications include the requirements for the preparation of base and surfacing courses in accordance with these specifications and in conformity with the dimensions shown in the drawings and with the lines and grades established by the Contractor at the site, subject to approval by the Employer. The pavements, such as flexible pavement, concrete block pavement, and concrete pavement with easy maintenance, shall be provided as required. These pavements must be laid over sub-base courses that will distribute and transmit the loads to the underlying soil, causing the least possible differential settlements. The pavement shall be graded to allow the container handling equipment to operate at its optimum rates and to allow for storm water to enter the drainage system.

### **17.5.2 Rolling Road Metal :**

Immediately following the spreading of the coarse aggregates, it shall be compacted to full width by rolling with either three three-wheeled power rollers of 8 to 10 T weight or equivalent vibratory roller true to the line and camber as shown in the drawing. The course shall not be rolled when the sub-grade is soft or yielding or the rolling causes a wave-like motion in the base course or sub-grade. When rolling develops irregularities that exceed 12mm when tested with a 3-meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required, and the area rolled until it gives a uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template and any irregularities corrected as above. The use of murrum to make up depression shall not be permitted.

The rolling shall begin from the edges with the roller running forward and backward until the edges have been firmly compacted. The rolling shall then progress gradually from edges to the centre parallel to the centre line of the road lapping uniformly each preceding rear wheel track by one half width, and shall continue until the entire area of the course has been rolled by the rear wheel. On the super elevated portions of the road, the rolling shall commence from the lower edge and progress gradually towards the upper edge of the road.

Rolling shall be discontinued when aggregates are thoroughly keyed. Slight sprinkling of water may be done if required.

### **17.5.3 Screenings :**

#### **17.5.3.1 Material :**

Screenings to fill the voids in the coarse aggregates shall, as far as possible be the same material as the coarse aggregates. Where it is decided by the Employer to use other materials, the same shall be predominantly non-plastic materials such as Kankar nodules, gravel (other than river-borne rounded aggregate) or murrum, provided that the liquid limit and plasticity index of such material is below 20 and 6 respectively, and the fraction passing the 75-micron sieve does not exceed 10 per cent.

#### **17.5.3.2 Grading Requirements Of Screenings**

Size of Screening	Sieve Designation (IS: 460)	% by Weight Passing the Sieve
13.2 mm	13.2 mm	100
	11.2 mm	95-100
	5.6 mm	15-35
	180 Microns	0-10

This grading, however, shall not be mandatory, in case either murrum or gravel is used as screenings.

#### **17.5.3.3 Application of Screenings:**

After the coarse aggregate has been rolled as described in Clause 5.5.2, screenings shall be applied uniformly and gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roller will cause them to settle into the voids of the coarse aggregates.

The screenings shall not be dumped in piles on coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreaders. The screenings shall be applied at a uniform and slow rate (in three or more applications) so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface making the filling of voids difficult or preventing the direct bearings of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregates. Damp and wet screenings shall not be used under any circumstances.

#### **17.5.3.4 Sprinkling and Grouting :**

After spreading the screenings, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling shall be continued and additional screenings applied where necessary until the coarse aggregates are well compacted and grout of screenings and water form a wave ahead of wheels of the roller. Care shall be taken to see that the base of sub-grade does not get damaged due to the addition of the excessive quantities of water during the construction.

#### **17.5.3.5 Binding Material :**

Binding material, to prevent relling of WBM shall consist of fine grained material possessing P.I Value upto 6.

Application of binding material shall not be necessary where murrum or gravel is used as screenings. Binding material shall be obtained from quarries/sources approved by the Employer.

#### **17.5.3.6 Application of Binding Material:**

After the application of screenings as described above, the binding material shall be applied at a uniform and slow rate (in two or more successive thin layers) so as to ensure filling of all voids. After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry

swept in with hand brooms/mechanical brooms or both so as to fill the voids properly. This shall be followed by rolling with a 6 -10 tonne roller during which water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading, rolling and brooming of binding material shall be performed on sections which can be completed within one day's operation and shall continue until no more binding material can be forced into the voids of the coarse aggregates and until the slurry of binding material and water forms a wave ahead of the wheels of moving roller. Damp and wet binding material shall not be used under any circumstances.

#### **17.5.4 Flexible Pavements:**

##### **17.5.4.1 General**

This specification establishes material and construction requirements for the flexible pavement with Bitumen Premix Carpet, as per the provisions of IRC.

##### **17.5.4.2 Bitumen Premix Carpet:**

###### **Material**

Coarse aggregate: The aggregate shall consist of crushed stone of clean, hard, tough, durable rock of uniform quality and shall be clean, free from excess of dust, flat or elongated pieces, soft or disintegrated stone, clay, or other deleterious matter. The size of aggregate shall be as mentioned in the drawings.

Sand: The sand shall consist of clean, hard, durable, uncoated, coarse dry particles and shall be free from injurious amounts of dust, soft or flaky particles, organic matter, or other deleterious substances.

Binder: The binder shall be bitumen of penetration 80/100 conforming to IS:73. The bitumen shall be stored in drums at the roadside. Any drum leaking or damaged shall not be accepted.

##### **17.5.4.3 Quantities of Materials:**

Material	For Premix Carpet per 100 m <sup>2</sup>	For seal Coat per 100 m <sup>2</sup>
For Premix Carpet 20mm thick		
Coarse Aggregate 12mm	2.75 m <sup>3</sup>	and downsize.
Bitumen 80/100	150 kg	68.3 kg.
Coarse sand as sealing aggregate	-	0.6m <sup>3</sup>
For Premix Carpet 25mm thick		
Coarse Aggregate 12mm and down size	3.5m <sup>3</sup>	
Bitumen 80/100	185 kg.	68.3 kg
Coarse sand as a sealing compound	0.6 m <sup>3</sup>	
For Premix Carpet 50 mm thick		
Coarse Aggregate 25mm and downsize. (For 35 mm thick carpet layer)	5.5m <sup>3</sup>	
Coarse Aggregate 12 mm and down size (for 15 mm thick carpet layer)	2.0 m <sup>3</sup>	
Bitumen 80/100		

For 35mm thick Carpet (I layer)	269 kg.	68.3 kg
For 15mm thick Carpet (II layer)	110 kg.	
Coarse sand and sealing aggregates	0.6m3	
For Premix Carpet 75 mm thick		
Coarse Aggregate 25mm and down size (for 50mm thick layer)	8.5m3	
Coarse Aggregate 12mm and down thick II layer)	3.5m3	
Bitumen 80/100		
a) For 50 thick I layer	375kg.	68.3kg.
b) For 25 thick II layer	185kg.	
Coarse sand as sealing aggregate	0.6 m3	

#### 17.5.4.4 Laying:

##### Preparation of Road Surface

The existing surface shall be thoroughly cleaned of dust, loose materials, caked mud, and other foreign matter with the help of a wire brush, chisel, picks, etc., before laying the tack course. The cleaning shall be carried out in such a manner as to expose the stone metal to a depth of 1 to 2 mm without dislodging the interlocking of the metal. All dust and other material thus removed shall be carried away and dumped at suitable places as directed by the Employer.

If potholes or ruts are found on the existing road surface, these irregularities must be filled in with premix chippings and well rammed about a week before the carpet is laid.

##### Tack Coat:

The bitumen shall be heated in asphalt boilers to 177°-188°C and shall be spread uniformly at the rate of 1 kg / m2 by means of sprayers. The applied binder shall be evenly brushed.

The tack coat shall be applied just ahead, keeping pace with laying of premix carpet.

#### 17.5.4.5 Preparation of Premix:

Mechanical mixers shall be generally used for preparation of premix. Improvised hand mixing drums may be used if permitted by the Employer.

Stone chippings of specified size shall be thoroughly mixed dry in the mixer at the rate indicated above. Binder heated at temperature suitable for the grade of bitumen is added to the mixer drum at the specified rate per 100m2 of surface and thoroughly mixed till the stone chips are completely coated with the binder. The premix shall be emptied on to wheelbarrows or stretchers and carried to work site.

##### Spreading of Premix:

Immediately after applying the tack coat the premix shall be spread with rakes to the required thickness and distributed evenly by means of a drag spreader. The camber shall be checked by means of camber board and the unevenness shall be rectified.

##### Rolling:

When the premix has been laid for a length of 15-20 meters, rolling shall be commenced with tandem rollers (8 to 10 tonnes). Rolling should commence from edges and proceed towards the center longitudinally.

The wheels of the roller shall be continuously moistened to prevent the premix adhering to the wheels and being picked up.

After the preliminary rolling and honeycombing, high spot or depressions shall be rectified by adding or removing the premix as per requirements and the surface shall be rolled again to compaction. Camber shall be checked at every stage and any defects found shall be rectified, Excessive rolling shall be avoided.

#### **17.5.4.6 Seal Coat:**

##### **i) For low rainfall areas - under 150cm/yr.**

A premixed seal coat, mixed preferably in a mechanical mixer after heating the sand should be applied immediately after laying the carpet and rolled. Materials required for this seal coat are as per Clause 5.5.4.2.

##### **ii) For high rainfall areas - over 150cm/yr.**

The material requirement for seal coat in high rainfall areas is as under:

Binder 80/100 = 98 kg/100m<sup>2</sup> of road surface

Coarse aggregates = 6.3mm passing IS. 10mm

Square mesh retained on IS sieve 2.36mm = - 0.9m<sup>3</sup> /100m<sup>2</sup> of road surface.

A liquid seal coat, preferably with chippings as above (though coarse sand can also be used) should be applied after laying the carpet. The binder, heated to permissible temperature, should be applied to the cleaned surface, blinded with chippings and rolled.

Traffic may be allowed on the road preferably 24 hours after providing the seal coat.

#### **17.5.5 Lean Concrete Base:**

##### **17.5.5.1 Materials:**

The materials used for lean concrete base shall be natural or crushed gravel or crushed rock complying with IS:383 except as detailed below. Aggregates shall have a maximum nominal size not more than 40 mm or less than 20 mm. Cement shall be ordinary Portland cement complying with IS:269.

Water shall comply with the requirements of the Specification - Plain and Reinforced Concrete.

##### **17.5.5.2 Mixing Lean Concrete:**

Lean concrete shall be mixed in batch mixer complying with the relevant clauses of the Specification for Plain and Reinforced Concrete. Alternatively, it may be mixed in a continuous mixer provided that the proportioning of the mix is entirely by weight and the mixing is as satisfactory as mixing in a batch mixer. In both cases, the Contractor shall maintain the mixer in good working condition.

Laying Lean Concrete Base. Lean concrete base shall be laid by plant capable of distributing material in a layer of uniform thickness without segregation. Compaction shall be completed within one hour of adding water to the material. Care shall be taken to compact effectively at joints in layers and adjacent to structures, using small compactors if necessary in confined spaces.

##### **17.5.5.3 Quality Control:**

Samples of the mixed material shall be taken from the hopper of the spreader or paver at random intervals and at the rate of five samples for every 1000 m<sup>2</sup> of base laid. From each sample, the Contractor shall prepare two 150 mm cubes. The cubes shall be made, cured, and tested in accordance with IS:516 except that they shall be compacted as described in Specification - Plain and Reinforced Concrete.

The average strength of each group of five samples tested at seven days shall be not less than 6 N/mm<sup>2</sup> or more than 16 N/mm<sup>2</sup>. If more than one average group strength in five falls outside these limits, the cement content of the mix shall immediately be altered to ensure compliance with the strength requirement.

##### **17.5.5.4 Rectification of Surfaces:**

Any area of lean concrete base which is outside the tolerance of + 6 mm shall be rectified as follows:

Provided not more than two hours have elapsed from the time of mixing, areas, which are high, shall be scarified to a depth of not less than 75 mm, the surplus material removed, and the area recompacted to comply with the Specification. If the material has been mixed for longer than two hours, the material shall be removed to the full depth of the layer over the operating width of the paving machine and over a length sufficient to enable the paving machine to relay the area. The area shall then be re-laid to comply with the Specification.

Areas which are low lying shall be removed to a depth of the layer over the operating width of the paving machine and over a length sufficient to enable the paving machine to relay the area. The area shall then be re-laid to comply with the Specification.

**17.5.6 Rigid Pavement:**

**17.5.6.1 Mix proportion / and strength :**

Mix shall be designed as per the design and the flexural strength shall not be less than specified value at 28 day in the field. The strength which is known as mean flexural strength shall depend upon quality control. The following relationship shall be used in calculating mean flexural strength.

$$S = S_1 / 1.1 t \cdot V / 100$$

Where S = average strength at 28 days for which the mix is to be designed (kg/ sq.cm. or N/mm<sup>2</sup> or MPa) as specified.

S<sub>1</sub> = minimum (flexural) strength in the field at 28 days (kg/sq.cm. or N/mm<sup>2</sup> or MPa) as specified.

t = factor (dimensionless) depending on specified tolerance level as per table II

V = co-efficient of variation (percent) specified as per table I (dimensionless percentage) Value of Coefficient Of Variation (Percent) V For Different Ranges Of Strength

Degree of quality control	Minimum specified flexural Stretch (Kg/cm <sup>2</sup> )					
	Less than 40		Greater than 40		40	
	Tolerance Level	Coefficient of variation V	Tolerance Level	Coefficient of variation V	Tolerance Level	Coefficient of variation V
Very Good	1 in 15	10	1 in 15	7	1 in 20	7
Good	1 in 10	15	1 in 15	10	1 in 15	10
Fair	1 in 10	20	1 in 10	15	-	-

**Note:**

(1) Very Good Quality Control: Control with weight hatching, use of graded aggregates, moisture determination of aggregates, etc. Rigid and constant supervision by the Quantity Control Team.

(2) Good Quality Control: Control with weight hatching, use of graded aggregates, moisture determination of aggregates, etc. Constant supervision by the Quality Control Team.

(3) Fair Quality Control: Control with volume hatching for aggregates. Occasional checking of aggregate moisture. Occasional supervision by the Quality Control Team. Value for Tolerance Factor (t).

Tolerance level No. of samples	1 in 10	1 in 15	1 in 20	1 in 40	1 in 100
10	1.37	1.65	1.81	2.23	2.76
20	1.32	1.58	1.72	2.09	2.53
30	1.31	1.54	1.70	2.04	2.46
Infinite	1.28	1.50	1.64	1.96	2.33

**17.5.6.2 Water Cement Ratio:**

The actual and designed quantity of water shall be used in the mix. The cement content shall be kept within a range of 350 Kg/cum to 425 Kg/cum only. The water cement ratio should invariably be kept between 0.39 to 0.42.

**17.5.6.3 Trial Mix:**

Trial mix shall be made and beam tested for flexural strength as per requirement of IS 516- 1959. Nine sets of beams shall be tested, three for 7 days and three for 28 days. If the difference between the highest and lowest value at 28 days in any trial mix is more than 15% of strength of these beams, the test shall be discarded and further trial mix made. Crushing Strength of concrete shall be approved for the flexural strength.

#### **17.5.6.4 Preparation of base:**

Before fixing the form work for laying concrete, the base shall be checked for proper compaction, density and levels.

#### **17.5.6.5 Trial Bays:**

Before commencement of work and while a paver is not used, a trial bay of 3.5m x 3.5m and of same thickness as that of the designed pavement shall be laid at an approved place. After laying the concrete, cores shall be taken out when the concrete is 7 days old, to determine the degree of compaction achieved, should any of the cores show honey combing, the trial bay shall be re-laid. The method of compaction and spreading and also desired surface finish shall be approved.

#### **17.5.6.6 Form Work:**

##### **Steel Formwork:**

All side forms shall be of mild steel except for curves having radius less than 45 meters. The steel forms shall be of M.S. channel section and depth equal to thickness of pavement.

A section shall have length of 3 metres except on curves of less than 45m radius, where shorter section or wooden formwork may be used. In case of transverse joints, a full length of the bulk head shall act as formwork. When set to grade and staked in place, no deviation of the top surface from the specified level shall be allowed. Use of bent, twisted or worn-out form shall not be permitted. The method of connection between the two length of forms shall be such that the joint formed is free from play or movement. At least three stakes for bracing pins or stakes shall be provided for each 3.00m of form and the bracing and support must be ample to prevent the springing of the forms under the pressure of the concrete or weight or thrust of machinery operation on the forms.

##### **Wooden forms:**

Wooden forms shall normally be used only for curves having radii of less than 45m. Wooden forms shall be wrought on one side, these shall have minimum base width of 100 mm and depth equal to edge thickness of concrete. These forms, when specially permitted to be used on straights, shall have minimum length of 3.0m. Forms shall be held by stakes set at intervals not exceeding 2m, two stakes to be placed at each joint. The forms shall be firmly nailed or secured to the side stakes, and securely braced at pint where necessary so that no movement will result from the pressure of the concrete or the impact of the tamper and during finishing work. Wooden forms shall be capped along the inside upper edge with 50mm angle iron, well recessed and kept flush with the face of wooden forms.

##### **Setting of Forms:**

The forms shall be jointed neatly. After the forms are placed and set the base of the forms shall be thoroughly tamped in an approved manner. All forms shall be cleaned and oiled each time before they are used. Forms shall be set, for at least one day's work ahead of concreting and shall remain in position for at least 12 hours after laying of concrete or longer as directed by the EIC. When forms have to be fixed on existing concrete bases they shall be secured at the side by M.S. stakes of 20 dia properly anchored into the base. Holes of suitable size for stakes shall be drilled at least 75 mm deep into the base and after the

stakes are inserted they shall be properly wedged so that the stakes shall not get loosened during compaction of concrete.

The trueness of form shall be checked by means of a 3m straight edge and any deviation greater than 1.5 mm shall be rectified. No deviation from the straight edge shall be permitted at the joints.

#### **17.5.6.7 Batching and Mixing :**

All the ingredients of concrete shall be batched by weight. Weigh hatching shall be done with fully computerized weigh batching plant of minimum 30 cum / hour capacity (or as indicated). Where combined hatching and mixing plants are not available, weigh hatching of adequate capacity shall be used for weighing of aggregates and cement. Power driven mechanical concrete mixers of adequate capacity in conjunction with weigh batches shall be used.

A small quantity of water will be added before loading of aggregates and cement. The remaining water shall be added during the mixing operation. The mixing shall be done for at least two minutes and until a uniform colour and consistency are achieved.

Quantity of concrete mixed in any one batch shall not exceed the rated capacity of the mixer. The drum of the mixer shall be completely emptied before ingredients for the next mix are charged into it. Concrete mixed as above shall not be modified by addition of water or otherwise in order to facilitate handling or for any other purpose.

#### **17.5.6.8 Placing and Compaction of Concrete:**

Concrete shall be transported without delay and incorporated in the works within 20 minutes from the time of discharge. The concrete shall be deposited and spread to such a depth that when compacted and finished, it shall conform to the grade and cross section specified in the plan to ensure the minimum slab thickness shown on the drawing to be obtained at all points.

In order to obtain adequate compaction, the concrete shall be spread so as to stand proud of the finished level and produce a surcharge. With screed and internal vibrator, slabs of thickness not exceeding 20cm shall be laid in one layer. Where medium duty pavers are used, this limit shall be raised to 25 cm. Concrete for slabs of greater thickness shall be laid in two equal layers. The second layer shall be laid over the unfinished but compacted first layer within half an hour (within setting time of the cement used) of the laying of the first layer.

Concrete shall be deposited in such a manner as to require as little handling as possible. Spreading, compacting and finishing (except final completed belt finishing) operations shall be within a period not exceeding one hour from the time the mixing starts. In case of dry and hot weather, this time will not exceed 35 minutes. Concrete shall be placed around man-holes or other structures after these have been brought to the correct alignment.

#### **Compaction of concrete:**

Compaction shall be carried out by electrically operated needle and screed vibrators as stipulated hereafter. Needle vibrators shall be used all over the area for obtaining initial compaction of concrete. These shall be of diameter not less than 4.5 cm. If the vibrators are pneumatic, the pressure must not be below 4 Kg/ cm<sup>2</sup>. If electrically operated they shall have a minimum frequency of 3500 impulses per minute. Minimum number of petrol driven vibrators as specified by the EIC with minimum frequency of 3500 per minute shall be provided at each work head as a stand by arrangement. The screed and internal vibrator shall conform to IS. 2506-1985 respectively.

Vibrating screed consisting of a steel section or timber section weighing not less than 15 Kgs per metre with a tamping edge of not less than 7 cm. width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with an M.S. plate to be rigidly fixed by means of counter sunk screws. Where screed vibrators are used for

compaction, at the discretion of the EIC for compaction of edges and joints, vibrators may be supplemented by hand tamping and Roding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted.

When using vibrating screed for compaction it shall not be dragged over the concrete. During the initial passes, it shall be lifted to the adjacent forward position in short steps. Subsequently, it shall be slowly slid over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

Concrete shall be deposited on the base as near the forms as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of forms, care being taken that it is worked well around the forms. The concrete shall not be dumped from the bucket directly upon or against the forms.

Workmen shall not be allowed to walk on freshly laid concrete. All operations shall be carried out from suitable wooden bridges spanning the lane.

#### **17.5.6.9 Use of Pavers:**

The contractor shall use a slip form/ fixed form paver as indicated for depositing, consolidation & finishing of concrete pavement. The paver(s) shall be of adequate capacity and suitable width of work bridge to complete the concrete pavement within the stipulated/ agreed period of completion.

#### **17.5.6.10 Joints in Concrete Pavement (using sealing compound):**

##### **General:**

Joints shall be of the types and dimensions as indicated and shall be located as indicated.

##### **Dummy Joints:**

The dummy joints shall be 8 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3 to 1/4 of the thickness of the slab. The joint may be formed by depressing into the soft but compacted concrete a high tensile mild steel 'Tee' or flat bar of depth not less than the required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft seal or other suitable lubricant and have built-in handles rigidly fixed to facilitate its removal without spalling or crumbling the edges. When the steel bar is removed, joints shall be nearly reformed immediately with proper tools and with mortar/fine material from the slab itself. No additional cement mortar shall be used. Alternatively, the slot may be formed by sawing the concrete with a joint cutting machine (diamond cutter) of approved design within 6 hours of placing under moderate climatic conditions and when the concrete has sufficiently hardened. Under extreme cold conditions, this period may be suitably increased based on experience. In all cases, except where cutting is done with saw, the joint edges shall be bull nosed. Care shall be taken that the edges of the joints are not damaged. The edge shall not stand proud of the concrete slabs.

##### **Construction Joints:**

The construction joints shall be 10 mm wide and straight and vertical through the full thickness of the slab. The vertical edge of the concrete on the side of the joint shall be treated with a coat of lime wash or bituminous paint before the adjacent bay is concreted. A groove 2.5 cm deep and 1 cm wide shall be formed at the top surface of the joint to receive the sealing compound. The groove shall be formed in the same manner as that for a dummy joint. The edges of the groove shall be bull-nosed and not stand proud of the concrete surface.

**Expansion Joints :**

The expansion joints shall be straight and shall extend through the full thickness of the slab and shall be of the shape and dimensions shown on the drawings. The slab edges adjacent to the joint shall be formed truly vertical. The joints shall be filled with a 2 cm thick filler board. Cold applied joint sealant (polysulphide or polyurethane) of approved make with minimum ten years of performance guarantee will be used as joint sealant. The guarantee should be taken in writing from the contractor before the approval of joint sealants. The technical specifications of the cold applied joint sealants (irrespective of whether polysulphide or polyurethane) should meet the requirements mentioned in BS-5212, BS 4254 and EN-141875- 2003 (for hydrolysis/water resistance test). In addition, the Movement Accommodation Factor (MAF) of the sealant should be minimum  $\pm 30\%$ . The groove to receive the sealing compound may be formed by cutting the extra filler board to the required depth.

**Sealing of Joints :**

All joints shall be sealed as soon as practicable after 28 days of placing of the slabs. The joints shall be finished flush with the finished concrete surface if the sealing of joints is done in summer and 3mm below the finished concrete surface, if the sealing of joints is done in winter. After the sealing compound has hardened, the excess sealing compound, if any, adhering to the slab outside the joints shall be removed by scraping or otherwise and the surface left clean. The pavement shall be opened to traffic only after the completion of joint sealing over the entire pavement.

**Cleaning of Joints :**

All foreign materials in the joints shall be removed with pneumatic blower. The joints shall, thereafter, be cleaned with a coir brush. Fine particles clinging to the concrete faces shall be removed with the help of an air compressor only to avoid damage to the edges. The joints shall be cleaned and surface dried before the application of primer.

**Application of Primer:**

The cleaned joint shall be primed with a 20-25 mm side painter 1s brush, while painting, light pressure shall be applied so that the primer penetrates into the pores of concrete. The primer shall be applied twice on one side (i.e. by forward and reverse movement of brush) The primer shall be applied in the thinnest possible complete film and then left for some time till the primer feels "tacky" soon after the primer is applied, the joint is covered with 10-15 cm wide paper strips so that no dust is deposited on the primer.

**Sealant joints:**

Only cold applied Polysulphide or Polyurethane joint sealant of approved make will be used in rigid pavements. The criteria for selection of the joint sealant will depend on the minimum performance guarantee of ten years offered by the firm. This performance-based selection would accrue better cost-effective results rather than using a joint sealant without any guarantee. The technical specifications of the cold applied joint sealants (irrespective of whether polysulphide or polyurethane) should meet all the requirements mentioned in BS-5212, B4254 and EN- 141875-2003(for hydrolysis/water resistance test).In addition, the movement accommodation factor (MAF) of the sealant should be minimum  $\pm 30\%$ . While the joints shall be sealed flush with the adjacent pavement surface in summer, in winter they shall be filled to a depth of 3-4 mm below the surface. This procedure will reduce the possibility of ingress of grit and other foreign matter into the sealing compound as well as dislodging of the hardened sealing compound under traffic.

**17.5.6.11 Joints in pavement concrete, (using polysulphide/polyurethane material):****General:**

Joint shall be of the types and dimensions specified and be located in all as directed by Garrison Engineer. The edges of the groove/joints shall be bull nosed & not stand proud of the concrete surface.

**Dummy Joints:**

The size of joints shall be as indicated/ specified. The joint shall be formed using mechanical equipment (diamond cutter) within 6 hour of placing of concrete under moderate climatic conditions and when the concrete has sufficiently hardened. Cutting or sawing by a sawing mounted at movable frame and driven mechanically will also be permitted as a method for making the joint. Care shall be taken that the edge of the joints are not damaged.

In case of sudden rain or storm, the work can be concluded at the dummy joint but the latter will then be formed into a construction joint.

**Construction Joints:**

Construction joints shall also be provided at places where concreting is stopped due to unforeseen circumstances. The size of joints shall be as specified and as shown on drawings. Construction joints shall be straight and vertical through the full thickness of the slab. The vertical edge of the concrete of the side of the joint shall be treated with a coat of lime wash or bituminous paint before the adjacent bay is concreted. A groove of the dimension as specified in the contract shall be formed. The groove shall be formed in the same manner as that for a dummy joint.

**Expansion Joints:**

The expansion joints shall consist of a joint filler board as detailed in the drawing. The depth of the non-extruding filler pad joint filler board) shall be cut by 25mm from the top to prepare the joint.

Joints shall be straight and shall extend through the full thickness of the slab and shall be of the shape and dimensions shown on the drawings. The slab edge adjacent to the joint shall be formed truly vertical. The joints shall be filled with approved joint filler. Before the provision of the expansion joint, the face of the already laid concrete slab shall be painted with the approved primer at the rate of 2.6 liters per 10 square metres. The expansion pad shall be properly cut to shape. Bond breaker tape shall be applied on the top face of the pad before inserting the closed cell backup rod. It shall then be placed in position abutting the painted face of the already laid concrete slab. The adjacent slab shall then be concreted. The faces of the pad against which the new concrete slab is to be laid shall also be painted with the approved primer before laying the concrete. While concreting a neat groove as per drawing shall be formed on top of the pad, taking care that the edges are absolutely straight and that the groove so made does not get filled with any material like concrete, mortar, and other rubbish.

Expansion joints shall be provided both longitudinally and transversely at spacing as shown on the drawing or as directed by the Engineer-in-Charge.

**Procedure of Joint Filling with Polysulphide/Polyurethane Sealant:**

The technical specifications of the cold applied joint sealants (irrespective of whether polysulphide or polyurethane) should meet all the requirements mentioned in BS-5212, BS 4254 and EN-141875- 2003 (for hydrolysis/water resistance test). In addition, the Movement Accommodation Factor (MAF) of the sealant should be minimum  $\pm 30$  %. The criteria for selection of the joint sealant of approved make will be a minimum performance guarantee of ten years offered by the firm. This performance based selection would accrue better cost-effective results rather than using a joint sealant without any guarantee. Contractor shall not procure the materials required for joint filling unless the samples are approved by the GE and ten years of guarantee is given in writing by the contractor. The primer and sealant shall get tested by GE from a reputed testing laboratory who has the NABL accreditations like Indian Rubber Manufacturer's Research Association's Laboratory/CRR/IIIT/NIT/SEMT Wing, CME Pune before approval. The test certificate shall be obtained for every 5 MT of material incorporated in the work.

**Joint Preparation:**

Before commencing joint sealing operations, the following shall be ensured: -

The groove extends fully across the bay between consecutive longitudinal joints in the case of transverse joints and is continuous in the case of longitudinal joints.

No concrete and foreign matter shall be left in the groove.

In case of expansion joint, the filled materials is exposed to the full length of the joint and expansion joint filler is tightly packed.

Joint surface must be dry, free from dust, coating, bituminous mastics, concrete curing agencies, could release agents, oil, grease and loose particles.

All joints shall be thoroughly cleaned out by compressed air and sanding with emery paper or other approved means and shall be approved by Engineer-in- Charge before they are sealed.

The cleaned and prepared joints shall be primed on the sides of the joints up to the depth where sealing component is to be provided and filled with approved sealant.

Wipe out oil and grease by solvent soaked cloth (such as Xylene, Toluene or Acetone or Gardo clean).

Before sealing, insert a bond breaker tape and bond breaker (closed cell polyethylene frame rod) caulked tightly into the base of the sealing groove to prevent the sealant from adhering to the base of slot. Width of bond breaker (backup rod) shall be 20 to 25% more than the joint so that there is no seepage of sealant through joints edges.

#### **Fixing/Masking Tape:**

Fix masking tape to prevent edges of joints becoming dirty due to spillage of sealant at the time of pouring.

Application of Primer:

Suitable primer shall be first applied to the vertical faces of the concrete joint before pouring cold applied sealant conforming to specifications, in order to improve the adhesive qualities of the product. Primer as specified by manufactures shall be applied to the joint vertical surfaces and allowed to dry for 30 minutes to 2 hours depending on the climatic condition. The surfaces shall be primed twice@ 0.075litre (minimum) primer per square metre.

If the primer film has become completely tack free, the surface must be re-primed before applying the sealant.

If the primed areas are left unsealed overnight the primer film must be removed by grit blasting or grinding and the joints interfaces shall be re-primed.

#### **Mixing:**

Mixing and application of sealant will be through mechanical means to avoid any human error. The mixed product shall be used immediately as per manufacturer's instructions within its pot life i.e., within 30 minutes. The mixed sealant should be kept for a few minutes to allow air to escape before commencement of jointing filling.

#### **Application or Pouring of Sealant:**

Mixed sealant shall be applied by mechanical means (machine application) based on the manufacturer's instructions and shall be executed by his approved and trained applicator. Application temperature of sealant should be in between 5 to 45 degree Celsius (or as per manufacturer's instructions). It should be filled to a level 2 to 3mm below the top of the pavement leaving a recess to protect the sealant from damage. To prevent accidental spillage of sealant on the top surface and to give a neat finish masking tape should be applied on front edges of joint in such a manner that the material will not be spilled on the exposed surface of the concrete. Any excess filler on the surface of the pavement shall be removed immediately and the pavement surface cleaned. All necessary precautions as per the manufacturer's recommendations shall be taken. The sealant should be immediately tooled either with stainless steel or wooden spatula of the size of the joint to give a smooth finish before it begins to set. Masking tape shall be removed immediately after the sealant has been tooled. The sealant should be allowed to cure as per manufacturer's instructions during which period no traffic should be allowed on the pavement.

The test certificate shall be obtained for every 5 MT of material incorporated in the work.

#### **Some Miscellaneous Aspects:**

The sealants are sensitive to temperature while in storage as well as during mixing. Temperatures for all phase of handling of the sealing compounds viz mixing, placing and curing conditions must be in accordance with manufacturer's recommendations.

All safety precautions during handing and application of these sealants as prescribed by the manufacturers shall also be strictly adhered to.

**Precautions:**

Some people are sensitive to resins, hardeners, vapours etc. Therefore, it is advisable to use hand gloves/ goggles and suitable protective clothing.

Avoid application below 10°C temperature.

Avoid application on damp or Moist surfaces.

Do not expose primer to naked flames or other sources of ignition. (e) Materials to be kept in no smoking area.

Containers should be tightly sealed when not in use.

In the event of fire, extinguish with carbon dioxide or foam.

Should accident skin contact occur, remove immediately with a resin removing cream, followed by soap and water. Do not use solvent.

In case of contact with eyes, rinse immediately with plenty of clean water and seek medical advise. Use only in well-ventilated areas.

All consumables (masking tape, empty cartridges etc) should be removed and disposed off safely.

**Separation Membrane:**

A separation membrane shall be used between the concrete slab and the sub base. Separation membrane shall be polythene sheeting 250 microns thick laid flat without creases. Before placing the separation membrane, the surface shall be swept clean of all the extraneous materials using air compressor and screen sand layer shall be laid over cleaned surface. Wherever overlap of plastic sheets is necessary, the same shall be at least 300mm and any damaged sheeting shall be replaced at the Contractor's expense. The separation membrane may be nailed to the lower layer with concrete nails.

**17.5.6.12 Finishing of Concrete:**

Straight Edging Immediately after the compaction of concrete and the construction of joints but before the concrete has hardened and while the concrete is still in plastic state, the pavement surface shall be inspected for irregularities with a profile checking template and any needed correction made by adding or removing concrete by means of long handled floats and scraping straight edge followed by further compaction and finishing. The long-handled floats may be used to smoothen and fill in open textured areas in the pavement surface but the final finishing is to be made with scraping straight edges.

The scraping straight edges are to be 3 metres long with flexible long enough to reach the other side of slab when operated from one side of the pavement. They are to be placed parallel to the forms at the side of the pavements and worked backwards and forward uniformly across the width of the slab. After this operation has been completed and the surface shall be brought to the required finish, the straight edges shall be moved forward by not more than half their length and this process repeated.

The straight edge testing and re-floating shall continue until entire surfaces:

are free from observable departure from the straight edge;

conforms to the required levels and cross section; and

when the concrete has hardened, it shall conform to the specified surface levels.

The foregoing work shall be carried out while the concrete is still plastic and workable and in such time sequence as to ensure the removal of water of laitance from the surface.

After the concrete has sufficiently hardened to about 12 hours and not later than 24 hours, the surface shall be tested again for high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to ensure that the grinding does not in any way damage the concrete surface.

The final surface finish is to be such that when tested with 3 metres long straight edge placed anywhere. within the same or adjoining slab in any direction on the surface there is no gap greater than 3 mm between the bottom of the straight edge of the surface of the pavement.

**Belting:**

Just before the concrete becomes non-plastic the surface shall be belted with a two-ply canvas belt not less than 20 cm wide and atleast 1 metre longer than the width of the slab. Hand belt shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transverse to entire line of pavement and with a rapid advance parallel to the centre line.

**Brooming:**

After belting and as soon as surplus water, if any, has arisen to the surface the pavement shall be given a broom finish with an approved steel or fibre broom not less than 45 em wide. The broom shall be pulled gently transversely and in straight strokes over the surface of pavement from edge to edge. Adjacent strokes shall be slightly over-lapped. Brooming shall be perpendicular to the centre line of the pavement and so, executed that the corrugations thus produced will be uniform in character and width, and not more than 1.5 mm deep. No pressure will be applied to be broom and scoring shall be done under the weight of broom head without tearing the surface. Brooming shall be completed before the concrete reaches such a state that the surface is likely to be tom or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities, depressions, and pot-holes such as may be caused by accidental disturbing of particles of coarse aggregate embedded near the surface.

**Edging:**

Immediately after belting/brooming has been completed, the edges of the slab shall be carefully finished with an edging tool of 6 mm radius and the pavement edges shall be left smooth and true to line.

**Honey combing:**

As soon as the side forms are removed minor honey combed areas shall be filled with mortar composed of one part of cement to two parts of fine aggregate. Major honey-combed areas or segregated concrete or other defective work or areas damaged by the removal of the forms or concrete damaged by rain or any other reasons shall be removed and replaced. The total area of honey-combed surface more than 2.5 sq.cm. each shall not exceed 4% of the area of the slab side. Honey-combing exceeding 300 cm<sup>2</sup> in area at any one location shall be considered as major honey combing.

Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it was laid. The impression shall be formed when the concrete is green so as to leave permanent mark of setting.

**17.5.6.13 Curing and Protection of Concrete:**

**Initial Curing:**

Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used. shall be of such length (or width) that as laid they will extend at least 450 mm beyond the edges of the slab. The mats shall be so placed that the entire surface and edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer-in-Charge, the concrete has set sufficiently to prevent damage to the surface. Before being placed with the wettest side down, the mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained fully wetted and in position for 24 hours, after the concrete has been placed, or until the concrete is

sufficiently hard to be walked on without getting damaged. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed before use for curing purposes. If burlap is obtained in strips, the strips shall be laid to overlap at least 150 mm.

Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted. Alternatively, Membrane curing/polythene film is advocated for curing, especially in arid regions, and curing is done as specified.

#### **Final curing:**

Upon removal of the burlap, the slab shall be thoroughly wetted and cured as follows:

Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high, immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of the slab shall then be covered with sufficient sandy soil to produce a blanket of earth not less than 37 mm in depth after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the mornings of subsequent days up to 29 days and shall thereafter remain in place until the concrete has attained the required strength when the covering shall be removed, and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and re-saturated.

Concrete shall not be subjected to any load or weight of any plant until at least 14 days after laying. Concentrated loads or sharp objects like iron wheels of a concrete mixer and any vehicular traffic, including construction traffic, will not be allowed on the concrete surface for 28 days.

#### **17.5.6.14 Testing of pavement concrete:**

Testing of pavement concrete shall be in accordance with the relevant IS Specifications.

#### **Seven (07) - day strength.**

The concrete mix should be prepared for the flexural strength given in the design and will be accepted on 28-day strength. However, the 7-day strength gives an early indication of the strength likely to be achieved. 7-day strength shall be determined at least 8 to 10 days prior to laying of concrete. At least 3 beams should be casted and tested for flexural strength as per IS: 516 of 1959. The strength achieved should be 75% of the 28 days strength. If it is less, then the concrete mix should be redesigned and retested. After the laying of concrete starts, determination of 7-day strength is not necessary.

#### **Twenty-Eight (28) - day Strength.**

At least 3 beams for every slab (100ft x 12.5 ft x 1ft) will be cast and tested for flexural strength as per IS: 516 of 1959. The concrete mix should be prepared for the flexural strength given in the design. After at least 30 samples have been cast for a slab laid in similar conditions, their results should be tabulated and the LCL determined as follows:

$$LCL = X - tv$$

Where

LCL = Lower Control Limit (minimum flexural strength)

X = Mean flexural strength from the samples tested,

t = Tolerance level factor,

v = Standard deviation of the samples tested.

LCL so determined should not be less than specified value. Along with the beams, cubes will also be cast and tested for compression as IS: 516 of 1959. The compressive strength will be tabulated along with the corresponding flexural strength to establish correlation between flexural and compressive strength.

Workability:

Compacting factor tests and slump tests should be carried out as per IS: 1199 of 1959. In case concrete is being machine-laid, then only compacting factor tests should be carried out; otherwise, either of the two can be carried out at the discretion of the EIC. Compacting factor/ slump tests shall be carried out for every 10 cum of concrete mixed. The concrete shall not be laid unless the appropriate test has been carried out and authority given for the start of laying. Any batch of concrete giving a compacting factor or slump which does not comply with the laid down value (+0.02 in case of compacting factor only) shall be rejected and removed from the site.

**Acceptance of concrete:**

Concrete shall only be accepted if it satisfies the following main conditions:

LCL of every lot (at least 30 samples) is not less than the specified value,

The coefficient of variation is not greater than 10%.

Tolerance Level Factor is 1.5.

There is no honeycombing in the concrete.

Critical Examination of Test Data:

In case the LCL of a lot is less, then the following procedure shall be adopted before core tests are undertaken:

Omit the slab having the lowest average strength and reevaluate the remaining test dates of the samples.

If the reevaluated data conforms to the above acceptance criteria, accept the lot, less the slab omitted.

In case of unsatisfactory result, repeat the process by omitting the next lowest till all weak slabs are segregated for further testing by core cutting, and the part lot gets specified value.

**Core Tests:**

In case the concrete fails in flexure test i.e. the LCL is less than specified for a particular lot, then concrete shall not be rejected unless it also fails in core test. In core test, atleast two cores of the same will be cut per slab. The crushing strength of this core is then determined. The crushing strength should not be less than 0.8 times the corresponding crushing strength of 15 cm cubes. The crushing strength determination will be as per IS: 516 of 1959. In case the L/D ratio of the core is between 1 and 2, then the crushing strength of the cube will be reduced. The correction will be carried out as per the formula given below:

$$F = 0.11n + 0.78$$

Where F = Correction factor

L & n = - ratio (L and D are height and Diameter respectively of core D)

In case the concrete fails the flexure (LCL) test, but is found satisfactory in core test, it shall be accepted as the core test takes the precedence over the flexure test, However, in case the concrete fails both flexure as well as core test, then it shall be rejected and replaced.

All holes from which cores have been cut, will be filled with the same concrete from which the original slab was laid i.e., concrete of the same design mix.

**17.5.6.15 Quality Control:**

The following quality control tests shall be carried out at frequencies specified against each during progress of work:

S. No.	Test	Test Method	Frequency
1	Coarse Aggregates		
	(a) Flakiness Index	IS:2386 (Part-1)	one test for every 100 Cum of aggregates.
	(b) Impact Value	IS: 2386 (Part-4)	-do-
	(c) Los Angeles Abrasion Value	IS: 2386 (Part 4)	-do-
	(d) Deleterious materials	IS: 2386 (Part-2)	Before approval of the query and at every subsequent change in the source of supply

	(e) Moisture content	IS: 2386 (Part-3)	Minimum of two test per day for correcting the water demand of the mix.
	(f) Soundness	IS: 2386 (Part-S)	Before approving the aggregates and every month subsequently
	(g) Alkali aggregate reactivity	IS: 2386 (Part-7)	-do-
2	<b>Fine Aggregates</b>		
	(a) Silt content	IS: 2386 (Part-1)	One test per 250 Cum.
	(b) Gradation of sand.	IS: 386 (Part-1)	-do-
	(c) Deleterious materials	IS: 2386 (Part-2)	Before approval of the quarry and at every subsequent change in the source of supply.
	(d) Moisture content	IS: 2386 (Part-3)	Regularly for correcting the water demand of the mix on daily basis.
3	<b>Cement Physical and chemical tests</b>	IS: 269 IS:455 IS:1489 IS: 8112 IS:12269	Once for each source of supply and occasionally when called for in case of long/ improper storage. Besides the contractor also will submit daily test data on cement released by the manufacturer.
4	<b>Water Chemical tests</b>	IS: 456	At approval of source of supply, subsequently at interval of three months.
5	<b>Mixed Aggregates Grading</b>	IS: 2386 (Part-1)	1 test per 150 Cum.
6	<b>Concrete</b>		
	(a) Slump test (Workability of fresh concrete)	IS: 1199	One test per each dumper load at both hatching plant site and paving site initially when works starts. Subsequently sampling may be done from alternate dumper.
	(b) Flexural strength of concrete	IS: 516	One test consisting of nine works test beam for every 150 cum of concrete. Three of the beams shall be tested at 7 day and three at 28 days for flexural strength. The remaining three beams shall be kept as reserve exclusive for government use for subsequent testing (if so desired by Government) and preserved for one year from completion of work under the contract. The contractor cannot claim testing of these beams for any purpose, as a matter of right.
	(c) Core strength on hardened concrete.	IS: 516	In case of doubt or in case of lab test not found satisfactory.
	(d) Thickness determination		From the level data of concrete pavement surface and sub base at grid points of 5/6.25m x 3.5m.
	(e) Thickness measurement for trial length		3 cores per trial length.
	(f) Verification of level of string line in the case of slip form paving and steel forms in the case of fixed form paving		String line or steel form shall be checked for level at an interval of 5.0m or 6.25m. The level of tolerance allowed shall be + 2mm. These shall be got approved 1-2 hours before the commencement of the concreting activity.

Quality control test for levels alignments and texture shall be carries out as under: -

Level tolerance +5mm

Width of pavement and position of paving edges +10mm

Pavement thickness -5mm to +25mm

Alignment of joints, widths, depth of dowel grooves to be checked @ one joint per 400m length or a day's work whichever is more.

Surface regularly both transversely and longitudinally Once a day or one day's work, without disturbing the curing operation. Texture depth:

S. No.	Time of Test	Number of measurements	Required Texture depth	
			Special Value	Tolerance
1	Between 24 hours and 7 days after the construction of the slab until the slab is first used b vehicles	An average of 5 measurements	1.00 mm	+ 0.25mm
2	Not later than 6 weeks before the pavement is opened to traffic.	An average of 5 measurements	1.00 mm	+ 0.25mm -0.35mm

### **17.5.7 Concrete Block Paving:**

#### **17.5.7.1 Materials:**

Concrete paving blocks shall comply with relevant IS codes and requirements given hereunder:

##### **Cement:**

The cement used in the manufacture of precast concrete paving blocks shall be ordinary Portland cement complying with IS:269. The cement content of the compacted concrete shall be not less than 380 kg/m<sup>3</sup>.

##### **ii) Aggregates:**

The fine and coarse aggregate shall be natural aggregates complying with IS:383 and as given in Specification- Materials. The nominal maximum size of aggregate shall not exceed 20 mm.

##### **iii) Water:**

Water shall be clean, free from deleterious matter and comply with IS:3025.

##### **iv) Other Materials Admixtures:**

Admixtures shall not be used without the approval of the Employer. The Contractor shall inform the Employer in writing of the admixtures to be used. Admixtures shall conform IS:9103. Pigments: Any pigments used shall comply with IS:3493.

##### **v) Finishes :**

Natural Colour Blocks: A block described as 'natural colour' shall not container pigment. Surface finishes: Surface finishes, including colour, shall be as directed or approved by the Employer.

Pigmented blocks: When pigmented blocks are specified, samples shall be submitted to the Employer for approval.

##### **vi) Dimension and Tolerances Dimensions:**

Nominal sizes and aspect ratios

Standard rectangular blocks shall be manufactured with a work size length of 200 mm and a work size width of 100 mm. The work size thickness shall be 60 and 80 mm.

Wearing Surface Area

A chamfer round the wearing surface (no deeper than 7 mm) shall be permitted, and the work size and width of any chamber shall be declared by the manufacturers. The wearing surface area shall not be less than 70% of the plan area.

**Tolerances:** The maximum dimensional deviations from the stated work sizes for paving blocks shall be as given below:

- Length:  $\pm 2$ mm
- Width:  $\pm 2$ mm
- Thickness:  $\pm 3$ mm

##### **vii) Samples and Testing:**

**a) Sampling:**

Sampling procedure shall be in accordance with IS: codes or equivalent. The Employer shall at all reasonable time, be permitted access to the place where the paving blocks are manufactured or stored, for the purpose of examining and sampling the materials and the finished paving blocks.

**b) Compressive Strength :**

The compressive strength of paving blocks, sampled shall not be less than 49 N/mm<sup>2</sup> and the crushing strength of any individual block shall not be less than 40 N/mm<sup>2</sup>.

**Compliance with Specification:**

If concrete blocks are delivered to site from an approved manufacturer, the Contractor shall satisfy himself by testing that, at the time of delivery, the paving blocks comply with the requirements of this Specification and if requested by the Employer, shall forward a certificate to this effect, indicating the frequency of testing.

Should any of the test results, for either block manufactured on or delivered to Site, not comply with the requirements of this Specification, the consignment or batch as appropriate shall be rejected as not complying with the specifications.

**17.5.7.2 Construction of Concrete Block Paving:**

Concrete block paving shall be laid to comply with IS:6509 and the requirements as given hereunder:  
Subgrade The preparation of the subgrade shall not commence until all subgrade drainage has been completed and side drains or channels are capable of removing water from the immediate vicinity of the formation.

The subgrade, sub-base and base shall be prepared so that:

- i) The surface levels are within the tolerances given in Table I
  - ii) The longitudinal falls and cross falls are such that no depressions hold water. A minimum longitudinal fall of 1.25% and a minimum cross-fall of 2.5% shall generally be adopted.
  - iii) The surface is tight and dense enough to prevent laying course material being lost into it during construction and use.
  - iv) Provision is made to:
    - a. drain water from the laying course in service (e.g. by installation of drainage when the laying course is on impermeable foundations)
    - b. prevents migration and loss of laying course material into drainage (e.g., by use of a geotextile)
- Trimming and regulation shall then be carried out to bring the formation to the correct level and grade within the tolerance stated in Table I and finally, the formation shall be re-rolled with a smooth-wheeled roller having a load of not less than 2.5 t/m width of roll.

**Sub-base :**

Materials for the sub-base shall comply with the requirements for granular sub-base as per MORTH specifications. The sub-base layer shall be laid on the prepared formation and compacted in accordance with MORTH specifications. The thickness of the sub-base shall be as per approved design.

**Lean Mix Concrete Base :**

Where shown on the approved drawings or if specified by the Employer, the Contractor shall lay a lean mix concrete base for block paving as per Clause 5.5.5 of this specification.

**Edge Restraints :**

Edge restraints shall be formed before compacting adjacent blocks.

**Laying Course :**

The laying course shall consist of 2-10 mm naturally occurring coarse sand or crushed rock fines graded in accordance with IS:2386. The coarse sand or crushed rock fines shall not contain more than 3% by weight of clay, silt and fine dust. The moisture content of the laying course should be as uniform as possible, and the material should be moist without being saturated.

The Contractor shall construct the laying course so that after compaction, it forms an approximately 50 mm thick layer below the paving blocks. The sand shall be struck off to such a level that, when blocks have been vibrated, the upper face of the blocks shall be true to the finished level. Before the blocks are laid, the laying course shall not be subjected to any form of traffic including pedestrian traffic, before, after or during screeding.

**Concrete Paving Blocks ( M-55Grade , 120 mm thick):**

Blocks shall be laid in herringbone bond, except where specifically instructed by the Employer. Blocks shall be placed firmly together without disturbance to the laying course and the order of placing the blocks shall ensure this. At edges or obstructions such as gully grating or manholes, blocks shall generally be cut to fit. Cutting may be carried out with a hydraulic splitter, a hammer and bolster, or by sawing.

Immediately adjacent to gullies and manholes the tolerance shall be +3 mm, -0 mm.

The laid blocks shall be compacted to the finished levels by a vibrating plate compactor which transmits an effective force not less than 75 kN/m<sup>2</sup> at a frequency of 75-100 Hz and has a plate area not less than 0.25 m<sup>2</sup>. Sufficient passes shall be made to compact the laying course to produce an even surface.

Vibration shall not be carried out within 1 m of an unrestrained edge or laying face.

After initial vibration, sand or crushed rock fines shall be brushed into joints and further passes of the vibrating plate compactor made to fill the joints, more sand being spread over the surface if required.

The tolerances in Table I apply on straight profiles. Equivalent tolerances shall apply on vertical curves. All profile devices such as pegs, pins, profile boards or guide wires shall be set to the true plan line with a maximum tolerance of +25 mm and to the true level with a maximum tolerance of +3 mm. Spacing of support pints for guide wires shall be less than 10 m.

Table I: Tolerances on Surface Level for Concrete Block Paving:

1. Permissible tolerance on Centre line of pavement construction relative to horizontal alignment: +10 mm.
2. Permissible tolerance on surface levels:

Layer of Pavement	Maximum permissible in deviation from design level (mm)
Sub-grade	+/- 20
Sub-base	+/- 15
Road-base (Surface Course) Overall	+/- 6
Flatness	10 under a 3 m straight edge 2 between adjacent blocks
Adjacent to gullies, surface drainage channels and outlets (see Note)	+6, -0

NOTE: The permissible deviations for the upper level of drainage inlets and channels should be +0, -0 mm to ensure positive drainage.

**17.5.7.3 Kerbs and Gutters:**

**Kerbs:**

This work comprises the construction of concrete kerbs in situ, and installation of precast concrete kerbs on foundation concrete laid on prepared subgrade, sub-base, base-course, asphalt or concrete surface. Kerbs shall be provided at the locations to the lines, grades, and typical sections as per approved Drawings or established by the Employer.

**Materials:**

Cement shall be ordinary Portland cement to IS:269.

Aggregates shall conform to the requirements of Specification - Materials. All aggregate shall be of a size appropriate to the sections and method of manufacture of the kerbs. The coarse aggregate to be used, when tested in accordance with IS:2386 shall not exceed the following limits:

- Aggregate crushing value 30%
- Flakiness Index 35%

The preparation and placing of concrete shall conform to the requirements of the Specification, Clause 5.2, Plain and Reinforced Concrete. Reinforcement, where used, shall comply with the Specification Clause 5.2, Plain and Reinforced Concrete.

**Equipment:**

Equipment shall be of the number and type outlined in the Contractor's Programme of Work as approved by the Employer.

**In-situ Kerbs:**

Concrete Class

In situ kerbs shall be constructed of concrete OPC 25/20

Expansion, contraction, and construction joints for kerbs. Joints shall be constructed at the intervals and places as approved by the Employer. All joints shall be of the type and materials and conform to the approved dimensions of the kerb.

When constructed in connection with or abutting concrete pavement, the method of constructing the joints in kerbs shall conform to the requirements for joints in the pavement. When constructed separately from concrete pavement, or in connection with flexible base or surface courses, contraction joints in kerbs may be constructed by sawing through the kerb to a depth of not less than 32 mm below the surface of the gutter. Alternatively, contraction joints may be formed by inserting an approved removable metal template in the fresh concrete, or by other methods approved by the Employer.

Sealing of the joints will not be required unless the kerb and is constructed in connection with or abutting concrete pavement.

**Precast Kerbs:**

Precast concrete kerbs shall comply with IS:5758 and be manufactured by hydraulic pressing. Form for precast kerb shall be constructed so that the kerb sections will conform to the approved shape and dimensions.

**17.5.7.4 Construction Requirements:**

Subgrade Soil below subgrade level to a depth of 200 mm in cut shall be scarified, broken up, adjusted to optimum moisture content and re-compacted to the required density. If Quality Control tests show the required compaction cannot be achieved, the layer shall be replaced with suitable excavated material. Subgrade in cut shall have a minimum CBR value as per requirement of relevant IS Codes. When the subgrade is formed on embankment, it shall be to the full width of the top of the embankment.

Material placed in the top 300 mm of embankments, shall exclude particle sizes greater than 75 mm and shall have a minimum subgrade CBR value as per requirement of relevant IS Codes.

The width to be excavated shall be 300 mm each side of the outside edges of the kerb or gutter. The subgrade shall be of uniform density as approved by the Employer. Rock, shale, or soft and yielding material shall be excavated 15 mm below the subgrade elevation and replaced with suitable backfill material. The backfill material shall be compacted to meet the compaction requirements specified in Clause 17.4.3 of this specification. All subgrade shall be rolled or compacted to provide a smooth surface and shall be approved by the Employer before placing concrete.

**Concrete:**

Concrete kerb foundation and backing concrete shall be OPC 15/20. The composition, consistency, proportioning, batching, mixing, and curing of concrete shall conform to the requirements of Clause 17.2.

The area to be covered with the kerb shall, immediately after finishing, be cleaned of all laitance and roughened. The concrete shall be placed and compacted and then shaped with a steel tool conforming to the section. The Concrete shall be compacted with an approved internal vibrator or by hand spudding and tamping. The surface shall be shaped by use of a steel tool to produce the section. The edges shall be rounded by the use of wood moulding or by the use of an edger to form the required radius.

**Reinforcement:**

Reinforcement, if required shall be held in the position by clips, bar chairs, or other approved devices.

**Precast kerbs:**

Precast kerb sections shall not be moved (except as required for the removal of forms) or placed until the concrete has attained 75% of the design 28 day strength.

Precast kerb sections shall be set in a sand-cement grout on the concrete kerb foundation. They shall be butted up close together without mortared joints unless otherwise mentioned or instructed by the Employer.

Grouted joints, where indicated, shall consist of the one part Portland cement and three parts of fine aggregate, and one-fifth part of hydrated lime with sufficient water to produce a plastic mix as approved by the Employer. Grouted joints shall be cured by an approved method for a minimum period of four days.

Where kerbs are laid with concrete pavement, joints shall be provided in the kerb, foundation and backing in the same locations as in the pavement and constructed and sealed to similar details using the same materials.

For curves of 12 m radius or less, precast kerbs or appropriate radius or length shall be used. Kerb units shall not deviate from line and level by more than 3 mm in 3 m. Standard precast concrete quadrant units shall be used where appropriate.

**Finishes:**

a) In situ kerbs: surface shall be uniform and smooth finish

b) Precast kerb: surface shall be finished to a true and even. Surfaces concealed in the forms will require no finishing. All voids and honeycombed areas shall be repaired with a sand-cement grout.

**Curing:**

Kerbs shall be cured in accordance with the provisions for Clause 5.2, Plain and reinforced concrete Clause

**Backfill:**

The area adjacent to kerbs shall be backfilled with approved material to the top edges of the kerbs.

The backfill shall be placed and compacted to a density equal to or greater than the adjacent undisturbed natural ground.

**17.5.8 Removal of Surplus Earth:**

Surplus earth and soil from excavation shall be removed from construction area to the area demarcated by the Employer.

**17.5.9 Brick Pitching:**

**17.5.9.1 Excavation:**

Trench shall be excavated/dressed true to line, section and grade as per approved drawings prior to starting the pitching work.

**17.5.9.2 Material:**

Bricks shall be locally available best quality bricks as per Specification - Brick Masonry Work. Cement, sand and water used shall be as per Specification - Material.

The concrete mix used for bedding shall be as per Specification - Plain and Reinforced Concrete.

**17.5.9.3 Workmanship:**

The work of pitching shall be done after the bottom concrete has been laid and sides properly trimmed to the required grade and thoroughly compacted.

Brick pitching shall be done in 1:4 cement mortar using first class locally available bricks. Bricks shall be laid in herringbone pattern with their length at 45° to the length of the ditch as shown in drawings.

Mortar joints shall never exceed 6mm in thickness and all bricks shall be laid with vertical joints quite full of mortar.

Bricks shall be soaked for a period of at least 12 hours immediately before use and no broken or damaged brick shall be used in any part of the work except such as will be required to close any line of bricks.

The face of pitching shall be made even and smooth.

The brickwork shall be raked and flush pointed with cement mortar 1:3 as specified.

**17.5.10 Traffic Markings:****17.5.10.1 General:**

This work shall consist of the painting of white or yellow lines, chevron striping, arrows and lettering on road, pavements and painting on kerbs.

**17.5.10.2 Material:**

Thermoplastic material for road markings shall comply with specification for road and bridge works published by IRC.

Road markings shall be white, or they shall be yellow complying with IRC specifications and as directed by the Employer.

Chlorinated rubber paint for painting kerbs shall be plasticised and drying shall be by solvent evaporation alone. It shall have the properties given in Table II given below.

Epoxy resin adhesive shall comply with AASHTO M237

Table II: Paint for Kerbs

Property	Allowable Limits
Relative density	1.48 minimum
Viscosity at 21°C	65 to 70 KU
Drying Time	Approx. 10 -15 min
Coverage	3 m2 per litre maximum
Brightness	80 minimum
Flexibility	Passes around 12 mm diameter mandrel
Chlorinated rubber content	9.0%

**17.5.10.3 Quality Assurance:**

The quality and workmanship of the completed marking installation shall conform to the best modern practice.

The complete marking installation shall be warranted to the Employer from the date of issuance of certificate of final completion against peeling, chipping, flaking, delaminating and shoving for a period of one year or until the markings are normally worn away by traffic.

The Contractor shall submit his programme schedule, catalogues, manufacturer's specifications and test data of products proposed to use in this work to the Employer.

**17.5.10.4 Construction Requirements:****General:**

Traffic shall be kept off markings until the installation has fully cured.

**Road Marking:**

Spraying equipment shall consist of a motor-powered self-propelled machine with compressor. A minimum line width of 100 mm shall be sprayed in one pass. The bead gun shall be synchronized to spray glass spheres immediately onto the hot thermoplastic. An automatic skip mechanism shall be fitted to produce broken and dotted lines without pre-measurement. If hand methods are used the Contractor shall provide stencils, specialised labour and anything necessary so that the results obtained match in quality and finish the mechanically sprayed work to the satisfaction of the Employer. Lines, chevron striping, arrows, and lettering shall be provided to the size and in the location as per approved Drawings and in accordance with the Indian Road Congress Standards. Kerbs shall be painted alternately black and yellow, covering the entire exposed surface. Colour changes shall be made at joints between kerbs. The surface to be painted shall be clean and dry. Pre-marking for painting shall be done manually on straight lines and curves using a 100 m long string. On straight, the pre-marking shall consist of 1 dot mark every 3 m, and on curves every 1 m. The pre-marking dot shall be a circle of 40 mm diameter cut into equal parts by a gap of 100 mm. Longitudinal changes in line types shall be within 300 mm of the location as per the approved Drawings. Paint shall be applied 1.5 mm thick for broken, dotted, and continuous lines, striping, pedestrian crossings, stop lines, special letters, arrows, and symbols shall be 3 mm thick. In addition to the ballotine premixed in the material, a further quantity shall be sprayed onto the hot spray-plastic markings at a rate of application of 400 – 500 g/m<sup>2</sup>.

**Road Sign:**

Road sign to be supplied and fixed in accordance with the specification for road and bridge works published by Indian Road Congress or as directed by the Employer. The entire work of the installation and materials shall meet the approval of the Employer.

**17.6 Storm Water Drainage:****17.6.1 General:**

The intent is to drain the storm water of entire port area without any undue pooling and finally water to be let in the sea.

**17.6.2 Scope:**

The schematic layout of drainage system is shown in drawings. Storm drainage consists of furnishing transportation, labour, equipment and materials to construct storm drainage system in accordance with Contractor own Design and Drawings complying Indian standards. The work includes construction and installation of the following:

- a) Reinforced concrete pipe for storm water conveyance.
- b) Open Concrete drain as well as box drains for collection and conveyance of storm water including nalla discharge.
- c) Pipe culverts for nalla discharge.
- d) Storm drain catch basins and related drainage structures and appurtenances.
- e) Storm drain outlets into sea including flap gates and related features.
- f) Sewage Collection & Transfer system

**17.6.3 Materials:****17.6.3.1 Precast Concrete Pipe and Fittings :**

All reinforced concrete pipes shall be class NP3 conforming to IS: 458. RCC pipe shall be of NP4 type shall be used below road.

**17.6.3.2 Flap Gate:**

The drainage gate shall be designed to allow free outflow and prevent backflow for maximum seating heads up to 7.6 meters (25ft). The gate shall be provided with adjustable, double pivoted hinge links so designed

to permit complete seating, full opening, and with stops or other arrangements to prevent cover from rotating sufficiently to become wedged in the open position. Pivot lugs mounted to frame shall be adjustable to allow adjustment of hinge links without having to remove cover from gate. The hinge links shall be bronze-bushed, structural steel (or high strength ductile iron, cast manganese bronze or wrought stainless steel). All assembly hardware shall be stainless steel. The frame shall be cast iron, cast in one piece, with reinforcing ribs and a cast on lining eye shall be provided for manual operation. The frame shall have a machined seating surface inclined from vertical at minimum of 2.5 degrees to assure positive closure. All cast iron shall be painted with manufacturer's standard shop coat paint (or special paint). Structural steel hinge links shall be galvanized. All bronze and stainless-steel parts do not require further finish.

#### **17.6.4 Execution:**

##### **17.6.4.1 Installation of Pipe, Fittings and Appurtenances :**

Excavation, trenching, installation, compacting soil and finishing operations for all pipe and soil materials shall conform to the Indian standards. Carefully examine each pipe prior to placing. Promptly set aside all defective pipe and all damaged pipe. Clearly identify all defects. Do not install defective pipe or damaged pipe. Provide all required equipment for lowering pipe safely into the trenches. The details of catch pit, drainage channel are shown in drawings.

##### **17.6.4.2 Pipe Joints:**

All pipe joints shall be watertight and of such design as to remain sealed after possible settlement. Pressure Testing: The length of pipe shall be tested as per Indian Standard.

##### **17.6.4.3 Repair and Retesting:**

Sections of pipe not meeting the pressure test requirements shall have individual joints tested and sealed.

##### **17.6.4.4 Storm Drain Cleaning:**

Prior to final acceptance and final catch basin-to-catch basin inspection of the storm drain system by Employer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the storm drain at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.

Upon Engineer's final catch basin-to-catch basin inspection of the storm drain system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

##### **17.6.4.5 Tolerances:**

Pipe Inverts: Plus 10 mm, minus 10 mm.

Catch Basin Grates: Plus 0.00 mm, minus 10 mm.

#### **17.6.5 Inspection:**

Prior to final approval of any pipe installation, a thorough inspection shall be made of entire installation. Any indication of defects in material or workmanship, or obstruction to flow in the pipe system, shall be further investigated and corrected as necessary by the Contractor at no additional cost to the Employer.

#### **17.6.6 Construction of Catch Basins and Trench Drains:**

##### **17.6.6.1 Excavation and Backfill:**

Excavation and backfill as required, accomplishing the construction. Backfill shall be as specified for the adjoining pipe trench.

Install catch basins and trench drains at the locations based on IS code and as specified herein. Construct forms to the dimensions and elevations required for cast-in-place units. Forms shall be tight and well braced.

##### **17.6.6.2 Concrete Work:**

Cast-in-Place Concrete before placing formwork, compact existing in situ soil and provide a layer of compacted bedding material. Before placing the concrete, remove all water and debris from the forms. Place the concrete and screed the top surface of exposed slabs and walls. When the initial water has been absorbed, float the surfaces with a wood float and lightly trowel with a steel trowel to a smooth finish free from marks or irregularities. Finish exposed edges with a steel-edging tool. Remove forms and patch any defects in the concrete as required.

Cure concrete by preventing the loss of moisture for a period of 7 days. Accomplish with a membrane-forming curing compound. Apply the curing compound immediately after removal of forms or finishing of the slabs. Protect concrete from damage during the 7-day curing period.

**Precast Units:**

Prior to placing precast units, compact existing in-situ soil and provide a layer of compacted bedding material.

**17.6.6.3 Extensions:**

Extensions to be installed as per the requirement. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior trowelled smooth. Prevent mortar from drying out and cure by applying a curing compound. Extensions shall be watertight.

**17.6.6.4 Installation of Frames and Grates:**

Set frames and grates at elevations indicated or as determined in the field and in conformance with the design and Drawings. Frames may be cast in, or shall be set in mortar.

**17.6.6.5 Cleaning:**

Upon completion, clean each structure of all silt, debris, and foreign matter.

**17.6.6.6 Final Grades for Field Inlets:**

The final finish grades of the top of the grate on all storm water inlets and trench drains shall be adjusted to receive surface flows without pooling. No inlets will be acceptable if they protrude above the finished paving surface.

**17.6.7 Installation of Flap Gate:**

Install flap gates at locations as per the manufacturer's recommendations.

**17.6.8 Rainwater Harvesting System:**

A rainwater harvesting system shall be provided for the Admin Building.

**17.7 Earthwork:**

**17.7.1 General:**

This section of the specifications includes requirements for accomplishing all earthworks, including filling, anti-termite treatment, riprap, and yard grading for this Contract.

**17.7.2 Nature of the Ground:**

The Contractor shall judge for himself the nature of the ground and shall be fully responsible for ascertaining all necessary information concerning the permanent water table, period of rainfall, flooding of the site, and all matters affecting the excavation & foundation work.

**17.7.3 Earthwork Method:**

The Contractor shall not undertake any earthwork, including the operation of any borrow area or quarry, without having obtained the Employer's prior approval to the methods which he proposes to employ. He shall not thereafter modify such methods without the consent of the Employer.

#### **17.7.4 Correct Widths and Depths of Excavations:**

In the event of excavation being made larger than the sizes shown on the drawings, the Contractor shall fill in the excavated void to the correct profile with mass concrete as described under specification for 'Plain and Reinforced Concrete' or other approved compacted material at his own expense.

#### **17.7.5 Method of Excavation:**

Excavation may be carried out by machine or any other method approved by the Employer. In soil, excavations shall be taken to within 150 mm of the formation or foundation level, and all subsequent excavation in any section must be carried out by hand not more than 24 hours before the commencement of construction in that section unless agreed otherwise by the Employer. As soon as possible after inspection by the Employer, the bottom level of the excavation shall be sealed with blinding if specified, and the required construction shall commence. No excavation for foundations shall be filled in or covered with concrete until the Contractor has notified the Employer that it is ready for inspection and has received sanction to proceed with the works. The Contractor shall give a minimum of 24 hours' notice of any inspection.

#### **17.7.6 Shoring Excavations:**

The Contractor shall, to the satisfaction of the Employer, shore the sides of the excavations for structures, trenches, and pits to prevent them from slipping or falling. Should any slips, falls, or settlement nevertheless occur, they shall be made good by the Contractor at his own expense with selected fill or with mass concrete as may be directed by the Employer. In removing shoring from the sides of excavations, care shall be taken to avoid loads onto any concrete until it has hardened sufficiently to carry such loads. Timber or other materials used for shoring the sides of excavations shall be removed as the work proceeds, except when ordered to be left in by the Employer. The Contractor shall submit to the Employer for inspection calculations and working drawings for the proposed scheme of strutting and retaining the sides of the excavations not later than four weeks before commencing any excavations, and shall not proceed with the appropriate section of the works until receipt of the Employer's written consent. The receipt of such consent shall not relieve the Contractor of any of his duties and responsibilities under the Contract.

#### **17.7.7 Staking:**

The earthwork operations comprise the establishment of layout plans and staking for the installations at the start of the work, in conformity with the construction plans. The general staking plan shall be submitted by the Contractor to the Employer for his approval before the start of the work. All of the topographical references, as well as any other supplementary references that are deemed necessary for proper execution of the work, shall be marked out on the drawings and established on the ground by visible and stable landmarks.

Additional supplementary staking shall be established as may be necessary for horizontal and vertical reference points, subject to approval by the Employer. The Employer reserves the right to make changes in grade to suit developed conditions.

#### **17.7.8 Filling & Backfilling Generally:**

During compaction, the backfill as specified in Clauses 17.7.8.1 & 17.7.8.2 below shall have uniform moisture content within 2% of the optimum for the compaction plant employed or as may be directed by the Employer after tests. Where necessary, the Contractor shall adjust the moisture content of the backfill material either by drying out or by adding water. After such drying out or adding of water, the backfill shall be thoroughly mixed until the moisture content is uniform. Should the material being placed as filling or as backfilling while acceptable at the time of selection, become unacceptable to the Employer due to exposure to weather conditions or due to flooding or have become puddled, soft or segregated during the process of the works, the Contractor shall at his own expense remove such damaged, softened or segregated material and replace it with fresh approved material. When placing the filling or backfilling, the Contractor shall make due allowance for any settlement that may occur before the end of the Period of Maintenance, remove any excess material, or make up any deficiency of backfilling to the specified levels.

#### **17.7.8.1 Backfilling with Excavated Material:**

Foundation trenches, column bases and the like may be backfilled with selected excavated material if approved by the Employer, these being well rammed and consolidated by hand or compacted by an approved vibratory 5 ton roller or other approved vibratory equipment to the satisfaction of the Employer in layers not exceeding 150 mm thick, to achieve a dry density not less than the maximum dry density obtained as per IS 2720 (Part 8).

#### **17.7.8.2 Selected Granular Fill:**

Where directed by the Employer or where the drawings indicate the use of selected granular fill, this shall comprise well-graded non-plastic granular material, placed in layers not exceeding 150 mm.

Each layer is well compacted by an approved vibratory 5 ton roller or other approved vibratory equipment before the next layer is placed. The density after compaction shall not be less than the maximum dry density obtained as per IS 2720 (Part 8).

Selected granular fill shall be obtained from an approved source and shall comply with Clause 5.7.8.3 below.

#### **17.7.8.3 Suitable Material:**

i) It shall be the responsibility of the Contractor to locate suitable material and carry out such tests as the Employer may require, demonstrating the suitability of the fill to be supplied.

ii) The fill shall have a minimum stone 75 mm, a liquid limit not exceeding 25% and a plasticity index not exceeding 6. Total water-soluble salts shall not exceed 3%.

iii) Material shall have a CBR not less than 30% at 95% maximum dry density.

#### **17.7.8.4 Hardcore Under Building Floor:**

Hardcore shall, unless otherwise directed, consist of gravels/crushed stone of 50 mm size and shall be free from dust, soil, rubbish, wood, and other deleterious matter and shall be to the approval of the Employer. Approved hardcore materials shall be spread uniformly over prepared subgrade and packed properly, with interstices filled with sand. The hardcore shall then be compacted by suitable mechanical compactor to the satisfaction of the Employer. The top of the hardcore shall be flushed with sand to have smooth and curve surface for placing of polythene sheets.

#### **17.7.8.5 Underwater Placement of Fill Material:**

The method of operation for underwater placement of material obtained from borrow locations, duly approved by the Employer is subject to the approval by the Employer. The methods of fill placement shall be designed so as not to result in any detrimental pollution of the waterway.

#### **17.7.8.6 Compaction:**

Compaction methods and layers shall be submitted to the Employer for approval.

Compactions shall be performed with approved vibratory compaction equipment well suited to the soil being compacted. Material shall be moisture or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction. Finished slope fill shall be stable before placing slope protection.

#### **17.7.8.7 Tolerance:**

After installation and compaction of fill and backfills the leveling tolerances will be as follows:

- 2 cm from the levels indicated on the drawings
- ½ % on any plane

On slope or vertical tolerance of ±10 cm at any point will be permitted before placing slope protection.

If these tolerances are not achieved the works will be corrected to the Employer's satisfaction at the Contractor's expenses.

**17.7.9 Trimming of Slopes:**

The slopes of cuttings & embankments shall be trimmed by hand or by approved mechanical means to uniform batters as directed by the Employer.

Any rock or boulder appearing in the face of a cutting shall be trimmed back to within the tolerance specified above and in addition any such rock or boulder which in the opinion of the Employer is unstable shall be completely removed and the resulting void filled with compacted material with the approval of the Employer.

**17.7.10 Draining of Excavation:**

All excavations shall be kept free of water at all times and the Contractor shall provide efficient appliances and drains for dealing with water to the satisfaction of the Employer. Particular care shall be taken to keep dry, rock and other surfaces against or upon which concrete may be deposited and proper precautions shall be taken to prevent the leaching out of cement or otherwise damaging unset concrete.

**17.7.11 Existing Levels:**

Before work commences at the site the Contractor shall agree to the existing ground levels with the Employer.

**17.7.12 Disposal of Surplus Excavated Material:**

Subject to provision of this specification all materials arising from site clearance which are surplus or unsuitable for use in the Works shall become the property of the Contractor and shall be disposed of by him either off the site or to an approved tip off of if agreed by the Employer on the Site in an approved manner.

The Contractor shall propose two sites for disposal of unsuitable or surplus material, one of which shall be specified as having priority and which must be filled before the second is used, together with a separate location where hard debris, such as concrete, kerbing etc. shall be disposed of. The Contractor shall seek approval for all nominated sites from the concerned local authority before work commences.

**17.7.13 Trench Excavation:**

The Contractor shall execute to the required alignment and depth separate trenches unless otherwise indicated, for each utility run. The trench shall be sufficiently wide for the proper laying of the utility and shall be excavated to a depth that provides necessary cover.

The bottom of all trenches may be over-excavated to a minimum of 15 cm to allow for bedding material.

Condition in the trench shall be such that connections can be accomplished without getting mud, silt, gravel or other materials to the joint. The trench shall be adequately dewatered before laying bedding.

The bottom of utility trenches shall be graded to secure the required slope and tamped as necessary to provide a firm bed. Backfilling in the trenches shall be well compacted to the satisfaction of the Employer.

When trench excavation is required across existing surfaced roads as well as used tracks, the Contractor shall provide and maintain a suitable graded diversion complete with adequate signs, all to the satisfaction of the Employer. Such excavations shall be backfilled in accordance with Clause 17.7.8.0 & 17.7.8.1.

Where the road has a sealed surface, this shall be replaced after the backfill has been suitably consolidated to the satisfaction of the Employer and approved.

**17.7.14 Protection of Services:**

The Contractor shall ascertain for himself the location of all permanent main services, and shall maintain and protect these where affected by the works and shall in no way interfere with these permanent services without receiving the written permission of the Employer.

**17.7.15 Trenches not to be Left Open:**

Trench excavations shall be carried out expeditiously and subject to any specified requirements of the Contract, the backfilling and surface reinstatement of the trench shall be commenced and completed as soon as reasonably practicable after the pipes have been laid and joined.

#### **17.7.16 Polythene Sheeting:**

Polythene sheeting where necessary shall be of 1000 gauge and of approved manufacture supplied in rolls and laid by rolling over the prepared base at the levels and in the areas shown on the drawings.

Where a joint is necessary at the side or at the end of a sheet, this shall be double welt folded joint made by placing the edges together & folding over twice. The joint shall be prevented from opening prior to concreting by blocks placed at intervals on top of the joints.

The Contractor shall protect the sheets from damage during laying and subsequent operations and shall replace all damaged sheets to the satisfaction of the Employer.

#### **17.7.17 Anti-Termite Treatment:**

The treatment shall be carried out by an approved specialist sub-contractor. The chemicals used shall conform to IS:8944.

##### **17.7.17.1 Treatment to Soil Under Slabs at Plinth Level & Ground Floor:**

After earth filling and before the dry rubble or core packing, the centre surface of the filled earth will be treated with a chemical emulsion recommended by the specialist sub-contractor at the rate specified by the manufacturer. Light rodding shall be done to facilitate spraying and absorption.

##### **17.7.17.2 Treatment to Junction of Wall & Floors:**

Rodding to be carried out along the junction of plinth beams and earth filling at 15 cm intervals and recommended chemical emulsion sprayed at the rate of 2 litres per linear meter so as to mix intimately with the soil. 17.7.17.1 and 17.7.17.2 shall be carried out simultaneously to establish the chemical barrier.

##### **17.7.17.3 Treatment to Soil along the External Wall Perimeter:**

After levelling and before flagging or plinth protection is laid, soil along the external wall perimeter of the building up to a depth of 30 cm shall be treated at the rate of 4.5 litres emulsion per linear meter of plinth walls. If necessary, rodding at 30 cm intervals shall be carried out to facilitate spraying and absorption.

##### **Treatment of Critical Areas**

Soils under piers, utility pipe openings, floor drains, electrical conduit entry joints shall be thoroughly flooded with the chemical emulsion at an approximate rate of 25 to 30 litres per square meter. If drainage pipes are laid along the walls and the chemical barrier laid as per paragraph 5.7.17.2 is disturbed/broken, additional treatment to such areas will be necessary.

##### **17.7.17.4 Precautions:**

Precautions shall be taken not to disturb the treated areas by leveling, digging or earth filling, as this will break the chemical barrier. In case such situation arises, the area is to be treated again to restore the chemical barrier.

#### **17.8 Brick Masonry Works**

##### **17.8.1 General:**

This specification establishes the materials, dressing, laying, joining, curing, workmanship etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS:2212.

##### **5.8.2 Materials:**

Refer specifications under 'Materials'.

##### **5.8.2.1 Cement Mortar:**

Cement mortar shall meet the requirements of IS:2250 and shall be prepared by mixing cement and sand by volume. Proportion of cement and sand shall be 1:6 (1 part of cement and 6 parts of sand), or as directed by the Employer for brick masonry of one brick thickness or more, while 1:4 cement mortar (1 part of cement and 4 parts of sand) shall be used for brick masonry of half brick thickness. The sand being used for mortar shall be sieved. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within initial setting time of cement after water is added to the dry mixture. Mortar unused for more than initial setting time of cement, shall be rejected and removed from the site of work.

#### **17.8.2.2 Proportioning:**

The unit of measurement for cement shall be a bag of cement weighing 50 kg and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulking.

#### **17.8.2.3 Mixing:**

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Employer may, however, permit hand-mixing as a special case, taking into account the magnitude, nature and location of work. The Contractor shall take the prior permission of Employer, in writing, for using hand-mixing before the commencement of work.

#### **Mixing in Mechanical Mixer:**

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually, and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at least 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at least 300mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time (thirty (30) minutes for ordinary Portland cement conforming to IS:269 after addition of water. Mixer shall be cleaned with water each time before suspending the work.

#### **Hand Mixing:**

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix, which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

#### **17.8.3 Construction Procedure:**

##### **17.8.3.1 Soaking of Bricks:**

Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of the bricks as well as to remove dirt, dust, and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar, as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use, as they are likely to slip on the mortar bed, and there will be difficulty in achieving the plumbness of the wall as well as proper adhesion of bricks to the mortar. The period of soaking shall be determined at the site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in the construction work.

The soaked bricks shall be removed from the tank, sufficiently early so that at the time of laying, they are skin dry. The soaked bricks shall be stacked over a clean place, wooden planks, or masonry platforms to avoid earth, dirt being smeared on them.

### **17.8.3.2 Laying:**

#### **Brick Work (one or more brick thicknesses):**

Brick work (one or more brick thicknesses) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks be used.

A layer of average thickness of 10mm of cement mortar shall be spread on full width over a suitable length of the lower course or the concrete surface. In order to check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30mm. Each brick with frog upward shall be properly bedded and set in position by gently tapping with handle of a trowel or a wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be filled from the top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal, and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked at every 1 m interval.

The masonry walls of structures shall be carried up progressively, leaving no pane 1 lower than the other. If this cannot be adhered to, the brickwork shall be raked back according to bond (and not left toothed) at an angle not more than 45 degrees, but raking back shall not start within 60 cm of a corner. In all cases, returns, buttresses, counter forts, pillars, etc., shall be built up carefully, course by course, and properly bonded with the main walls. The brickwork shall not be raised more than fourteen (14) courses per day. At the junction of any two walls, the bricks shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

The courses at the top of the plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam, and at the top of the parapet shall be laid with bricks on edge. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness up to 12mm; however, any gap between the finished brick work and the soffit of the roof slab /beam shall be suitably sealed with the mortar.

#### **Brick Work (half brick thickness):**

For brick walls of half brick thickness, all courses shall be laid with stretchers. Wall shall be reinforced with 2 nos. - 6mm diameter mild steel reinforcement bars, placed at every fourth course. The reinforcement bars shall be straightened and thoroughly cleaned. Half the mortar thickness for the bedding joint shall be laid first, and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement, covering it fully.

The reinforcement bars shall be carried at least 150mm into the adjoining walls or RCC columns. In case the adjoining wall is of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6mm dia. M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of the beam or slab shall be laid by restricting the mortar thickness to 12mm. However, any gap between the finished brickwork and the soffit of the slab/beam shall be suitably sealed with mortar.

#### **Cavity Walls:**

Brickwork in cavity walls shall be included with general brickwork. It shall consist of one wall of one or more brick thicknesses, while the other wall shall be of half brick thickness at a clear gap of 50mm. The brickwork on either side of the cavity shall conform to the specifications already stated under Clause 5.8.3.2. At the base of the cavity wall, the walls shall be solidly constructed up to 300mm above the ground level. The cavity wall shall be terminated 300mm below the soffit of the roof slab/beam, and the courses over this shall be continued in solid brickwork.

The cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hay hands, which shall be drawn up the cavity as the work

proceeds. Any mortar that may unavoidably fall on the wall ties shall be removed daily, and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity. The outer and inner leaves shall be tied by means of wall ties. Ties shall be of mild steel round bars of 8mm dia. 200 long with hooks at both ends. These shall be placed not more than 750mm c/c horizontally and not more than 300mm vertically, and staggered. Additional ties shall be provided near the openings. There shall be at least, be 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement to protect them from corrosion.

In order to keep the cavity dry, air slots shall be provided in the cavity walls at the bottom as well as the top to the extent of 50 sq cm area of vents to every 2.0 sq. metre area of the wall.

**Circular Brick Work:**

The detailed specification for brick work covered under Clause 5.8.3.2 shall apply, insofar as these are applicable. Bricks forming skew backs shall be dressed or cut so as to give proper radial bearing. Defects in the dressing of bricks shall not be covered up by extravagant use of mortar, nor shall the use of chips etc, be permitted.

The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be between 5mm and 15mm.

#### **17.8.4 Jointing:**

Joints shall be restricted to a width of 10mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

#### **17.8.5 Curing:**

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinkling water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work and shall be done for at least 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose.

#### **17.8.6 Staging / Scaffolding:**

Staging/scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. Design of staging/scaffolding shall be submitted for approval of the Employer, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:3:6 during plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS:2750.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

The following measures shall also be considered during erection of the scaffolding/staging.

- a) Sufficient sills or underpinnings, in addition to base plates, shall be provided, particularly, where scaffoldings are erected on soft grounds.
  - b) Adjustable bases to compensate for uneven ground shall be used.
  - c) Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.
  - d) Horizontal braces shall be provided to prevent the scaffolding from rocking.
  - e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
  - f) The scaffolding/staging shall be checked at every stage for plumb line.
  - g) Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected afresh. Efforts shall not be made to bring it in line with a physical force.
  - h) All nuts and bolts shall be the clamps/couplings are firmly tightened to avoid slippage.
  - i) Erection work of a scaffolding/staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil Employer.
- For smaller works or works in remote areas wooden ballies may be permitted for scaffolding/staging by the Employer at his sole discretion.

#### **17.8.7 Embedment of Fixtures:**

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:3:6, at the required positions, as the work proceeds.

#### **17.8.8 Compressible Joint Fillers:**

Soft board shall be used where specified at joints requested by the Employer. Filler shall be cut to exact widths and shall have all edges neatly trimmed. Fixing of filer shall be strictly in accordance with the manufacturer's printed instructions.

#### **17.8.9 Polysulphide Sealant for Joints:**

Polysulphide joint sealer or other equal and approved shall be used. Application shall be strictly in accordance with the manufacturer's instructions.

#### **17.8.10 Galvanized Mild Steel Butterfly Wall Ties:**

For all vertical joints between brickwork and concrete, galvanized mild steel butterfly pattern wall ties are to be cast in concrete at 400 mm vertical spacing and then built into the mortar bed joints of the wall. Where specified, both skins of cavity walls are to be built in brick wall; the skins shall be tied together with galvanized mild steel butterfly pattern wall ties and spaced at the rate of one every 600 mm horizontally and 400 mm vertically, staggered every 400 mm vertically at ends, jambs, and quoins.

### **17.9 Structural Steel Work**

#### **17.9.1 General:**

This section includes requirements of all structural steel work required for the completion of the Works, as shown on the drawings and as specified herein.

All structural steel used by the Contractor for the construction shall conform to relevant IS codes or equivalent as approved by the Employer and described in these specifications. If deviation or a substitution of material is sought, the Contractor shall submit written request to Employer along with necessary supporting documents including test results, manufacturer's certificate, etc. along with reasonable time for evaluation without disruption of the construction schedule. It shall be the Contractor's responsibility to satisfy the Employer that his proposed deviation or substitution will in no way be detrimental to the quality of the works intended in the Contract. In case of any doubt the Employer may ask for additional information, testing or retesting which the Employer may feel necessary, which the Contractor shall carry out to the Employer satisfaction and with no impact on the construction schedule.

It shall be noted that site fabrication and painting of steel members shall not be allowed. The Contractor has to make his arrangements accordingly.

## **17.9.2 Structural Steel:**

### **17.9.2.1 Steel Grades:**

Unless otherwise stated all steel shall conform to one of the following grades.

- a) Carbon Steel: ASTM A 36 or approved equivalent (F<sub>y</sub>=36 Ksi) IS 2062 Gr A
- b) Intermediate strength steel: BS 7191 Gr 355D, API Spec.2 H Gr 50 or APPROVED EQUIVALENT (F<sub>y</sub>=50kSI).

Steel supply to specifications equivalent to those listed above shall be considered as substitution and shall require written approval by Employer to this effect.

### **17.9.2.2 Structural Steel Types:**

#### **(i) Rolled Shapes and Plates:**

All rolled shapes and plates shall be carbon steel grades as defined and unless otherwise specified.

#### **(ii) Tubulars:**

All Tubulars shall be fabricated in accordance with API Spec. 2B, from plates which should conform to one of the steel grades indicated in Clause (i) above.

Mill - manufactured line pipes, where acceptable shall be of prime quality and shall conform to API 5L Gr. B or equivalent, seamless.

The use of spirally welded and electric resistance welded pipes shall not be permitted for any load bearing structural member.

#### **i) Usage**

The usage of different grades of steels shall be as determined by design. For jacket type structures (if used by Contractor), the guidelines of API RP 2A shall be followed for material usage.

#### **ii) General Requirements**

##### **a. Process**

The steel shall be manufactured by the basic open hearth, electric furnace or basic oxygen process. No rimmed or capped steel shall be used.

##### **b. Delivery, Storage and Handling**

All rolled shapes and plates are to be delivered in accordance with ASTM A6, "Standard Specifications for General Requirement for Rolled Plates, Shapes sheet piling and bars for structural use".

Fabricated Tubulars shall conform to the dimensional tolerances of API Spec. 2B, "Specifications for Fabricated Structural Steel Pipe".

For mill manufactured pipes, where permitted for use, dimensional tolerances of API Spec. 5L, "Specification for Line Pipe", shall apply with additional requirements for straightness listed in API Spec. 2B.

All structural steel shall be stored and covered in a manner which will ensure that no damage shall occur to it from moisture, dirt, grease or any other cause which might impair bond with concrete.

##### **a. Identification:**

A sufficient supply of approved structural steel shall be stored at the site at all times to ensure that there will be no delay of the work.

Steel will be reasonably free from defects, mill scale and rust.

Structural steel shall be bundled and tagged with grades, size, and suitable identification mark for checking, sorting and placing size and mark numbers. Tags and markings shall be waterproof and shall not be removed until steel is placed.

##### **b. Mill Tests:**

All mandatory inspection and testing listed in ASTM A6, "Standard Specification for General

Requirements for Rolled Steel Plates, Shapes, Sheet piling, and Bars for Structural Use", shall apply. Supplementary inspection and tests when specified in individual specifications shall also apply.

In addition to above for all steel materials the following are mandatory requirements:

Product Analysis: One sample per heat. Acceptability standards as specified in ASTM designation A6 shall apply for all elements.

In addition, a field weldability test shall be performed in accordance with the requirements of relevant IS codes or equivalent with a heat input of 15–20 kJ/cm and the results of the test shall meet the requirements specified for the base material. This requirement shall be a prerequisite for the acceptance of the material.

**c. Mill Certificates:**

Contractor shall supply the Employer with a certificate indicating the process of manufacture, results of chemical and mechanical tests including specified supplementary tests for the material. Each test certificate shall bear the heat number and other identification marks such that the same can be correlated with the material. These certificates shall be signed by manufacturer's representative and furnished along with material.

When any steel is supplied from stock, the Contractor shall satisfy the Employer that the steel has been manufactured and tested and complies with all the tests and requirements of the specification under which the steel is being furnished with necessary documentary proof of original manufacturers. The heat numbers on mill certificates should be correlated with markings on the material. Steel material without acceptable mill certificate shall not be used.

**i. Special Requirements**

**a. Carbon Steel**

All carbon steel material shall meet the following:

Max. Carbon (C<sub>max</sub>) = 0.22%

Max. Carbon Equivalent (CE) = 0.45

(For CE formula refer 2.5.2)

**b. Intermediate Strength Steel**

The carbon equivalent shall be a maximum of 0.43 (ladle analysis) as determined from the following formula:

$CE = C/5 + (Cr + Mo + vCu + Ni)/15 + Mn/6$

V less than or equal to 0.08%

Nb less than or equal to 0.05%

V+Nb less than or equal to 0.10%.

**i. Other Requirements:**

All plates shall be ultrasonically inspected for defects and discontinuities in accordance with ASTM A578. Acceptance Standard shall be level II.

If intended to use plates having defects requiring repair for welding procedure qualification, these plates shall be shipped clearly marked "For Welding Procedure Qualification Only".

**ii. Heat Treatment:**

Heat Treatment shall be performed on all elements where properties have been degraded by forming and fabrication.

The use of furnaces is desirable for all heat treatments. When local heat treatments are deemed necessary, a detailed procedure shall be submitted to the Employer for approval prior to performing such heat treatments.

**a. Stress Relief:**

Stress relief heat treatment shall be performed on all materials subject to the following conditions:

- Elements subjected to press or roll forming where the temperature of the steel is above 38°C or less than 427°C during the forming operation.
- Elements subjected to press or roll forming where the outer fibre strain exceeds five (5) percent as defined by the formula.

$$\text{Percent Strain} = 100 t/D$$

Where t = thickness of element

D = outside diameter

- Welded assemblies containing one or more elements with the thickness exceeding 65 mm.

#### Stress Relief Temperatures

All stress relief shall be achieved by thermal methods by heating the element or assembly to a temperature between 590°C to 620°C for carbon steel and intermediate strength steel.

### **17.9.3 Quality Control:**

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. Materials or workmanship shall meet with the provisions of specifications and approval of Employer.

Before start of work, Contractor shall submit a detailed quality control plan of fabrication and erection for Employer's approval. Such QC plan shall include inter alia, the welding process proposed, type of electrodes to be used, acceptable criteria to be used for error in erection etc.

The quality control procedure/operations shall cover but not be limited to the following items of work:

- Bolts, Nuts and Washers: Manufacturer's, certificate, dimension checks, material testing
- Electrodes: Manufacturer's certificate, thickness, and quality of flux coating.
- Welders: Qualifying Tests
- Welding Sets: Performance Tests
- Paints: Manufacturer's certificate, physical inspection reports regarding quality of paints, primers & thinners.
- Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.
- Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.
- Painting: Preparation of surface for painting, application and uniformity of coats.

### **17.9.4 Fabrication:**

The Contractor shall prepare detailed drawings giving complete information necessary for the fabrication of the steel works. All information should be clearly given, and the drawings shall be in conformity with the best modern practice. A marking diagram allotting distinct identification marks to each separate piece of steel work shall be prepared in sufficient detail to ensure convenient assembly and erection. Symbols for welding used on the drawings shall be in accordance with IS:813 "Scheme of Symbols for Welding".

The Contractor shall prepare comprehensive bill of material sheets for each shop drawing giving therein all the items shown on the drawings together with their weights, mark numbers, cutting lengths, etc.

All fabrication shall be in accordance with IS:800 "Code of Practice for use of Structural Steel in General Building Construction".

### **17.9.5 Welding:**

The metal arc process shall be used for welding in all cases, unless otherwise specified by the Employer.

The welding procedure shall be in accordance with the requirements of IS:816 "Code of Practice for Use of Metal Arc Welding for General Constructions in Mild Steel". The symbols for welding as shown on the drawings will be interpreted in accordance with IS:813.

Electrodes used for hand welding or for automatic welding machine shall conform to IS:814 "Covered Electrodes for Metal Arc Welding of Structural Steel".

### **17.9.6 Galvanizing:**

Galvanizing, where specified, shall be of the best quality conforming to IS:2629 "Recommended Practice for Hot Dip Galvanizing of iron and Steel".

### **17.9.7 Installation:**

Install in locations shown, as indicated on Contractor's drawings, to line, plumb, and level, rigidly attached in place with all connections to other work neatly made and drawing up tight. Joints caulked to provide a weather-proof installation. Erection equipment shall be suitable and safe for the workmen.

Errors in shop fabrication or deformations resulting from handling and transportation that prevent the proper assembly and fitting of parts shall be reported immediately to the Employer and approval of the method of correction shall be obtained.

Anchor bolts and anchors shall be properly located. After assembly the various parts of a completed frame or structure shall be aligned and adjusted accurately before being fastened. As erection progresses, the work shall be accurate fastened to take care of all dead loads, wind and erection stresses. Unless removal is required all erection bolts used in welded construction may be tightened securely and left in place.

Drilling may be used in such a manner as not to distort or damage the metal. The use of gas-cutting torches in the field for connecting fabrication errors will not be permitted on any major member of the structural framing.

#### **17.9.8 Bolting:**

Bolts shall be driven accurately in holes without damaging the thread. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on bevelled surfaces, bevelled washers shall be provided to give full bearing to the head or nut.

#### **17.9.9 Shop Painting:**

Paint all surfaces, except those to be embedded in concrete with exterior ferrous metal primer on properly prepared surfaces, as specified under 'Painting'. Surfaces which will be embedded in concrete shall not be painted but shall be cleaned as required for painting.

#### **17.9.10 Inspection & Testing:**

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Employer to carry out inspection and/or tests in accordance with the Contract.

The Contractor shall guarantee compliance with the provisions of this specification.

The Contractor shall carry out sampling and testing in accordance with the relevant British Standards or equivalent as directed by the Employer, unless otherwise specified in the Contract. The Contractor shall get the specimens tested in a laboratory approved by the Employer and submit to Employer the test results in triplicate within 3 (three) days after completion of the test.

### **17.10 Steel /Aluminium Doors, Windows and Ventilators**

#### **17.10.1 General:**

This section of the specification includes the requirements necessary to provide in place all steel / Aluminum doors, windows, and ventilators.

#### **17.10.1.1 Indian Standards:**

IS 6248	Specification for metal rolling shutters and rolling grill
IS 1081	Code of practice for fixing and glazing of metal (steel and Aluminum) doors, windows and ventilators.
IS 4351	Specifications for steel door frames.
IS 1948	Specifications for Aluminum doors, windows and ventilators.
IS 1361	Specifications for steel windows for Industrial buildings.
IS 1038	Specifications for steel doors/windows and ventilators.
IS 1200 (Part XIV)	Method of measurement of glazing.
IS 3614	Specifications for fire check doors.
IS 7452	Specification for hot rolled steel sections for doors, windows and ventilators.
IS 2835	Flat transparent sheet glass.

IS 5437	Wired and Figured glass.
IS 25583	Safety glass.

### 17.10.2 Pressed Steel Door/Window/Ventilator Frame:

Pressed steel door/window/ventilator frame shall conform to IS:4351.

The frames shall be made of 16gauge pressed steel bent to shape using bending machine, and mitred with square edges. The frames shall be provided with spacers by welding 50 mm x 5 mm flats to the portion of the frame in contact with the wall jambs @ 600 mm vertical spacing.

The frame shall be fixed to the masonry by means of 300 mm x 25mm x 6mm hold fast welded to the spacers and grouted with M-20 grade concrete in minimum 350 mm x 100 mm x 100 mm sized hole in the masonry.

In case of concrete, the frames shall be fixed by 96 mm long, 12 mm dia metallic counter sunk type dash fasteners through the frame and spacers.

Provisions for hinges, locking arrangement and other hardware shall be provided in the frames by machine cutting required size cutout on the frame body and welded / screwed to 3 mm thick M.S. pad plates-already welded over the cut out from behind.

The frame surface shall be thoroughly cleaned of rust, mill scale, dirt, oil etc. and then finished with painting (by priming with red oxide zinc chromate primer conforming to IS:2074 and painting on forming to IS:1477 Part (II) or by approved shade electrostatic powder coating (25 micron).

### 17.10.3 Pressed Steel Door Shutter:

Pressed steel shutters shall be hollow type with 18gauge pressed steel welded at meeting of the sheets with pad plate of M.S flat 3 mm thick all along perimeter. The cavity shall be packed with rigid phenolic foam board adequately cut into shape to fully fit into the box cavity without gaps.

The shutter shall be formed by machine bending of 18 gauge (as specified in item) pressed steel sheet in form of hollow box making an overall thickness of 40mm forming truly square edge in accordance with the shutter profile. It shall further be braced with channel shaped horizontal stiffeners formed by folding 16 gauge MS sheets (35mm wide) @ 500 mm max. And fixed by flush riveting. 3mm thick M.S. pad plates shall be welded inside at required locations for fixing of hardware such as tower bolt, aldrop etc.

For double shutter doors, an M.S. angle 25mm x 45mm x 3 mm thick shall be welded to one of the shutters providing a minimum 25mm wide rebate for the other shutter at the meeting point during closed condition.

The shutter surfaces shall be painted with electrostatically powder coating/two coats of synthetic enamel paint over a priming coat of red oxide zinc chromate conforming to IS 2074/IS 1477 (Part-11). The shutters shall be fixed to the door frame by means of heavy duty MS butt hinges of 150mm size conforming to table 6 of IS 1341 @ 600mm max.

In case of air tight door shutters, approved quality continuous neoprene rubber beading shall be provided continuously along the door frame rebate fixed with neoprene rubber adhesive of approved make.

In case of partly glazed door shutter. Glass as specified shall be fixed with glazing clips and solid drawn 10 mm x 10 mm, MS beading backed with putty and fixed by countersunk screws. Necessary rebate for fixing the glass shall be provided by arranging the shutter bracing accordingly. The shutters shall be provided with locking device, handles and other hardware as specified.

### 17.10.4 Steel Windows & Ventilator:

Steel windows, ventilators shall in general conform to IS 1081, IS 1038, IS 7452.

#### 17.10.4.1 Materials:

Rolled Steel Sections:

Rolled steel sections for the fabrication of steel windows, ventilators shall conform to IS 7452.

Glass Panes:

Glass panes for glazing purpose shall be as specified in item description. All glass panes shall have property squared corners and straight edges. Glass panes shall be of following types in accordance with item description:

- i) 4 mm thick transparent sheet glass conforming to IS 2835 (wt. 7.2 kg/m)
- ii) 5.5 mm thick wired glass conforming to IS 5437.
- iii) 6.3 mm thick laminated safety glass conforming to IS 2553.

**Workmanship:**

The profile and type of windows, ventilators (glazed, partly glazed/louvered, side hung/top hung/ fixed shutter, composite) shall be as per Contractor's drawings.

The frames shall be fabricated of sections cut to size and metered. Corners shall be welded to form a fused welded joint. Process of welding shall be flash butt welding. The welded joints shall be grinded to square and flat edges.

Where larger units are to be formed by coupling individual units, the mullions, transoms shall be bedded in mastic to ensure weather tightness. Mastic shall be applied liberally to the channels of the outside frame sections before assembly, and the two units being coupled shall be drawn together tight with clamps, the mastic being squeezed out and cut off neatly when the units shall be screwed together tight.

Where fixed glazing units are placed over openable units a push fit weather bar shall be provided.

Before glazing, all opening parts shall be checked for their operational smoothness. The frame shall be completely cleaned, and bedding putty shall be placed in the rebate before glazing. Glass then shall be cushioned into the bedding and shall be fronted with front putty in a manner so as to enable the painting to be done upto the sight line. The back putty oozing out over the glazing rebate shall be cut off square and smoothed down.

For panes exceeding 600 x 300 mm in size, glass shall be secured by special glazing clips inserted in holes already provided in the steel sections, before applying the front putty.

For glazing of very large areas, rust proof steel beading with metered corners shall be provided with screws @ 10 cm. from each corner and @ 20 cm. apart from each other. Putty shall be provided to the face of the bead in contact with glass, in addition to back putty.

Side hung shutters shall be connected to the frame by means of friction hinges. The handle for side hung shutters shall be of pressed brass mounted on a steel handle plate welded to the opening shutter frame and shall not be removable easily after glazing. The handle shall have a two-point nose which shall engage with a brass striking plate on the fixed frame in a slightly open as well as in a fixed position.

Top hung shutters shall be provided with steel butt hinges welded to the fixed frame after cutting a slot in it. Top hung casements shall be provided with peg stay of 3 holes of pressed brass, 300 mm long which when closed shall be held tightly by the locking bracket fitted to the fixed frame or to the window.

Before fixing the frames, the size of the opening shall first be checked and cleaned of all obstructions. The positions of the unit in the reveal shall be taken off and shall be marked on the reveal at the jambs using a plumb line. In case of fixing with masonry, holes for fixing the lugs/hold fasts shall be cut at required locations. In case of concrete or stone, the frames shall be fixed by means of dash fasteners. In case of masonry, the lugs shall be grouted in the holes with cement concrete, M-15 Grade when fixing to steel work, mastic shall be applied to the sill of the opening and the unit shall be placed on it with the jambs and head buttered with mastic and the unit shall be fixed with special fixing dips or with nuts and bolts.

The windows/ventilators shall be checked to ensure smooth operation, perfect level and plumb.

All the steel surfaces shall be thoroughly cleaned free of rust, mill scale, dirt, off etc. by sand and shot blasting and then finished with painting by priming with red oxide zinc chromate primer conforming to IS 2074 and painting conforming to IS 1477 (Part II) or by hot dipped galvanizing conforming to IS 1477 Part (I). Putty shall also be provided with painting in a manner so as to seal the putty glass junction. Surfaces not meant for painting shall be cleaned of any strains of paint.

### **17.10.5 Rolling Shutters:**

#### **17.10.5.1 General:**

Rolling shutters shall be of best quality conforming to IS 6248 - 1979 and obtained from approved make. These shall include necessary locking arrangement and handles, fixing bolts, safety devices, anchoring

rods etc. These shall be suitable for fixing in position as specified i.e. outside or below lintel or between jambs of the opening. The door shall be push and pull type and also operated with chain crank as required. Electrically operated rolling shutters shall be used wherever specified.

#### **17.10.5.2 Galvanizing:**

All M.S. materials, including lath sections, clips, guides, lock plate, guide channel, bracket plate, suspension shaft hood cover & other components, shall be hot dip galvanized with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be not less than 750 mm/m<sup>2</sup> both sides and the coating shall be free from flaking or peeling, conforming to IS:1477-1977 (Part I & II).

#### **17.10.5.3 Shutters:**

The shutters shall consist of M.S. lath sections conforming to IS 513-1986, 1.25 mm thick and 75 mm wide unless otherwise specified. The laths shall be machine rolled and straightened with an effective bridge depth of not less than 16 mm and shall be interlocked together throughout their entire length and joined together at the end with end locks by means of cast iron or galvanized mild steel clips conforming to IS 2108-1977 riveted at either end, which shall prevent lateral movement of the individual lath sections. These shall be mounted on a specifically designed pipe shaft. Each lath section shall be a continuous single strip piece without any joint.

#### **17.10.5.4 Springs:**

The springs shall be, preferably of coiled type. The spring shall be manufactured from high tensile spring steel wire conforming to grade 2 of IS 4454-1981 or strip of adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong mild steel brackets.

#### **17.10.5.5 Guide Channels:**

The guide channels shall be of mild steel deep channel section and of rolled, pressed or built-up construction. The thickness of the sheet used shall not be less than 3.15 mm. The minimum depth of guide channels shall be 60 mm for clear width of shutters upto 3.5 m and 75 mm for 3.5 m and above guide. The gap between the two legs of the guide channel shall be sufficient to allow free movement of the curtain and at the same time close enough to prevent rattling of the curtain due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the walls or columns by means of heavy-duty bolts or screws.

The guide channels shall be attached to jambs, in plumb, either in the overlapping or projecting torsion or embedded in grooves, depending on the method of fixing to the approval of the Employer.

#### **17.10.5.6 Fixing:**

Brackets shall be fixed on the lintel or under the lintel as shown with metal fasteners, screws, bolts, etc. The shaft along with the spring shall then be fixed to the brackets.

The shutters shall be laid on the ground and the side guide channels shall be bound with it with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels, and the cover frame shall then be fixed to the walls through the plate welded to the guides. Fixing shall be done accurately in workman's-like manner so that the operation of the shutter is easy and smooth.

#### **17.10.5.7 Grilled Curtain:**

Wherever specified rolling shutter shall be provided with grilled curtain partly or fully, as required.

#### **17.10.5.8 Electrical Devices:**

Suitable electrical devices, push buttons, etc. shall be provided at suitable location to control the opening and closing the rolling shutter. Suitable limit switches shall be provided to automatically stop motor when

shutter reach the fully open and closed positions. The control switchgear, cabling, etc. should be of reputed make, conforming to relevant IS codes.

### **17.10.6 Aluminium Glazed Doors/Windows/Ventilators :**

#### **17.10.6.1 General:**

Aluminium glazed doors/windows/ventilators shall be of specified sectional size, dimension and profile as per Contractor's drawing.

#### **17.10.6.2 Materials:**

All Aluminium sections shall be extruded sections of INDAL aluminium alloy as per IS:733 and 18:1285.

Aluminium sections shall be anodised as per IS: 7088 to min. 25 microns.

Glass used for glazing shall be of following type in accordance with item description.

i) 5.5 mm thick wired glass conforming to IS 5437.

ii) 6.3 mm thick laminated safety glass conforming to IS2553.

iii) 5.5 mm thick transparent sheet glass conforming to IS 2835 (wt. 72 kg/sq.M)

#### **5.10.6.3 Workmanship:**

Frames shall be square and flat, the corner of the frame being fabricated to true right angles. Details of construction of frames, shutters etc. shall be as per drgs.

Side hung window shutters shall either be fixed to the frame with pivots, or aluminium alloy hinges. For fixing the hinges, slots shall be cut in the fixed frames and the hinges inserted inside may be riveted to the frame. The hinges shall normally be of the projecting type conforming to IS designation A-5-M of IS 617, IS 733. In which case Peg stay of 300 mm long complete with Locking bracket and conforming to IS codes same as for hinges shall be provided. Friction hinges may also be provided in which case peg stays are not required.

The handles for side hung shutters shall be of cast aluminium conforming to IS designation A-5-M of IS 617 and shall be mounted on a handle plate rivetted to the opening frames. The handle shall have anodised finish with minimum anodic film thickness of 25 micron or electro colour finish. The handle shall have a two-point nose which shall engage with an aluminium striking plate on the fixed frame. The striking plate shall be finished in the same manner as for the handle.

In case of top hung shutters, aluminium alloy cast hinges and peg stays (same as per side hung shutters) shall be provided.

Centre hung shutters shall be hung on the two pairs of cup pivots of aluminium alloy of IS designation NS-4 of IS 737 and IS designation A-5-M of IS 617 or chromium/cadmium plated brass/bronze cup pivots riveted to the outer and inner frames to permit to swing through an angle of 85°. Cast aluminium (conforming to IS designation A-5-M of IS 617) or chromium/cadmium plated bronze spring catches shall be fitted in the centre of the top bar of the shutter. The spring catch shall be secured to the frame by screwing/riveting to the frame and shall close into an aluminium catch plate riveted/welded to the outside of the outer shutter frame bar. Aluminium or cadmium plated brass chord pulley wheel in an aluminium bracket shall be fitted at the sill of the shutter with Aluminium or galvanized/cadmium plated steel screws.

The door shutters shall be fitted with pivots as specified. The handle for doors shall be of Aluminium and as per design. The door shutters shall be provided with locking device, floor spring, O/H door closer and any other hardwares, specified in item.

In case of composite Door/window/ventilator units, the units shall be coupled. Weather bar shall be provided whenever a coupling member is fitted over an external opening shutter.

Glazing shall be fixed to the extruded sections by means of extruded aluminium beading. Glass panes shall be provided with rubber lining before fixing.

The aluminium frames shall be fixed to the masonry by means of aluminum lugs fixed to the frame (by counter sunk galvanized machine screws) and grouted with M-15 grade concrete in the hole in the masonry. In case of concrete wall, the frames shall be fixed by 96 mm long, 12 mm dia metallic dash fasteners. Any steel material coming in contact with aluminium shall be galvanized.

The windows/ventilators/doors shall be checked to ensure smooth operation, perfect level and plumb.

## **17.11 Steel Sheet Roofing and Siding:**

### **17.11.1 General:**

This section includes all labour materials and equipment necessary to furnish in place all steel roofing and siding, all flashings, closers, and accessories used in conjunction with the siding to make a weather-tight installation, and related hardware and fasteners required for completion of this Contract and as herein specified.

The Contractor shall supply, deliver, and fix everything necessary to complete the installation of roofing, cladding in accordance with the specification.

The roof slope in general shall not be flatter than 1:5. The normal pitch if not specified, shall be 1:2.

Materials shall be from an approved manufacturer. The items supplied shall be free from cracks, chipped edges or corners, or other damage. Storage and safety precautions shall be taken to avoid damage to the accessories.

Reference shall be made to the following Indian Standards:

IS 277: Galvanized steel sheet (plain & corrugated)

IS 730: Hook bolts for corrugated sheet roofing.

IS 459: Specification for unreinforced corrugated and semi corrugated asbestos cement sheets.

IS 1230: Cast iron rainwater pipes & fittings.

IS 1728: Specification for sheet metal rainwater pipes upto 100 mm nominal size gutters, fittings and accessories.

### **17.11.2 Materials:**

#### **17.11.2.1 Corrugated GI Sheet Roofing / Cladding:**

Corrugated GI sheet

G.I. sheets shall be of specified thickness and of class-3 galvanized as per IS 277 and shall be of approved brand by the Employer. The thickness of the sheets shall be worked out based on the wind speed expected in the project area.

GI Ridges and Hips

These shall be of specified thickness and of class 3 plain galvanized and shall be bent to the required shape and dimensions as per Contractor's drawings without damaging the sheet in the process of bending.

GI Valleys and Flashings

These shall be of specified thickness and of class 3 plain galvanized and shall be bent to the required shape and size as per Contractor's drawings without damaging the sheet in the process of bending.

GI Gutters

These shall be of specified thickness and of class 3 plain galvanized and shall be constructed to the required shape and size as per Contractor's drawings.

Wind Ties

Wing ties of mild steel shall be as per requirement of the design.

### **17.11.3 Workmanship**

#### **17.11.3.1 Corrugated GI Sheet Roofing**

Spacing of Purlins

One purlin each shall be provided at the ridge and the eaves. Spacing of the purlins shall be as per the requirement of the design. Purlin shall coincide with the centre line of the end lap. Ridge purlin shall be placed such that ridges can be placed properly. Portion overhanging the wall support should not be more than one fourth the purlin spacing.

Finish for Purlins

The top surfaces of the purlins shall be painted before fixing the sheets and the embedded portion shall be finished with two coats of coal tar.

Laying of sheets

Sheets shall be laid on the purlins to a true plain with the lines of Corrugation truly parallel or normal to the sides of area to be covered, unless otherwise specified. They shall be bent up along their side edges close to the wall and the junction shall be protected by flashing on projection drip course as specified.

### Laps

End laps shall be 150 mm for 1:2 slope and 200 mm for flatter ones. Side lap shall be of two ridges of corrugations on each side.

### Cutting of Shaft

Sheets shall be cut according to the dimensions. Sheets shall be cut with a straight edge and chisel to give a straight finish.

### Fixing of sheets

The sheets shall be fixed to the roof members with J or L polymer coated bolts, polymer cap, seal washer and thrust washer. The bolts shall be long enough to project at least 12 mm above the top of their nuts. The grip of J or L hook bolts on the side of purlins shall not be less than 25 mm. There shall be at least three hook bolts placed at the ridges of Corrugations in each sheet in every purlin and their spacing shall not exceed 300 mm. Sheets shall be joined together at side laps by polymer coated bolts and nuts as specified, each bolt with a polymer cap (grease filled) steel washer and polymer coated thrust washer. Bolts shall be placed zigzag on overlapping Corrugations. The spacing of the beam bolts shall not exceed 600 mm in each of the staggered rows.

### Holes

Holes for all bolts shall be drilled in the ridges of the corrugations from the underside before placing in position. The holes in the sheet shall be at least 50 mm from the edge. The holes in the washers shall be of diameter of the hook bolts or the seam bolts. The nuts shall be tightened from above to give a leak proof roof.

### Ridges and Hips

The overlap for ridges and hips on either side of C.G.I. sheet and end legs shall be at least 225 mm. Ridges & hips shall be fixed to the purlins with polymer coated hook bolts, thrust washer and polymer cap. At least one of the fixing bolts shall pass through the end laps of ridges and hips on either side. If it is not possible extra hook bolts shall be provided. Each endlap of ridges and hips shall be joined together by at least galvanized iron seam bolts and GI washers. Ridges and hips shall fit squarely on the sheets.

### Valleys and Flashings

The edge, wherever the roof sheeting or valley gutter is turned up against a wall shall be made weatherproof with flashing. Flashing shall be bent to shape and fixed as specified. Lap over the sheet shall be minimum 150 mm. End laps between flashing sheets shall not be less than 225 mm.

Flashing shall be inserted into brick work or masonry joints to a depth of 50 mm and shall be filled with cement mortar (1:3). When flashing has to be laid at a slope, it shall be stepped at each course of masonry. The steps shall be cut back at an angle of at least 30°.

Valleys shall be bent to shape and shall have at least 225 mm end lap and projection on either side under CGI sheet. Valleys shall be fixed to the roof members below with polymer coated GI bolts, polymer cap, seal washer and polymer coated thrust washer. At least one fixing bolt shall pass through end laps of the valley piece.

### Gutters

The longitudinal edges shall be turned back by 12 mm and beaten to form a rounded edge. The ends of the sheet at junctions of pieces shall be hooked into each other and beaten flush avoid leakage.

Gutters shall be laid to minimum 1:120 slope. Gutters shall be true to line and slope and shall be supported by brackets as specified.

### Wind Ties

Wind ties shall be of 40 mm x 6 mm flat iron section and other size as specified. These shall be fixed at the two eaves end of the sheet. Fixing shall be done with the same loose bolts which secure sheets to the purlins. Slot holes shall be cut in the wind ties to allow for temperature variations.

## **17.11.3.2 Precoated Galvanized Sheet Roofing / Cladding:**

### Material

The base metal of the roofing shall be Cold Reduced Steel Sheet conforming to IS-513. It shall be galvanized by Hot-dip process as per IS-277. The bottom unexposed surface shall then be coated with

alkyd backer of min. 7 microns Top exposed surface shall have epoxy primer of min. 7 microns followed by polyester topcoat of min. 16 microns of specified colour.

**Properties**

The pre-coated galvanized steel sheets shall meet the following performance standards:

Pencil Hardness: H-2H

Formability: 2-3 t

Impact Resistance: 40"/lb.

Salt spray test: 750 hours

QUV-Weatherometer Test: 1000 hours

Humidity Test: 1000 hours

Temperature Resistance: 150°C

Fire performance: Class 1

**Profile**

The profiles shall have a depth of not less than 35mm and pitch of 190mm. Overall sheet thickness shall be 0.65mm min. and weight shall be 5.72 kg/sqm.

**Accessories**

All roofing accessories like ridge, gutters, north light curves etc. shall be fabricated out of the approved pre-coated sheet.

Metallic Fasteners and Fixing accessories shall be corrosion proof. Non-metallic fasteners shall be of neoprene. Sealants shall be neutral cure type and cold setting variety.

**17.12 Woodwork**

**17.12.1 General:**

This section of the specification includes requirements for furnishing and installing all woodwork including iron mongery as specified for the completion of all of the work of the Contract.

The Contractor shall supply all timber, fittings, ancillary materials for fixing such as glue, screws, bolts, hold fasts etc. required for the works all in accordance with dimensions and sizes required.

The Contractor shall ensure that any timber entering the site for incorporation in the permanent works is of an approved quality.

Pre-fabricated & assemble doors, windows and / or any other unit shall on arrival at the site, be subjected to a thorough inspection and approval by the Employer.

Timber for joinery work shall be wrought to the exact sizes and all surfaces shall be rubbed down and left clean for painting or staining.

**17.12.1.1 Indian Standards**

IS:2202-Part I	Specification for wooden flush door shutters (solid core type) plywood face panels
IS:2202-Part II	Specification for wooden flush door shutters (Solid core type) practice board and hard board face panels.
IS:1003 Part - I	Specification for Timber panelled and glazed shutters -Door shutters.
IS:3087	Specification for wood particle boards (medium density) for general purposes.
IS:3097	Specification for Veneered particles board.
IS:848	Specification for synthetic Resin Adhesives for plywood (phenolic and Amino plastic).
IS:205	Specification for non-ferrous metal butt hinges.
IS:2338	Code of Practice for finishing of wood and wood-based materials (Part-1 & Part-11).
IS:1341	Specification for steel butt hinges.
IS:4021	Specification for timber door, window and ventilator frames.
IS:303	Specification for plywood for general purpose.

**17.12.2 Material**

### **17.12.2.1 Timber**

#### Teakwood:

Teakwood shall be second class Indian Teakwood conforming to IS:4021 of good quality, well-seasoned and free from defects such as cracks, dead knots, sapwood etc. No individual hard and sound knot shall be more than 15 sq.cm in size and the aggregate area of such knots shall not exceed 2% of the areas of the piece. The timber shall be fairly close grained having not less than 2 growth rings per cm, width in cross-section.

#### Hard Wood:

Hard wood shall be first class wood conforming to IS:4021 of good quality, well-seasoned and free from defects such as dead knots, cracks, sapwood etc. No individual hard and sound knot shall exceed 6 sq. cm in size with no dimension more than 50 mm and the aggregate area of such knots shall not be more than 1% of the area of the piece. There shall not be less than 5 growth rings per cm, width in cross-sections.

#### Moisture Content in Timber

The maximum permissible percentage of moisture content for well-seasoned timber shall be as per IS 287.

#### Workmanship of Woodwork

Workmanship for wood and joinery shall be as per IS:1200 and IS:4021.

#### Painting / Polishing of Woodwork

Painting/polishing of woodwork shall be in accordance with specifications under 'Painting'.

### **17.12.3 Wooden Door / Window Frame:**

Wooden Door / Window frame shall be made of specified wood as per item description and shall be in accordance with detailed drawings of Contractor.

The wooden members of the frame shall be planed smooth and accurate to the full dimensions.

Rebates, rounding, moulding etc. shall be done before the members are jointed into frames. Joints in the framework shall be perfect with square edges and shall be pinned with hard wood/bamboo pins of 10 to 15 mm dia.

Woodwork shall be painted/polished or otherwise treated as specified. All exposed portions shall be coated with wood primer and concealed surface by bituminous paints as per specifications under 'Painting'.

Before any surface treatment is applied, the wood work shall be got approved by the Employer. The frames shall be fixed only after acceptance by the Employer. The frames shall be fixed to the masonry by 300 mm x 25 mm x 6 mm MS hold fasts embedded in M-15 grade concrete block of 350 mm x 100 mm x 100 mm in the hole of the masonry. In case of concrete, frames shall be fixed by 96 mm long 12 mm dia metallic dash fasteners.

### **17.12.3.1 Shutters:**

#### Particle Board Flush Shutter

Particle board flush shutter shall in general conform to IS:2202.

#### Materials

##### i) Particle Board

Particle board shall conform to IS 3097 and shall be three layer flat pressed teakwood based and of exterior grade (Grade-1), type-1, BWP type bonded with phenol Formaldehyde synthetic resin conforming to IS 848.

##### ii) Veneers

Veneers shall conform to class-I of IS:303 and (BS:476 Part-7)

##### iii) Teakwood

Specification of Teakwood shall be same as specified in Clause 5.12.2.1 of this section.

##### iv) Hinges

Hinges shall be of Extruded Aluminium Alloy and butt type conforming to IS:205. Size of hinges shall be in accordance with shutter width and as per IS:205.

#### Workmanship

The particle board of required size and thickness shall be lipped on all the edges with T-type teakwood lipping. The overall board lipping composition shall be of uniform and specified thickness and shall be property sized in view of the operation of shutter.

All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double leaf shutters, the meeting of the stiles shall be rebated by one third the thickness of shutter. The rebating shall be splayed.

The shutter then shall be veneered on both faces by gluing approved shade and textured commercial type 0.5 mm thick veneering conforming to class 1 of IS 303.

The veneering shall be done by gluing the veneer with BWP type, phenol formaldehyde synthetic resin conforming to IS 848 by hot press process on the shutter. Workmanship and finish of the veneering shall conform to IS 303.

The exposed surfaces of the lipping of the edges shall be French polished in accordance with specifications under 'Painting'.

The shutter shall be fixed to the door frame, by means of hinges @ minimum 3 hinges per leaf. Maximum spacing of hinges being 600 mm with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame etc.

#### **17.12.3.2 Medium Density Fibre Board Panel Shutter**

MDF board panelled shutter shall in general conform to IS: 1003.

#### Materials

##### i) MDR-board

Medium density fiberboard shall conform to IS: 12406 Exterior grade (EGSB). It shall be dense, homogeneous and manufactured from agro based lingo-cellulosic fibers bonded with BWP type phenol formaldehyde synthetic resin conforming to IS:848. It shall be categorized as class I for Surfaces of very low flame spread as per IS-1642.

##### ii) Teakwood

Specifications of Teakwood shall be same as specified in Clause 5.12.2.1 of this section.

##### iii) Synthetic Enamel Paint and Primer

Synthetic Enamel paint conforming to IS:1932 of approved brand and manufacturer and of the required colour shall be used for the top coat and undercoat of shade to match the topcoat as recommended by the manufacturer and specified under 'Painting'.

##### iv) Hinges Specification of hinges shall be same as specified in Clause 5.12.3.1 (iv)

#### Workmanship

Teakwood stiles, top rail and bottom rail of specified thickness and size shall be provided with suitable rebate.

The MDF board shall be fitted in by means of teakwood moulded beading of appropriate cross section. The beading shall be fixed by means of approved make neoprene based adhesive and nailing.

All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double leaf shutters, the meeting of the stiles shall be rebated by one third the thickness of shutter. The rebating shall be splayed. The surface of the teakwood stiles and rails shall be coated with 2 layers of approved quality polyurethane transparent coat with strainer to achieve the desired shade.

The shutter shall be fixed to the door frame by means of hinges @ minimum 3 hinges per leaf, maximum spacing of hinges being 600 mm. with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of door like smooth movement, proper closing against the door frame etc.

The joints between stiles / rails and the panel shall be properly finished. Extra neoprene adhesive shall be removed and no gap between panel and stiles/rails shall be permitted. Any stain of paint on the panel surface shall be properly removed.

### **17.12.3.3 Glazed Wooden Door Shutter:**

Materials

i) Wood

Teakwood for various members like stiles, rails, etc. shall be as specified-in Clause 5.12.2.1 of this section.

ii) Glazing Glass sheets for glazing shall be

a) 4 mm thick plain glass (wt. 7.2 kg/m<sup>2</sup>) conforming IS:2835, or

b) 5.5 mm thick wired glass conforming to IS:5437 or

c) 6.3 mm thick laminated glass conforming to IS:2553 as the case may be as per item description or

d) 5.5 mm thick toughened glass.

Glass sheets shall be free from flaws, scratches, cracks, bubbles etc.

iii) Hinges

Hinges shall be as specified in Clause 5.12.3.1 (iv)

Workmanship:

Teakwood stiles and rails of size as specified in item description shall be cut accurately and planed smoothly to required dimensions. The stiles and rails shall be provided with rebates for fixing the glazing and shall be joined together to form the profile of the shutter. The joinery work shall be as approved by Employer. Only after such approval, the joints shall be coated with white lead, pressed and secured by hardwood pins of about 6 mm dia. All the four edges of the shutter shall be square. In case of double leaf doors, rebates shall be provided at the meeting of stiles. Rebates shall be splayed type and one third the thickness of the stiles.

The glass sheets for glazing shall be fixed by teak wood beading having mitred joints and shall be fixed by means of approved neoprene based adhesive and nailing, the spacing between the nails being no more than 300 mm.

All wooden surfaces shall be coated with 2 coats of approved make polyurethane with strainer mixed to achieve desired shade.

The shutter shall be fixed to the door frame, by means of hinge @ minimum 3 hinges per leaf, maximum spacing of hinges being 600 mm with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame etc.

### **17.12.3.4 Fly mesh Shutter for Door and Window:**

Specifications for Flymesh shutter shall be similar to specification for wooden glazed door, excepting following features:

i) In place of glass, net of galvanized MS wire-mesh of IS gauge designation 856 wire and dia 0.56 mm shall be fixed to the shutter frame with teakwood beading.

ii) Flymesh shutter shall be for both doors as well as windows.

iii) All wooden surfaces shall be painted with synthetic enamel paint of approved shade in two coats over a priming coat in place of French polishing.

### **17.12.3.5 Fire-Resisting Door:**

Frame

Door frame with heat-activated intumescent fire seal strips of size 12 mm x 4 mm (for smoke sealing) mounted in the groove in the frame, suitable for mounting 60/30 minutes fire-rated shutters with one coat of anti-termite fire retardant primer.

Shutters / Panels

The shutters of the door shall be of approved make conforming to IS:3614 (Part I) shall be so designed so as to provide the specified fire resistance when tested as per IS:3614 (Part 2) and

BS:2750 to suit the specified requirement and the manufacturer must produce certificates of the recognized laboratory to the satisfaction of the Employer.

Asbestos free composite fire/smoke check shutters of 60 min, fire resistance rating, conforming to BS:476 part 22/IS:3614 Part 2) and shall comprise two non-combustible boards each 12 mm thick sand-witching 20 mm thick fire resistant insulation faced with 3 mm commercial ply veneering on both faces and seasoned teak wood lipping around the shutters with heat activated intumescent fire seal strips of size 12 mm x 4 mm mounted in the grooves in the shutters/panels on all sides except bottom.

Seal

A heat activated intumescent seal of approved quality and make conform to BS:476 (Part 8) shall be provided on all edges of doors to check the spread of smoke in case of fire.

Paint

The door frame and panel/shutter shall be treated with ready mixed silicate type fire retardant antiterminal primer& paint of approved shade and manufacturer as per IS: 162 (BS:476-Part I)

#### **17.12.3.6 Hold Fast:**

Hold fasts for use with wooden doors shall be made from mild steel flats not less than 5 mm thick in accordance to IS: 7196 and shall be galvanized. The shutter shall be supported by hinges as specified in Clause

17.12.3.1 (iv). Hold fasts shall be fixed with the timber frame by steel screws only. The framed in masonry wall shall be fixed in cement concrete blocks as directed by Employer.

#### **17.12.3.7 Ironmongery:**

The Contractor shall submit a complete schedule of ironmongery for approval by the Employer. The schedule of ironmongery shall indicate the manufacturer's catalogue number, function, material, finish, and other information required. The Contractor shall supply and fix all ironmongery, including cutting all necessary mortices, rebates, and the like.

a) Cargo Doors: All hardware by manufacturer. No lockset, padlocks shall be of the pin tubular type with solid or laminated brass case and steel hardened shackles.

b) Personnel Doors:

Hardware assembly No. 1: Exterior doors, double leaf

3 pairs butts: 12 cm x 12 cm

2 each flush bolts: :1 each lockset, 1 each stop

Hardware assembly No. 2: Exterior doors, single leaf

1½ pair butts: 12 cm x 12 cm 1 each lockset 1 each stop

Hardware assembly No. 3: Interior doors (except toilets)

1½ pair butts: 12 cm x 12 cm 1 each lockset 1 each stop

Hardware assembly No. 4: Toilet doors (0.70 x 2.00)

1 pair butt: 12 cm x 12 cm 1 each lockset 1 each stop

Windows / Ventilators

Hardware assembly No. 5: Leaf opening windows, Non-ferrous metal holders, and 1 latch set pair hinges.

Hardware assembly No. 6: Sliding Windows Roller 1 latch set 1 lockset.

d) Operated door locks shall be cored, and three keys for each lock and six master keys shall be furnished. Each key shall have a blank bow, one side for stamping purposes. Locks shall be keyed individually and in groups and master keyed in one series as directed by the Employer. The master keys shall be delivered directly to the Employer.

#### **17.13 Roofing Treatment**

##### **17.13.1 General:**

This section of the specifications includes the requirements to provide, in place, all roofing treatments specified herein, or as required to provide a complete installation.

##### **17.13.2 Material:**

The material shall consist of 2 pack clear / pigmented aliphatic polyurethane using polyether polyois (polyester or Castor Oil based polyois not acceptable), with iso-cyanurate for rendering flame resistant characteristic. The 2-pack system, consisting of pigment and the solvent (Xylene/Toluene, no filler) shall be mixed in definite ratio by weight strictly as per approved manufacturer's specification, for preparing the coating for application. The coating shall have physical features like high resistance to impact, abrasion and cracking, superior tensile strength (80 kg/cm<sup>2</sup> after 4 weeks at ambient temp.), and perfectly smooth, dust free, glossy finish retained at least upto 3 years. It should also be resistant to acid, alkalis and have a very low water absorption rate (0.5% max. at ambient temp. after 7 days).

The packs shall not be older than 9 months after the date of manufacture and packing.

### **17.13.3 Workmanship**

#### **5.13.3.1 Preparation of Surface**

The roof surface shall be thoroughly cleaned with a wire brush and all foreign matter etc. shall be removed. Well defined cracks on the surface shall be cut to 'V' section, cleaned and filled up flush with a paste of 2 component polyurethane-based crack filling compound and white cement in a ratio of 1:2.

#### **17.13.3.2 Primer Coat**

It shall consist of 2 pack polyurethane. Primer coat shall be mixed in the ratio as per manufacturer's specification. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat.

The primer shall be allowed to dry for a min. of 8 hrs. time before the successive finishing coats are applied  
Finishing coats:

#### **17.13.3.3 Finishing Coats:**

The finishing coats shall consist of three successive pigmented sealing coats each of 2 pack polyurethane mixed in the ratio as per manufacturer's spec. Application shall be with brush, to a smooth and even finish. The overall dry film thickness shall be 450 microns or min. covering capacity shall be 200gms/m<sup>2</sup> per coat. Each coat shall be allowed to dry for min. 12 hours before applying next coat. Care shall be taken for quick application after mixing the 2-pack primer in view of short pot life of the mix and shall be fully consumed within the stipulated period as per manufacturer's spec (Max. 60 minutes at 30°C)

The finishing coating shall be continued up the parapets/walls for a min. of 150mm over the finished roof surface. It shall be continued into rainwater pipes by at least 100mm.

#### **17.13.3.4 Cement Screed:**

The final finishing coat when tacky shall be sprinkled with 300-micron layer of clean sand. Plain cement concrete (1:2:4) of 25mm min. thickness with 24 SWG chicken wire mesh shall be laid to slope in panels not exceeding 6 M<sup>2</sup> area per panel over this. The joints between panels shall be raked out neatly (after stipulated curing period) to a min. 6mm x 6mm v-groove and filled up with an approved quality elastomeric compound sealant. Drain outlet shall be provided for all spouts/rain water pipes by suitable rounding, filling and sloping of PCC. At the junction of the roof and parapet or any other vertical surface, a fillet of 75mm radius shall be formed in cement mortar (1 cement: 4 coarse sand).

#### **17.13.4 Guarantee:**

The applicator shall execute a form of Roofing Treatment Guarantee.

### **17.14 Plastering and Pointing**

#### **17.14.1 General:**

This section shall cover all plastering (internal/external) and painting works as specified herein. Before commencing the work sample of works shall be made in accordance with the specification and got approved by the Employer.

#### **17.14.2 Materials:**

#### **17.14.2.1 Cement:**

Cement shall conform to specifications under 'Material' unless otherwise specified.

#### **17.14.2.2 Sand:**

Sand for plastering and pointing shall conform to IS 1542. Sand shall be hard, durable, dean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, day balls or pellets. Sand shad does not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc.

Sand whose grading falls outside the limits of IS 460 due to excess or deficiency of coarse or fine panicles shall be processed to comply with the standards.

Fine sand shaft be obtained from riverbeds not affected by tidal water of the sea and shall be clean, sharp, and free from excessive deleterious matter. The sand shall not contain more than 8 per cent of mud and silt as determined by field test with a measuring cylinder.

#### **17.14.2.3 Water:**

Water for plastering and pointing shall conform to specifications under 'Material'.

#### **17.14.2.4 Cement Mortar:**

Preparation of cement mortar shall conform to specifications under 'Brick Masonry' unless otherwise mentioned.

#### **17.14.3 Cement Mortar with Waterproofing Compound:**

Waterproof compound shall conform to IS 2645 of the approved make. The compound shall be well mixed with dry cement in the proportion of 3% by weight or as recommended by the manufacturer. Further procedures for preparation of cement mortar shall be as per Clause 5.14.2.4 above.

#### **17.14.4 Workmanship:**

##### **17.14.4.1 Preparation of Background Surface:**

The surface shall be cleaned off all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non-hard and hard surfaces respectively. Projections on surfaces shall be trimmed wherever necessary to get even surfaces. In case of brick/stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plasterwork. The masonry shall not be soaked but only damped evenly thereafter before applying the plaster.

In case of concrete work, projecting burrs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50 mm centers, the pocks being made not less than 3 mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease etc. and well wetted before the plaster is applied.

##### **17.14.4.2 Sequence of Operation:**

For external plaster, the plastering operations shall be started from the top floor and carried downwards. For internal plaster, the plastering may be started wherever the building frame, roofing, and brickwork are ready.

The surfaces to be plastered, shall first be prepared as described in Preparation of background surface in Clause 17.14.4.1 above.

The first underlay shall then be applied to ceilings. After the ceiling plaster to complete and scaffolding for the same removed, plastering on wall shall be started.

After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After a further suitable time interval as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.

Plastering of cornices, decorative features, etc., shall be completed before the finishing coat is applied. Unless otherwise specified Corners and edges shall be rounded off to a radius of 25mm, such rounding off shall be completed along with the finishing coat to prevent any joint marks showing out later.

#### **17.14.4.3 Scaffolding/Staging:**

Scaffolding/staging for plastering/pointing shall be as per specification under Brick Masonry, Clause no. 5.8.6 of Specification.

#### **5.14.4.4 Damage Rectification:**

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Employer.

#### **5.14.5 Plain Cement Plaster:**

##### **5.14.5.1 Preparation of Mortars:**

The mortars of specified mix shall be used as per the specifications of 'Cement Mortar' described in Clause 17.14.2.4 above.

##### **5.14.5.2 Application of Plaster:**

One Layer Plaster Work:

To ensure even, specified thickness, plaster of 150 mm x 150 mm shall be first applied horizontally and vertically at not more than 2-meter interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical/horizontal and shall be carefully finished. Rounding or chamfering of corners, arises, junctions etc., shall be carried out with proper templates to the size required.

In suspending the work, the plaster shall be left, cut clean to line, both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150 mm to any corners or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the comers or arises.

Two Layer Plaster Work

First or under layer

The first or underlay of the specified thickness shall be applied as described above in Clause 5.14.5.2. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

Second or finishing layer.

The second layer shall be complete to the specified thickness in the same manner as for first layer.

##### **17.14.5.3 Curing:**

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period the plaster shall be suitably protected from all damages by such means as approved by the Employer. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

#### **17.14.6 Sand Face Plaster:**

##### **17.14.6.1 Preparation of Mortar:**

The mortar of specified mix shall be used as per the specifications of cement mortar described above in Clause 17.14.2.4.

#### Application of Plaster

Sand face plaster shall consist of 13 mm thick (1 cement: 4 coarse sand by vol) underlayer and 7 mm thick (1 cement: 2 coarse sand by volume) top layer. Application of plaster shall be as described in 'two coat plaster work' in Clause 5.14.5.2 above.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Employer.

#### Curing

Curing shall be as described above in Clause 17.14.5.3.

### **17.14.7 Exposed Aggregate Finish Plaster:**

#### **17.14.7.1 Preparation of Mortar:**

The mortar of specified mix shall be used as per the specifications of cement mortar described above in Clause 17.14.2.4. White and coloured marble chips shall be of 6 mm to 12mm size out of Makrana/Ambaji, grade 1 or Dongri Chittor Brown/Rajnagar/Abu green grade-1 quality. Marble dust shall be obtained from crushing hard marble stone. It shall not be less than 1.0.

#### **17.14.7.2 Application of Plaster:**

Exposed aggregate finish plaster shall consist of 12mm thick plain cement plaster underlayer (1cement: 4 coarse sand by volume) finished rough and 20 mm thick top layer. Underlayer shall be applied in accordance with "One layer plaster work" described above in Clause 17.14.5.2.

Top layer shall be 20 mm thick admixture of white cement and grey cement (mix. ratio 1:1 by volume) mixed with white/coloured marble chips/pebbles of 6mm to 12mm nominal size as per item description. Mix ratio shall be 1cement: 1 marble chips/pebbles by volume Marble dust @ 15% by volume shall be added to the admixture. The pebbles to be used shall be well washed and drained. The admixture shall be thrown wet on to the under layer while it is still plastic using strong whipping motion at right angles to the face of the wall. One coat of neat cement slurry @ 2.75 kg cement per square metre of area shall be applied on to the underlayer to receive the top layer The whole plastering laid in panels with 12mm x 20mm grooves in between formed by holding removable wooden batons of 12mmx x 25mm size over the under layer. The top layer admixture pressed flat over the underlayer filling uncovered parts by hand, so that the finished surface represents a homogeneous surface. Loose mortar etc. on the top surface shall be cleaned/removed by brushing/washing /spraying with water jet after initial setting of mortar.

#### **17.14.7.3 Curing:**

Curing shall be as described above in Clause No. 5.14.5.3.

### **17.14.8 Pointing:**

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

#### **17.14.8.1 Preparation of Base Surface:**

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunken surface of the finished pointing or from the edge of the brick shall be less than 20 mm.

#### Mortar

Mortar shall be in accordance with the specifications of cement mortar described above in Clause 17.14.2.4.

#### Application of Mortar and Finishing

The mortar shall be pressed into the raked-out joints with a pointing trowel according to the type of pointing specified. The mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool.

The superfluous mortar shall be cut off from the edges.

#### Flush Pointing

The mortar shall be pressed into joints and shall be finished off flush and levelled. The edges shall be neatly trimmed with trowel and straight edges.

#### Cut or Weather Struck Pointing

The mortar shall first be pressed into joints. The top of the horizontal joints shall then be neatly pressed back by about 15 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles in case of brick & coursed rubble masonry.

#### Raised and Cut Pointing

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

#### Curing

Curing shall be as described above in Clause 17.14.5.3

### **17.15 Floor Finishing**

#### **17.15.1 General:**

This section shall cover all flooring and wall tiling work and specified herein. No work under this section shall be started until specifically allowed by the Employer and until all other major works such as plastering, embedding of conduits and pipes channels, window fixing etc. have been completed.

Samples of basic materials and work of adequate size representing the nature of variation including quality, size, texture after finishing to be used in the flooring work shall be prepared for all work and got approved by the Employer sufficiently prior to ordering. The approved samples shall be retained upto the end of the project. The works shall be got done by skilled and specialized workmen experienced in the respective trade of work.

Reference shall be made to the following Indian Standards:

IS: 4971 Recommendations for selection of Industrial floor finishes

IS: 2114 Code of practice for laying insitu terrazzo floor finish.

IS: 1237 Specification for Cement concrete flooring tiles

IS: 777 Specification for glazed earthenware wall tiles

IS: 2571 Code of practice for laying in situ cement concrete flooring

IS: 4631 Code of practice for laying of epoxy resin floor toppings.

IS: 3462 Code of practice for unbaked flexible PVC flooring.

IS: 5318 Code of practice for laying of flexible PVC sheet and tile flooring

IS : 3461 Spec for PVC asbestos floor tiles.

IS: 1443 Code of practice for laying in situ granolithic concrete floor topping.

IS: 5491 Code of practice for laying in situ granolithic concrete floor topping.

IS: 4441 Code of practice for use of silicate type Chemical resistant mortars.

IS : 4443 Code of practice for use of resin type chemical resistant mortar.

IS : 1196 Code of practice for laying Bitumen Mastic flooring

#### **17.15.2 Cement Concrete Flooring General:**

##### **17.15.2.1 General:**

Cement concrete flooring shall in general conform to IS 2571. Cement concrete flooring shall consist of a sub base (laid on the compacted earth or sand fill In case of ground floor only) a base course laid on the sub-base and then finishing layer of floor finishing. Where the cement concrete flooring is to be laid directly on the RCC slab, the surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry at 2 kg. of cement per Sq.Mtr. shall be applied, so as to get good bond between RCC slab and concrete floor. In case of ground floor, the filled and compacted bed on which the sub-base is to be laid, shall be as per specifications.

The bed for flooring shall be prepared either level or sloped as instructed by Employer.

### **17.15.2.2 Workmanship:**

#### Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness as per specifications. The sub-base shall be of cement concrete. In case of upper floors, the structural RCC slab shall be treated as sub-base.

#### Base Course

Base course shall be of cement concrete of specified mix and of specified thickness/item descriptions and shall generally conform to specification (Plain and Reinforced Cement Concrete).

The floor space on which base course is to be laid shall be divided into square/ rectangular or as per designed panels to prevent cracks in the floor finish. No dimension of the panels shall exceed 2m and length of the panel shall not exceed 1.5 times its breadth. Base course shall be laid on alternate panels. The borders of the panels shall have mitred joints at the corners of the room and intermediate joints shall be in straight line with panel joints.

The panels shall be bound by MS strips/PVC strips etc. These shall be fixed in position with their top at proper level, giving slope wherever required.

The flooring shall butt against masonry of wall which shall not be plastered.

When the base course is to be laid on hardened base, the sub-base shall be roughened by steel wire brushing and cleaned. Before laying the base course, neat cement slurry shall be brushed into the prepared surface.

Cement concrete shall be placed in position and beaten with trowel and finished smooth. Beating shall cease as soon as surface is found covered with cream of mortar. Necessary slope shall be provided.

#### Floor Finishing

Finishing of the surface shall follow immediately after the completion of base course. The base course shall be free of excessive moisture before starting the floor finishing. Use of dry cement, cement sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

While the concrete is still green, cement @ 2.75 kg per square meter of floor area shall be mixed with water to form a thick slurry and spread over the surface. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

The junction of floor with wall plaster, cladding, skirting shall be rounded off uniformly upto a radius of 25mm unless otherwise mentioned.

#### Curing

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

### **17.15.3 Cement Concrete Granolithic Flooring:**

#### **5.15.3.1 General:**

Cement concrete granolithic flooring shall consist of a sub-base, a base course, finishing layer of floor finish. Workmanship shall in general be same as for cement concrete flooring, unless otherwise mentioned.

#### **5.15.3.2 Workmanship:**

Workmanship shall in general conform to IS: 5491.

#### Sub-base

Refer Clause 17.15.2.2 above.

#### Base Course (under-layer)

Refer Clause 17.15.2.2 above.

#### Wearing Top Layer

The top layers shall be laid over first layer within 15 minutes of laying the first layer. The cement and aggregates for the top layer shall be mixed dry. After mixing, sufficient quantity of sand and water shall be added to make the mix plastic but not flowing. The top and bottom layer shall firmly grip together.

Floor Finishing

Refer Clause 17.15.2.2 above.

Curing

Refer Clause 17.15.2.2 above.

#### **17.15.4 Heavy Duty Flooring:**

##### **17.15.4.1 General:**

Heavy duty Flooring in workshop shall consist of a sub-base, a base course and a finishing layer of floor finish.

##### **17.15.4.2 Workmanship:**

Sub-base

Refer Clause 17.15.2.2 above.

Base Course

Base course shall consist of one layer of cement concrete of specified mix and thickness laid on sub-base in panels in accordance with Clause 17.15.2.2 above.

Floor Finish

Finishing layer shall be of cement, hardener, and stone aggregate mix of specified proportion and thickness laid over the base course. Unless otherwise mentioned, one part of approved quality hardener and four parts of cement by weight shall be mixed dry. This dry mixture shall be mixed with stone grit of 6mm and downsized in the ratio of 1 hardener and cement mixture: 2 stone grit by volume. Just enough water shall then be added to the mix.

The mixture so obtained shall then be laid on the base course within 2 to 4 hours of the latter's laying. It shall be firmly pressed into the bottom concrete to have a good bond with it. After the starting of initial setting, the surface shall be finished smooth and true with steel floats.

#### **17.15.5 Precast Hydraulically Pressed Cement Tiles Flooring:**

##### **17.15.5.1 Materials:**

Cement Concrete Tiles

Cement concrete tiles shall conform to IS 1237 and shall be of approved shade, with 10 mm downsize stone aggregates and using a 1:6 or as directed mixture of white and ordinary cement and shall be of specified thickness and approved shade.

Pigments

Pigments to be admixed with mortar or for grouting shall conform to Table 1 of IS 2114.

Cement Mortar

Cement mortar shall be of specified mix and thickness and shall be in accordance with Clause

##### **17.15.2.1 of the specification under 'Materials'.**

Workmanship

Workmanship shall in general conform to IS: 1443. The base on which tiles are to be laid shall be cleaned of all dust, dirt and properly wetted without allowing water pools. Cement mortar of specified thickness shall then be spread over the base for two rows of tiles and 3-5 metres in length. The mortar shall be laid in slope as per requirements and thickness of mortar shall not be less than 10mm at any place. The top of the mortar shall not be less than 10mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre & proceed outwards in the two directions at 90°. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 4.4 kg. of cement per Sq.M. shall be spread over the mortar bed laying 20 tiles at a time. The tiles shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level. The joints shall not exceed 1.5mm in width. After the day's work, the excess cement slurry on top and the joints shall be cleaned with broom stick and washed before the slurry sets hard. Next day, the joints shall be filled with the cement grout of the same shade as the matrix of the tile.

Tiles along the periphery shall be continued by average 12 mm under the wall plaster, skirting or dado.

#### Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

#### Grinding and Polishing

Grinding shall be commenced after 14 days when the tiles and the joints are property set. Grinding shall be done by machines except for skirting and small areas. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in the machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring all pin holes. It shall then be covered with a thin coat of grey/white cement mixed with pigments to match with colour of the flooring. This grout shall be kept moist for a week. Thereafter the second grinding shall be started with carborundum stone of 120 grit. Grinding and curing shall follow again. Final grinding shall be with carborundum of grade 220 to 350 grit using water in abundance. The floor shall be washed clean with water, oxalic acid powder shall then be dusted at 33 gms/sq. m. on the surface rubbed with machine fitted hessian bobs or rubbed hard with woolen rags. The floor shall then be washed clean and dried with a soft cloth or linen. If any tile is disturbed or damaged, it shall be refitted or replaced proper jointed and polished.

### **17.15.6 Cement Plaster Skirting**

#### **17.15.6.1 Material**

Cement plaster skirting shall be laid with cement mortar as per Clause 17.8.2.1 specification under Brick Masonry Work and shall be of specified proportion and thickness.

#### **17.15.6.2 Workmanship**

The surface on which the skirting is to be applied shall be prepared and skirting of specified thickness shall be laid in accordance with Clause 17.14.4.1, specification under Plastering & Pointing. The junction between flooring and wall shall be rounded off to a radius of 25mm if not otherwise mentioned.

While the mortar is still green, cement @ 2.75kg per square metre shall be mixed with water to form a thick slurry and applied over the mortar. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

### **5.15.7 Cast-In-Situ Terrazzo Flooring:**

#### **5.15.7.1 Material:**

Cement Concrete

Specification of cement concrete shall be same as in Specification under Plain and Reinforced Concrete.

#### Aggregates for Terrazzo Topping

The aggregate to be used in topping shall be marble chips of plain white Pink, Makrana. Grade Baroda green etc. as specified which shall be of 10mm nominal size. Marble powder to be used in terrazzo topping shall pass through IS Sieve Terazzo. Marble chips shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. All proportions of Materials used should be as directed by the Employer described in the item.

#### Pigment

Pigments to be used in Terrazzo shall be of permanent colour and shall conform to IS-2114, Table-1.

#### **17.15.7.2 Workmanship:**

Workmanship shall in general conform to IS -2114. Terrazzo flooring shall be of specified thickness and shall be laid in two layers and in panels. Under layer or base course shall be of cement concrete laid over sub-base and top layer shall be of terrazzo floor finish.

Top layer shall consist of mix of white cement, marble powder, marble chips, water and pigments. Cement and marble powder mix proportion shall be 3 : 1 by weight. Cement, marble powder mix shall be mixed with marble chips in the proportion of 4:7 by volume. Quality and shade of chips and powder shall be as

specified with a view to avoid variation in colour. Sufficient quantity of white cement shall be added in the cement mix to obtain the desired shade. Mixing shall be done in a trough or tub and complete quantities of white cement and pigment for a particular unit of job shall be dry mixed with aggregates. Water shall be added in small quantities to this dry mix to get a proper consistency. The mix shall be plastic but not so wet to flow. The mix shall be used within 30 minutes of its preparation.

The base course/under layer shall be divided in panels with dividing strips (G.I./Aluminium Alloy /PVC) up to the finished surface levels. The sub-base shall be cleaned of all dust, dirt or any loose material. It shall then be wetted with water, mopped and smeared with neat cement slurry.

Terrazzo topping shall be laid while the underlayer is still plastic but has hardened enough which is normally achieved between 18-24 hours after laying the underlayer. A cement slurry pigmented with the same colour as the topping be brushed on the surface immediately before laying the topping. The terrazzo mix shall be laid to a uniform thickness and be compacted thoroughly by tamping or rolling and trowelled and brought true to required level by a straight edge and steel floats so that the maximum amount of marble chips come up and spread uniformly over the surface and no part of the surface is left without the chips.

#### Curing

The surface shall be left dry for air curing for a period of 12-18 hours. Thereafter water shall be allowed to stand overnight in pools for a period of minimum four days.

#### Grinding and Polishing

Grinding and polishing shall be done with machines and shall start after 7 days of laying. First grinding shall be done with carborundum stone of 60 grit size. The surface shall then be washed clean and grouted with a grout of cement and/of coloring matter in same mix and proportion as the topping in order to fill any pin notes that appear. It shall then be allowed to dry for 24 hours and wet cured in the same manner as mentioned above in Clause 17.15.7.2. The second grinding shall be done with carborundum stone of 80 grit size. The surface shall then be prepared as after first grinding.

The third grinding shall be done with carborundum stone of 120 to 150 grit size. The surface shall then be prepared again as after first grinding.

The fourth grinding shall be done with carborundum stone of 320 to 400 grit size. The surface shall then be washed clean and rubbed hard with felt and slightly moistened oxalic acid powder @ 33 gms per square metre of floor surface. After the finishing works are over, the surface shall be washed with dilute oxalic acid solution and dried. Floor polishing machine fitted with felt on hessian bobs shall then be run over it until the floor shines.

In case of polishing, wax polish shall be applied on the surface with the help of soft linen over a clean and dry surface. Then the polishing machine fitted with bobs shall be run over it. Clean saw dust shall be spread over the floor surface and polishing machine operated again to remove excess wax.

### **17.15.8 Cast-In-Situ Terrazzo Skirting and Dados:**

#### **17.15.8.1 Material:**

Refer Clause 17.15.7.1 above.

#### **17.15.8.2 Workmanship:**

Cast-in-situ Terrazzo in skirting and dado shall be of specified thickness and of same shade as that of the flooring.

Underlayer for terrazzo on vertical surfaces shall be of stiff cement mortar 1:3 (1 cement: 3 coarse sand by volume) finished rough so as to give a good bond to the topping. Terrazzo topping shall be average 12mm thick and underlayer shall be 13 mm thick. Terrazzo topping shall be laid on the underlayer in accordance with Clause 17.15.7.2 above. Other details shall be same as for flooring excepting grinding which shall be manual.

### **17.15.9 Precast Hydraulically Pressed Terrazzo Tile Flooring:**

#### **17.15.9.1 Materials:**

Terrazzo Tiles

Terrazzo tiles shall be of specified thickness and shade and shall generally conform in all respects to IS-1237.

Pigment

Refer Clause 17.15.7.1 above.

Cement Mortar

Refer Clause 17.15.5.1 above.

#### **5.15.9.2 Workmanship**

Refer Clause 17.15.8.2 above.

Curing

Refer Clause 17.15.7.2 above.

Grinding and Polishing

Refer Clause 17.15.7.2 above.

#### **17.15.10 Terrazzo Tiles in Risers of Steps, Skirting and Dado:**

##### **17.15.10.1 Material:**

Terrazzo Tiles

Same as in Clause 17.15.9.1 above. The average thickness of tiles shall, however, be 20mm.

Pigments

Same as in Clause 17.15.7.1 above.

Cement Mortar

Same as in Clause 17.15.5.1 above.

##### **17.15.10.2 Workmanship:**

In case of brick masonry wall, the joints shall be raked out to a depth of at least 15mm while the masonry is being laid. In case of concrete work, the surface shall be hauled and roughened with wire brushes.

The wall surface shall be uniformly and evenly covered with 12mm thick backing of cement mortar 1:3 (1 cement: 3 coarse sand by volume). Before hardening of the cushioning mortar, back of each tile shall be covered with a neat layer of cement slurry @ 4.4.kg of cement per Sq.Mtr. and edges with white cement with or without pigment to match the shade of tiles and the tiles then shall be pressed on the backing and tapped.

The tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed.

The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

Curing, Grinding and Polishing

Same as in Clause 17.15.7.2 above.

##### **17.15.11 Glazed Tiles Work:**

###### **17.15.11.1 Material:**

Tiles

Glazed tiles shall conform to IS: 777 and shall be of specified shade, size and of approved manufacturer.

Pigments

Same as in Clause 17.15.7.1 above.

Cement Mortar

Same as in Clause 17.15.5.1 above.

###### **17.15.11.2 Workmanship:**

The tiles shall be laid over a coating of specified adhesive (as per approved manufacturer's specification) laid on base floor/ wall plaster. The joints of the tiles shall be flush pointed with cement paste (white cement and pigment conforming to IS-2114, Table 1) matching the shade of colors.

Curing

Same as in Clause 17.15.7.2 above.

### **17.15.12 Glazed Tiles in Risers of Steps, Skirting and Dado:**

#### **17.15.12.1 Materials:**

Same as in Clause 17.15.11.1 above.

#### **17.15.12.2 Workmanship:**

Same as in Clause 17.15.11.2 above.

Curing

Same as in Clause 17.15.7.2 above.

### **17.15.13 Kota Stone Flooring:**

#### **17.15.13.1 Materials:**

The slabs shall be of selected quality and shade, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. These shall be machine cut to the requisite size and thickness and chisel dressed. The slabs shall have the top (exposed) face polished before being brought to the site. Before starting the work, the Contractor shall get the samples of slabs approved by the Employer.

#### **17.15.13.2 Workmanship:**

Each slab shall be machine cut to the required size and shape and fine chisel dressed at all edges to full depth, and machine rubbed to a smooth surface finish. All angles and edges of the slabs shall be true square and free from chipping, carving a plane and a smooth surface.

Preparation of Surface

Cement mortar 1:6 (1 cement: 6 coarse sand by volume) of specified thickness shall be laid over the base after making it rough and cleaning thoroughly.

The mortar shall be laid for facing one slab at a time.

Laying

The slab shall be washed clean before laying. It shall be laid over cement mortar bedding on top, pressed, and lapped gently to bring it in level. It shall be then lifted and laid aside. Top surface of the mortar then shall be corrected by adding fresh mortar at hollows and depressions. The mortar then shall be allowed to harden and cement slurry of honey like consistency @ 4.4 kg of cement per Sqm shall be spread over the mortar. The edges of the slabs shall be buttered with white cement with or without pigment grout to match the shade of the slabs. The slabs shall then be gently placed in position and tapped with wooden mallets till it is properly bedded in level. The joints shall be as fine as possible. Surplus cement on the surface of the slab shall be removed. The slabs in flooring shall continue for not less than 10 mm under the plaster/skirting. The finished surface shall be true to levels and slopes as instructed by the Employer.

The slabs shall be laid in patterns and size shall not be less than 310mm X310mm. Cut uniform size may be used along periphery as required.

Curing

The floor shall be cured for a minimum period of 7 days by wetting.

Polishing and Finishing

Unevenness at the meeting edges of slabs shall be removed by fine chiselling. Polishing etc. shall be done in accordance with Clause 17.15.7.2 mentioned above except that cement slurry shall not be applied on the surface before each polishing.

### **17.15.14 Kota Stone in Risers of Steps, Skirting and Dado:**

#### **17.15.14.1 Materials:**

Same as in Clause 17.15.13.1 above.

#### **17.15.14.2 Workmanship:**

Same as in Clause 17.15.13.2 above.

Curing, Polishing, and Finishing

Refer Clause 17.15.7.2 above.

### **17.15.15 Marble Stone Flooring:**

#### **17.15.15.1 Materials**

##### Marble Slabs

The slabs shall be of the kind of marble specified in the item. The marble from which the slabs are made shall be of selected quality, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering, and flakes. The sample of Marble stone slabs shall be approved by the Employer.

The slabs shall be machine cut to the requisite dimensions.

##### Pigments

Same as in Clause 17.15.7.1 above.

##### Cement Mortar

Same as in Clause 17.15.5.1 above.

#### **17.15.15.2 Workmanship**

Same as in Clause 17.15.13.2 above.

##### Curing

Same as in Clause 17.15.13.2 above.

##### Polishing and Finishing

Same as in Clause 17.15.7.2 above.

### **17.15.16 Marble Stone in Risers of Steps and Skirting:**

#### **17.15.16.1 Materials:**

Same as in Clause 17.15.15.1 above.

#### **17.15.16.2 Workmanship:**

Same as in Clause 17.15.13.2 above.

##### Curing, Polishing, and Finishing

Same as in Clause 17.15.7.2 above.

### **17.15.17 P.V.C. Flooring:**

#### **17.15.17.1 Materials:**

##### P.V.C. Roll/ Tiles

P.V.C. Roll shall be of homogenous, un-backed, flexible type of approved, colour and pattern, conforming to IS - 3462/3461 and of specified thickness.

##### Antistatic PVC Roll

Antistatic P.V.C. roll shall conform to B.S.2050. Table-2 in addition to IS-3462

##### Adhesive

Adhesive shall be a neoprene-based rubber adhesive of approved make.

#### **17.15.17.2 Workmanship:**

##### Preparation of Base

The preparation of sub-base and base course shall be same as in Clause 17.15.2.2.

##### Finishing Layer

The base course shall be thoroughly dried and cleaned well before the laying of P.V.C. rolls/ tiles.

P.V.C. rolls/tiles shall be brought to the temperature of the area in which it is to be laid and stacked suitably near the site for a period of about 24 hours.

The layout of P.V.C. flooring shall first be marked with guidelines on the base course to required pattern without adhesive. The adhesive shall then be applied by spatula to the base floor and back of the PVC roll/tile. PVC rolls shall be placed in position from one end onwards slowly without creation on any air pockets between the roll and the base course. PVC rolls/ tiles shall be placed only when the adhesive is set sufficiently for laying. When set sufficiently for laying, the adhesive will be sticky to the touch but shall not mark the fingers. After placing, the roll shall be pressed suitably with a wooden roller weighing about 5

kg. The joint between adjacent rolls shall be thin hairline type. For PVC tiles laying shall start from centre and proceed outwards in the two right angle directions till the periphery of the room/area is reached. Fractional tiles of uniform cut sizes may be laid only along the peripheral border if so required owing to size of the room/area.

PVC rolls in flooring shall be continued for 100mm high skirting without any joints and with 50mm radius rounded corner at the junction of skirting and flooring. Any excess adhesive squeezing out of the surface shall be wiped off immediately with a wet cloth. In case of such excess adhesive becoming hard, it shall be removed with a solution of one part of commercial Butyl Acetate and three parts of turpentine oil or any other solution as advised by the manufacturer of the roll.

After a minimum period of 24 hours after laying the rolls/ tiles, the finished floor shall be cleaned with a wet cloth soaked in warm soap solution of 2 spoons of soft soap powder in 5 liters of warm water or detergent as per approved manufacturer's specifications.

#### **17.15.18 Acid-Resistant Tiles in Floors:**

##### **17.15.18.1 Material:**

The tiles shall be vitrified ceramic tiles and shall be homogeneous. They shall have the following properties:

Sr.No. Characteristics. Value Required Norms

- 1) Water Absorptions + 0.5% ASTM C 373
- 2) Scratch Resistance > 6 ASTM C 373
- 3) Chemical Resistance Unaffected ASTM C 650
- 4) Abrasion Resistance > 100 ASTM C 501 (Hardness)
- 5) Breaking Strength 1400 kg/sq.cm ASTM C 648
- 6) Density > 2.0 Gm/CC

##### **17.15.18.2 Workmanship:**

The base course shall be in accordance with Clause 17.15.2.2 and background surface shall be prepared as per Clause 17.15.13.2 and IS: 4443.

Tiles shall be fixed on the prepared surface over a bitumen priming layer, bitumen mastic layer and resin type chemical resistant mortar. The bitumen shall conform to IS-702 and laying of bitumen mastic shall conform to IS-1196.

Joints shall be allowed to set for 24 hours. The floor shall then be washed as per manufacturer's specifications to totally remove all marks from tile surface.

#### **17.15.19 Epoxy Floor Coating:**

##### **17.15.19.1 General:**

Epoxy floor coating shall consist of a solvent based, two pack system with epoxy resins and amine curing agents, chosen to withstand high degrees of chemical and abrasive action.

##### **17.15.19.2 Materials:**

Screed

The screed shall be a solvent free combination of epoxy resin, modified amine hardeners filled with specially graded and selected chemically inert aggregates of high strength. The system shall include an epoxy resin primer and screed which are both supplied in pre-weighed units ready for on-site mixing and application.

Finishing Coat

An epoxy resin sealing coat of specified thickness shall form the topping coat.

##### **17.15.19.3 Workmanship:**

Preparation of Surface

The surface shall be sound, clean and dry in order to achieve maximum adhesion with the primer coating.

Laying

The primer shall be applied by brush and shall be allowed to become tacky. The screed shall be prepared as per manufacturers specification and laid in specified thickness evenly over the base floor by trowel. The finished, cured screed shall have a slightly granular texture of uniform brown.

The epoxy resin topping shall be applied at least 24 hours after the laying of the screed. This topping shall be applied by brush or sprayed to a specified thickness in two coats with 3-5 hours interval between them. Care shall be taken to finish the topping perfectly smooth and devoid of any bubbles and unevenness. The newly laid floor shall be protected from dust or moisture and allowed to be used only after a minimum lapse of 48 hours.

## **17.16 Painting**

### **17.16.1 General:**

This section of specifications includes all requirements necessary for the white washing, colour washing, distempering, painting, and polishing of all surfaces specified herein or as may be necessary for the completion of the areas intended.

When shop priming, specified under other sections of these specifications, is provided, this may serve as the first of the number of coats herein specified.

All materials required for the execution of painting work shall be obtained directly from approved manufacturers and shall be brought to the site in makers' drums, kegs, etc., with seals unbroken.

In the case of ready mixed paints, thinning, if necessary, the brand of thinner shall be as per recommendations of the manufacturer.

Paint shall be applied by brushing or spraying. The brushing operations are to be adjusted to the spreading capacity advised by the manufacturer. During painting, every time after the paint has been worked out of the brush bristles, the bristles shall be opened up by striking the brush suitably.

The spray machine used may be of a high-pressure type or a low-pressure type, depending on the nature and location of work. After work, the brushes shall be completely cleaned off paint and shall be hung in a thinner if intended to be used afterwards. The spray guns shall be cleaned thoroughly after every break in work. The paint containers, when not used, shall be kept closed and free from air.

After the finishing of work, the adjacent surfaces not intended to be washed/ distempered/painted/polished shall be thoroughly cleaned of all paint patches and shall be finished in accordance with the surface finishing of such surfaces.

Indian Standards

IS 712 Specification for building limes.

IS 55 Specification for Ultramarine blue for paints.

IS 63 Specification for whiting for paint and putty.

IS 427 Distemper (dry), colour as required.

IS 428 Distemper (Oil Bound), colour as required.

IS 5410 Cement paint, colour as required.

IS 384 Brushes, paints, and varnishes, flat.

IS 486 Brushes, sash, tool, for paints and varnishes.

IS 110 Ready mixed paint, brushing, grey filler, and enamels for use over primers.

IS 426 Paste filter for colour coats.

IS 345 Wood filler, transparent liquid.

IS 3585 Ready mixed paint, aluminium brushing, priming water-resistant for woodwork.

### **17.16.2 White Washing:**

White washing in general shall conform to IS 6278.

#### **17.16.2.1 Workmanship:**

Scaffolding

Wherever scaffolding is necessary, it shall be erected in such a way that, as far as possible, no part of the scaffolding shall rest against the surface to be white/colour washed. For the white washing of the ceiling, proper stage scaffolding shall be erected.

#### Preparation of Surfaces

The surface shall be thoroughly cleaned of all dirt, dust, mortar dropping, and other foreign matter before whitewash is applied.

Surfaces already white/colour-washed shall be broomed down to remove all dust, dirt, loose scales of whitewash or other foreign matter.

All damaged portions of the surface plaster shall be removed to the full depth of plaster in rectangular patches and plastered again after raking the joints in masonry properly. Such portions shall be wetted and allowed to dry before any operation.

All holes, cracks, patches, etc., not exceeding 0.1 sq. m. in area, shall be made good with material similar to that of the surface. Surfaces affected by efflorescence, moss, fungi, algae, lichen, etc., shall be treated in accordance with IS 2395.

#### Preparation of Whitewash

The fat lime conforming to IS 712 shall be slaked at the site and shall be mixed and stirred with about 5 litres of water for 1 kg of unslaked lime to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 4 kg of gum dissolved in hot water shall be added to each cubic metre of lime cream. Approved quality utter marine blue conforming to IS 55 @ 3 grams per kg of lime shall also be added to the solution. The whole solution shall be stirred thoroughly before use.

#### Application

Whitewash shall be applied with a 'Moonj' brush to the specified number of coats. The operation for each coat shall consist of a stroke of the brush from the top to downwards, another from the bottom upwards over the first stroke. Similarly, one stroke horizontally from right and another stroke from the left. Each coat shall be allowed to dry before the next coat is applied.

The white washing on the ceiling should be done prior to that on the walls.

#### Protective Measures

Surfaces of doors, windows, floors, etc., which are not to be whitewashed, shall be protected from being splashed upon. Such surfaces shall be cleaned of whitewash splashed, if any.

### **17.16.3 Colour Washing:**

#### **17.16.3.1 Workmanship:**

##### Scaffolding

Scaffolding shall be as per Clause 17.16.2.1 above.

##### Preparation of Surface

Refer Clause 17.16.2.1 above.

##### Preparation of Colour Wash

A sufficient quantity of colour wash, enough for the complete job, shall be prepared in one operation to avoid any colour difference. The basic whitewash solution shall be prepared in accordance with the above Clause 17.16.2.1. Mineral colours of approved shade and quality not affected by lime shall be added to the whitewash solution in proportions as directed by the Employer. Solid lumps, etc., in the colour powder shall be ground to fine powder, sieved and mixed evenly and thoroughly with the white wash solution.

##### Application of Colour Wash

Application of colour wash shall be in accordance with the above Clause 17.16.2.1.

##### Protective Measure

Same as in Clause 17.16.2.1 above.

### **5.16.4 Dry Distempering:**

#### **5.16.4.1 Workmanship:**

##### Scaffolding

Same as m Clause 17.16.2.1 above.

#### Preparation of Surface

The surface shall be thoroughly brushed free from dust, dirt, grease, mortar droppings, other foreign matter, and shall be made smooth by sandpapering.

In case of distempering over existing distempered surface, the existing distempering shall be scraped by steel scrapers, leaving a clean surface.

All nails shall be removed. Pitting in plaster shall be made good with plaster of Paris mixed with dry distemper of the colour to be used. The surface then shall be rubbed down again with a fine-grade sandpaper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

The surface affected by moss, fungus, algae efflorescence shall be treated in accordance with IS 2395.

#### Priming Coat

A priming coat of whiting conforming to IS 63 shall be applied over the prepared surface. The priming coat shall be prepared by mixing 2.5 kg of whiting and one litre of glue solution (prepared by mixing 250 g of glue conforming to IS 852 with boiling water) and placing it in a covered vessel with enough water to cover the mixture, which shall be left to cool until it becomes a jelly.

The application of the priming coat shall be in accordance with the above Clause 17.16.2.1.

#### Preparation of Distemper

The dry distemper of approved shade and quality conforming to IS 427 shall be stirred slowly in clean warm water using 0.6 litres of water per kg of distemper. It shall be allowed to settle for at least 30 minutes before applying. The mixture shall be well stirred before and during use to maintain an even consistency.

#### Application of Distemper

After the priming coat has dried for at least 48 hours, the surface shall be lightly sanded and dusted off, avoiding rubbing off the priming coat. Prepared distemper shall then be applied in a minimum of two coats with proper distemper brushes in horizontal strokes, immediately followed by vertical ones, which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried. The finished surface shall be even and uniform without patches, marks, distemper drops, etc.

The application of a coat in each room shall be finished in one operation. After each day's work, brushes shall be thoroughly washed in hot water and hung to dry.

#### Protective Measure

Same as in Clause 17.16.2.1 above.

### **5.16.5 Oil-Bound Distempering:**

#### **5.16.5.1 Workmanship:**

##### Scaffolding

Same as in Clause 17.16.2.1 above.

##### Preparation of Surface

Preparation of the surface shall, in general, be in accordance with the above Clause 17.16.4.1, except that any unevenness shall be made good by applying putty made of plaster of Paris mixed with water, including filling up the undulation and then sandpapering the same after it is dry.

##### Primer Coat

The primer coat shall be alkali-resistant primer or distemper primer and shall be of the same manufacture as oil-bound distemper.

If the wall surface plaster has not dried completely, alkali-resistant primer or otherwise distemper primer shall be applied. The mixture of alkali-resistant primer shall be prepared as per the approved manufacturer's instructions.

The application of primer coat shall be in accordance with Clause 17.16.2.1 above.

##### Preparation of Oil-Bound Distemper

The distemper shall conform to IS 428 and shall be diluted with water or any other prescribed thinner recommended by the manufacturer.

##### Application of Distemper

After the primer coat has dried for at least 48 hours, the surface shall be lightly sanded and dusted off, avoiding rubbing off the primer coat. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed by immediate vertical strokes, which together shall constitute one coat. The subsequent coats shall be applied after at least 24 hours between consecutive coats to permit proper drying of the preceding coat.

The finished surface shall be even and uniform without patches, brush marks, drops, etc. Application of a coat in each room shall be finished in one operation.

14 cm. double-bristle distemper brushes shall be used. After each day's work/brushes shall be thoroughly washed in hot water with soap solution and hung to dry.

Protective Measures

Same as in Clause 17.16.2.1 above.

### **17.16.6 Waterproof Cement Paint:**

#### **17.16.6.1 Workmanship:**

Scaffolding

Same as in Clause 17.16.2.1 above.

Preparation of Surface

Preparation of the surface shall be in accordance with Clause 17.16.2.1. The surface so prepared shall be thoroughly wetted with clean water before the paint is applied.

Preparation of Paint

Waterproof cement paint of approved make shall be mixed with water and stirred to obtain a thick paste, which shall then be diluted to brush able consistency. The proportion of the mixture shall be as manufacturer. The paint shall be mixed in such quantity that it can be used up within an hour of mixing to avoid setting and thickening of the paint.

Application of Paint

The surface shall be treated with a minimum of two coats of waterproof cement paint. No less than 24 hours should be allowed between two coats, and the subsequent coats shall be applied only after the preceding coat has become hard to resist marking by subsequent brushing.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc. Cement paints shall be applied with a brush with relatively short, stiff hog of fibre bristles.

Curing

Curing shall start after the paint has hardened. Curing shall be done by sprinkling with water two or three times a day. This shall be done between coats and for at least two days following the final coat.

Protective Measure

Same as In Clause in 17.16.2.1 above.

### **17.16.7 Acrylic Emulsion Painting:**

#### **17.16.7.1 Workmanship:**

Scaffolding

Same as in Clause 17.16.2.1 above.

Preparation of Surface

Same as in the above Clause 17.16.5.1 under the specification of oil-bound distempering.

Preparation of Mix

Plastic emulsion paint shall conform to IS 5411 (Part-1) and shall be of approved shade. Preparation of the mix shall be as per the manufacturer's instructions.

Application of Paint

The paint mix shall be continuously stirred while applying to maintain uniform consistency. The number of coats shall be as per the item description. The painting shall be laid evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first, then brushing alternately in opposite directions 2/3 times, and then finally brushing

lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks, no clogging of paint puddles shall be permitted. The full process of crossing and laying off will constitute one coat. The paint shall be applied by means of a brush or roller. Before starting painting with plastic emulsion paint, the prepared surface shall be treated with two coats of primer consisting of cement, primer, whiting, and plastic emulsion paint shall start only after the preceding coat has become sufficiently hard to resist brush marking. Subsequent coats of plastic emulsion paint shall also be started after the preceding coat is dry by evaporation of water content.

The surface on finishing shall present a flat, velvety smooth finish, even and uniform shade without patches, marks, paint drops, etc.

#### Precautions

- i. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush. Old brushes, if used, shall be completely dried of turpentine/oil paints by washing in warm soapy water.
- ii. No oil-based putties shall be used in filling cracks/holes.
- iii. Washing of the painted surface shall not be done within 3-4 weeks of application.

#### Protective Measures

Same as in Clause 17.16.2.1 above.

### **17.16.8 Acrylic Copolymer Aggregate Finish:**

#### **17.16.8.1 Material:**

It shall be an acrylic-based textured wall coating consisting of quartz and silica aggregate, inorganic pigments, and other additives to form a crack-free, flexible, tough, waterproof coating.

#### Preparation of Surface

The surface to be coated shall be cleaned and all dirt, dust, grease, and loose particles shall be removed. Any old textured surface shall be removed with a removal agent as per the manufacturer's instructions.

#### Application

Bonding agent and water shall be mixed first. Then the flakes/granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be left for 20-30 minutes before starting the application. The bonding agent, flakes/granules, and water shall be mixed in different ratios for different finishes as per the manufacturer's specifications.

The first application shall be by steel trowel. It shall be smoothed, if the specified finish requires, by a plastic trowel.

Preparation of the surface shall conform to IS 2338 (Part-1) in general. All woodwork shall be dry and free from any foreign matter. Nails shall be punched well below the surface. The surface shall be smoothed off with abrasive paper used across the grain prior to painting, with the grain prior to staining. Any knots, resinous, or bluish sap wood, cutting out of which is not justified, shall be covered with red lead conforming to IS 103.

Plywood and blockboard shall be treated in the same manner as for woodwork.

Particle boards' surface shall be filled with a thin brush able filler and finished as for solid wood.

#### Priming

Priming shall be in accordance with IS 2338 (Part I and II). Dirt or any other extraneous material on the surface shall be removed, and the priming shall be applied by brushing. Priming should be done on all exposed and unexposed surfaces. Unless specified otherwise, all joinery work intended to be painted shall receive at least 2 coats of primer.

The type of primer shall be in accordance with Table 1 and Table 2 of IS 2338(Part II).

#### Stopping and Filling

Stopping and filling shall be done after priming. Stopping shall be made to the consistency of stiff paste and shall be used to fill holes and cracks. The filler shall be used to level up slight irregularities of the surface. Filler shall be applied with a putty knife and subsequently rubbed down to a level surface with abrasive paper.

The filler coat shall be allowed to fully flatten and harden before the subsequent coat is applied.

#### Application of Undercoat

Undercoat shall be applied after the surface has been primed, stopped, and filled, and rubbed down to a smooth surface. Under coat may be brushed or sprayed. After drying, the coat shall be carefully rubbed down and wiped clean before the next coat is applied.

The type of undercoat shall depend upon the finishing and in accordance with Table 1 and Table 2 of IS 2338 (Part 11).

#### Finishing

The finishing paint shall be as specified in the item description and shall be applied either by the brush or by spraying.

Reference shall be made to Table 1 and Table 2 of IS 2338 (Part-II)

#### Application of Clear Finishes

For the application of decorative finishes, the following procedures shall generally be adopted in accordance with IS 2338 (Part I)

##### i) Filling

Fillers shall be applied to prevent the excessive penetration of the finish into the surface to obtain a smooth finish. Fillers shall conform to IS 345.

Fillers shall be heavily applied to the wood surface by hand, using hessian or jute rag across the grain. It shall be rubbed when still wet to get better penetration. After 5-10 minutes, it shall be wiped off by and across the grain, followed by a height wipe with the grain. The filled surface shall be dried preferably overnight and smoothed with abrasive paper.

##### ii) Staining

###### a) Spirit Stains

Spirit stains are solutions of spirit-soluble dyes in Industrial methylated spirit.

###### b) Oil Stains

Oil stains are solutions of oil-soluble dyes in linseed oil, but usually consist of insoluble, semi-transparent pigments ground in linseed oil and thinned with turpentine or other solvent.

###### c) Preparation of wood for Staining

Surface intended for staining shall be kept scrupulously clean and free from greasy finger marks. It shall be prepared by careful smoothing with fine abrasive paper used in the direction of the grain.

Small cracks/nail holes shall be stopped with plastic wood/fine plaster of Paris. The stopping shall be rubbed down with fine abrasive paper when hard and touched with a thinned knotting before staining. In case of oil staining, stopping shall be done after staining using tinted putty or wood filler.

###### d) Application of Stains

Stains shall be applied by brushing and wiping or by spraying. The stain shall be so thinned that it can be applied fairly, liberally, without over-staining and overlapping.

##### iii) Sealing

A suitable sealer shall be applied on the filled and sanded surface to prevent absorption by the wood of the succeeding coats of finish and to seal stain and filler and thus preclude their bleeding into the finish coat.

Sealer may be sprayed on, taking care not to flood the surface, and it shall be allowed to dry hard.

When fully dry, the surface shall be sanded, taking care not to cut through at corners and edges. Dust shall be blown off and the surface wiped with a clean rag.

##### iv) Finishing

The stained surface shall be varnished, wax-polished, or trench-polished as required after it is dried.

###### a) Varnishing

Varnishing of wood and wood-based material shall be in accordance with IS 2338 (Part I).

Surfaces to be varnished shall be prepared to produce a smooth, dry, and matte surface, and all dust and dirt shall be removed from the surface.

The Varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with short light strokes to avoid frothing. It shall be allowed to flow out while the next section is being laid in. Excess Varnish shall be scraped out of the brush, and then the first section shall be crossed, re-crossed, and laid off lightly. The Varnish, once it has begun to set, shall not be retouched. In case of any mistake, the Varnish shall be removed, and the work shall be started afresh. Where two coats of varnish are applied, the first

coat shall be a hard-drying undercoating or flattening varnish, which shall be allowed to dry hard and then be flattened down before applying the finishing coat. Sufficient time shall be allowed between two coats. When flat varnishing is used for finishing, a preparatory coat of hard-drying undercoating of flattening varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be tightly rubbed down before the flat varnish is applied. On larger areas, the flat varnish shall be applied rapidly, and the edges of each patch applied shall not be allowed to set but shall be followed up whilst in free working conditions.

b) French Polish

French polish shall conform to IS 348. Suitable pigments shall be added to get the required colour.

The surface to be French polished shall be rubbed down to smoothness with sandpaper and shall be well dusted. Pores in the surface shall be filled with fillers. A pad of woollen cloth covered by a fine doth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles, applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry, and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and a near-gloss.

**17.16.9 Painting to Steel and Other Metal Surfaces:**

**17.16.9.1 General:**

Items to be Painted

All structural steel work and metals, including handrails, brackets, and steel inserts, shall be painted except if otherwise specified.

Standard

The operations, workmanship, schedules, and equipment for painting shall generally comply with the requirements of IS:1477 (Part I & II) "Code of Practice for Painting of Ferrous Metals in Buildings" & IS 2524 except insofar as this Specification modifies it.

General Requirements

All surfaces shall be thoroughly cleaned of all foreign matter adhering to the steel surface to Swedish Standard specification Sa 2½ by means of blasting with sand. Use of scraper wire brush and pig hammer is acceptable wherever blasting with sand is not possible due to lack of access.

Airless spray shall be used for painting of all structural steel. Painting by brush shall only be allowed in places where the use of airless spray is not possible.

The finished coat shall be generally smooth, of a dense and uniform texture, and free from sharp protuberances or pinholes. Each coating shall be checked for thickness by "Elcometer". Areas where the thickness is less than what is specified shall receive additional treatment.

All operations, such as handling & transportation, etc., shall be carried out in a manner that there is no damage to the coating.

Painting shall generally be done immediately after cleaning. The cleaned surface shall not be allowed to stand overnight before painting. Where galvanized surfaces are to be painted, they shall be cleaned and washed with a solution of copper sulphate before the application of the first coat of primer.

No painting shall commence until the cleaned surfaces have been approved by the Employer.

iv) Schedule

a) One coat of Organic Zinc Rich Primer (thickness, 60 m DFT).

b) Strip coat on each weld joint and edge of structure by surface-tolerant Epoxy-75 m DFT by Brush – One Coat

c) Two coats of High Build Abrasive Epoxy (DFT 100 µm for each coat)

d) Total System Thickness = 250 m DFT without Strip Coat

e) Strip coat and one coat of high-build epoxy should be immediately followed by primer. It is not permitted to keep the organic zinc-rich primer exposed to the atmosphere for a long time.

f) Painting system shall be guaranteed for 5 (five) years.

After completion of the erection and stanchion grouting, all the painted surfaces shall be carefully examined for any damage to the painting system and shall be rectified as directed by the Employer.

### **17.16.9.2 Preparation of Surface:**

The surface, before painting, shall be cleaned of all rust, scale, dirt, and other foreign matter with wire brushes, steel wool, scrapers, sandpaper, etc. The surface shall then be wiped finally with mineral turpentine, which shall then be removed of grease, etc. The surface then shall be allowed to dry. In case of GI surface, the surface so prepared shall be treated with Mordant solution (5 litres for about 100 sqm) by rubbing the solution generously with a brush. After about half an hour, the surface, if required, shall be retouched and washed down thoroughly with clean cold water and allowed to dry.

### **17.16.9.3 Application of Priming and Paints:**

Approved quality primer and paint in the specified no. of coats shall be applied as per the manufacturer's recommendations, either by brushing or spraying. Each subsequent coat shall be applied only after the preceding coat is dry.

## **17.17 Sanitary and Plumbing Works (Buildings)**

### **17.17.1 General:**

The work comprises supply, installation, commissioning, and testing of sewerage and drainage, sanitary fixtures and fittings within, including water supply to the building and up to 1.0 m outside the building wall. The work includes the supply of all materials as per specifications and drawings, laying, fitting, fixing, installation, and commissioning of the same.

All the water supply and sanitary works shall be carried out by the licensed plumbers approved by the Employer and skilled workmen, experienced in the trade.

All works shall be completely concealed either within shafts or chases or in fills and dropped ceilings unless specifically shown in drawings or required otherwise.

All work shall be adequately protected, to the satisfaction of the Employer, so that the whole work is free from damage throughout the period of construction up to the time of handing over.

No work shall be covered without the approval of SMPA.

The Contractor shall be responsible for coordinating the work with the work of other trades sufficiently ahead of time to avoid unnecessary hold-ups. Hangers, sleeves, recesses, etc., shall be left in time as the work proceeds, whether or not these are shown in drawings.

All clamps, screws, brackets, hangers, and all miscellaneous steel work needed in the work shall be fully galvanized.

Only the specified brand of material will be used, subject to the approval of the sample.

The Contractor shall submit as directed by the Employer samples, manufacturer's drawings, equipment characteristics, and capability data, etc., of all equipment, accessories, devices, etc. that he proposes to use in the installation, to the Employer for approval.

The Contractor shall prepare and submit to the Employer for approval, before the work is commenced, all drawings.

The work shall commence only after the drawings are approved by the Employer. Before the work is handed over, the Contractor shall clean all fixtures, removing all plaster, stickers, rust stains, and other foreign matter of discoloration of fixtures, leaving every part in acceptable condition and ready for use, to the satisfaction of the Employer.

All sanitary ware and fittings shall conform to IS standards. The Contractor shall submit samples of all fittings and fixtures proposed to be used to the Employer for his approval. The approved samples shall remain with the Employer till the completion of the work.

All workmanship shall conform to the Indian Standard Codes of Practice. The fixing and finishing shall be neat, true to level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning.

All fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of fittings. Tool marks on exposed fixtures shall not be accepted. Protective paper on fixtures shall be removed with hot water only at the final completion of work. All the water supply, drainage, and sanitary works shall be carried out strictly as per specifications, ISI codes, and the National Building Code with amendments up to date.

**17.17.2 Byelaws and Regulations:**

The installation shall be in conformity with the Byelaws, Regulations and Standards of the local authorities concerned, insofar as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and/or workmanship than those required by any of the above regulations and standards, then these specifications and drawings shall take precedence over the said regulations and standards. However, if the drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

**17.17.3 Fees and Permits:**

The Contractor shall obtain all permits/licenses and pay for any and all fees required for the inspection, approval, and commissioning of their installation and shall bear all expenses, if any, for the same.

**17.17.4 Completion Certificate:**

On completion of the installation for Plumbing, a certificate shall be furnished by the Contractor. This certificate shall be in the prescribed form as required by the local authority. The Contractor shall be responsible for getting the entire installation approved by the authorities concerned as required and shall bear expenses, if any, in connection with the same.

**17.17.5 Maintenance During Defects Liability Period:**

Contractor shall be required to carry out the maintenance of the Plumbing installation during the defect liability period.

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this Contract, attend to these within 10 hours of receiving the complaints, and take steps to immediately correct any deficiencies that may exist.

All equipment that requires repair shall be immediately serviced and repaired.

**17.17.6 Water Supply:**

**17.17.6.1 G.I. Pipes & Fittings:**

**G.I. Pipes**

All pipes for water supply inside the building shall be genuine galvanized steel tubes conforming to IS:1239 Part I (heavy grade 'C' class pipe).

The GI pipes shall be of approved make as per the list of approved makes.

**G.I. Fittings**

All fittings shall be malleable cast iron fittings as per IS:1879 (or as revised). All fittings shall have the manufacturer's trademark stamped on them. Fittings in G.I. pipelines shall include elbows, tees, bends, reducers, nipples, unions, bushes, G.I. Clamps of approved design, G.I. flanges with 3 mm rubber insertion, nuts, bolts, washers, etc. All fittings shall be tested at the manufacturer's works. Contractors may be required to produce a certificate to this effect from the manufacturer.

Laying and Jointing of G.I. Pipes (External)

**a) Trenches**

The galvanized iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in the Table below:

Dia of Pipe	Width of Trench	Depth of Trench
15 mm to 50 mm	30 cm	60 cm

At the joints, the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earthwork in trenches.

#### **b) Cutting and Threading**

Where the pipes have to be cut or rethreaded, the ends shall be carefully filed out so that no obstruction to the bore is offered. The end of the pipes shall then be carefully threaded conforming to the requirements of IS:554-1964 with pipe dies and tapes in such a manner as will not result in slackness of joints when the two pieces are screwed together. The screw threads of pipes and fittings shall be protected from damage until they are fitted.

#### **c) Jointing**

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipes. The end shall then be screwed into the socket, tee, etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed to make the joints completely water-tight. Pipes are kept at all times free from dust and dirt during fixing. Burr from the joints shall be removed after screwing. After laying, the ends of the pipes shall be temporarily plugged to prevent access of water, soil, or any other foreign matter.

#### **d) Pipe, Coating & Wrapping**

All underground pipes shall be protected by pipe coat primer and pipe coat wrapping. The pipe coat primer shall have a density of 0.92 g/cc and drying time of 24 hours at RH 70% and temp 30 °C. Viscosity shall be 1000 – 2000 cps.

The pipe coat shall be a puncture-resistant non-woven polyester mat 4 mm thick of high mechanical strength. The mat shall be in 7 layers. The layers shall be so arranged as to also give extra protection to the high molecular high-density polythene core, which is the main permeable agent in the system.

Pipe coat primer shall be applied on the pipe in a uniform coat, leaving no drop runs.

The entire surface of the pipe shall be primed without any patch left out. Unprimed surfaces shall be reprimed immediately. Any uncleaned pipe shall be scraped down to the surface of the pipe, and the reprimed pipe coat primer shall essentially be in a layer for quicker drying.

The surface shall be dry at the time of applying the pipe coat primer. Freshly primed pipe shall be placed on clean square cut skids and shall not be allowed to come in contact with ground or any foreign matter. It shall remain on skids until lifted or cradled after the coating and wrapping operation.

All primed pipes that have an excessive coat of dust accumulated over them before the primer is dry or where the primer has become dead shall be reprimed. Drying time shall be a minimum of 24 hours. The application of the pipe coat membrane shall be taken up soon after the primer coat has dried up completely, and in case within three days after priming. Otherwise, a fresh coat of primer shall be applied. The membrane shall be blown under tension by means of a blowtorch. In this process, the inner surface of the membrane, being a 10-micron-thick polyethylene layer, is burnt while at the same time the polymeric mix under it is softened, taking care that the centre core is not overheated. This molten polymeric mix is then pressed over the pipe surface so that no air is entrapped or voids formed underneath.

Pipe coat primer shall be applied with brushes after cleaning the pipe thoroughly. Pipe coat membrane shall be wrapped as mentioned above.

No wrinkling of the wrapper shall be allowed, and all overlaps shall be firmly fused to secure a firm wrapping. Coating shall be absolutely free from pinholes, bubbles, and holidays.

#### **17.17.6.2 Testing of Joints:**

After laying and jointing, the pipes and fittings shall be inspected under working conditions of pressure and flow. Any joint found leaking shall be redone, and all leaking pipes removed and replaced without extra cost.

The pipes and fittings, after they are laid, shall be tested to a hydraulic pressure of 1.5 times the working pressure. The pipes shall be slowly and carefully charged with water, allowing all air to escape and avoiding all shock or water hammer. The draw of traps and stop cocks shall then be closed, and the specified hydraulic pressure shall be applied gradually. The pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be

maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

#### **17.17.6.3 Trench Filling:**

The pipes shall be laid on a layer of 7.5 cm sand and filled up to 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth as specified and directed, and the surplus earth shall be disposed off as directed by the Employer.

#### **17.17.6.4 Laying and Jointing G.I. Pipes (Internal Work):**

Cutting, threading, and jointing – Ref. Clause 17.17.6.1.

##### **Fixing of GI Pipes**

All exposed GI pipes shall be fixed by means of standard pattern holder bat clamps, keeping pipes 1.5 cm clear of the wall. If the pipes are fixed in chases, they shall be fixed in position by iron hooks.

#### **17.17.7 Soil, Waste, Vent, and Rainwater Pipes and Fittings:**

##### **17.17.7.1 Cast Iron Pipes and Fittings:**

Cast iron pipes and fittings to IS:3989 shall be used for soil, waste, and vent pipes. Pipes and fittings with irregular bore, blow holes, and other manufacturing defects shall not be allowed to be used for work.

All fittings shall be of the degree specified or as required at the site.

All cast iron soil, waste, vent, and rainwater pipes used in the basement in exposed condition or where specified shall be centrifugally cast spun iron class (LA) pipes conforming to IS 1536. These shall be with spigot and socket ends.

The fittings for centrifugally cast spun iron pipes conform to IS 1538.

##### **Holder Bat Clamps**

Holder bat clamps shall be of a standard design fabricated from MS galvanized flat 32 x 1.5 mm thick and 12 mm dia. M.S., bar and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete (1:2:4) blocks 100 x 100 x 100mm.

##### **M.S. Stays and Clamps**

The clamps shall be made from 2.0 mm thick MS flat of 32 mm width, bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. It shall be formed of two semi-circular pieces with flanged ends on both sides with holes to fit in the screws, bolts, and nuts, 40 mm long. The stay shall be a minimum of one metre long of a 10 mm dia MS bar. One end of the stay shall be bent for embedding in the wall in cement concrete block of size 20 x 20 x 20 cm in 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size). The concrete shall be finished to match the surrounding surface.

##### **Floor Traps**

Floor taps shall be cast-iron deep steel type P or S traps with a minimum seal of 75 mm. They shall be with or without a vent. All traps shall be set in cement concrete blocks 1:2:4 mix without additional cost. Traps shall be provided with CP brass screwed down or hinged grating. Traps shall be provided with a suitable extension piece where required, with a CP brass grating to flush with the floor without any extra cost.

##### **Paintings**

All pipes in ducts and exposed positions shall be painted with two coats of synthetic enamel paint of any colour approved by the Employer over a coat of primer of approved quality.

##### **17.17.7.2 Concrete:**

All soil and waste pipes below the ground floor, fills and in wall chases (but not in open ducts) shall be supported and covered with 75 mm cement concrete 1:2:4 in bed and all around. Encasement of such pipes shall be done after testing of the pipes.

##### **17.17.7.3 Cutting and Making Good:**

All pipes shall be fixed and tested as building work proceeds. Cutting and chasing shall be kept to a minimum. No extra shall be allowed for cutting holes, chases etc. in walls and floors.

#### **17.17.7.4 Jointing:**

a) All joints for CI soil waste and vent pipes conforming to IS:1729/IS:3989 shall be made with malleable pig lead and spun yarn. Pig lead shall conform to IS:782 for caulking. Spun yard shall be of hemp and of good quality. It shall be soaked in hot coal-tar or bitumen and cooled before use. The quantity of lead to be filled per joint in various sizes of cast iron drainage pipes shall be as follows:

- 50 mm dia = 0.75 kg.
- 80 mm dia = 0.80 kg.
- 10 mm dia = 0.90 kg.
- 150 mm dia = 1.60 kg.

b) The joints for all CI centrifugally cast (Spun) iron pipes conforming to IS:1536 and fittings conforming to IS:1538 shall be made with pig lead. The quantity of lead per joint in various sizes of these pipes shall be as follows:

- 80 mm dia = 1.8 kg.
- 100 mm dia = 2.2 kg.
- 150 mm dia = 3.4 kg.
- 200 mm dia = 5.0 kg.
- 250 mm dia = 6.1 kg.

#### **17.17.7.5 Testing:**

All soil, waste, and vent pipes shall be tested by filling up the whole or part of the stack with water. All openings for connections, etc., shall be suitably plugged.

Contractor shall remove and replace all pipes having holes, cracks, etc. All leaking joints and access doors shall be replaced or remade to the entire satisfaction of the Employer. Water shall be retained in the stack for a maximum period of 2 hours. After all plumbing fixtures are installed, Contractor shall apply the smoke test to the entire stack to the satisfaction of the Employer.

The smoke test shall be carried out as under.

Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a bellow and a burner. The material burnt shall be greasy cotton waste, which gives out to a clear pungent smoke easily detectable by sight as well as by smell if there is leak at any point of drain.

#### **17.17.8 Sanitary Fixtures and Fittings:**

##### **17.17.8.1 General:**

All sanitary fittings are glazed earthenware shall be 'Hindustan Sanitary Ware/Nycer/Parry' or equivalent of approved make, white in colour and of one-piece construction. All metallic fixtures like taps, stop cocks, soap holders etc. shall be of CP brass 'Parco', 'GEM' or approved equivalent make. PVC fixtures shall be of 'Caliplast', 'Brite' or equivalent approved make. All wall fittings shall be fixed with wooden cleats and CP brass screws and washers.

##### **5.17.8.2 Workmanship:**

All sanitary ware shall be fixed in a neat workmanlike manner, true to the level and plumb. Manufacturer's instructions shall be followed closely regarding installation and commissioning. Cutting or making good of tiles is not permitted anywhere while fixing of fixtures and fittings.

##### **17.17.8.3 Protection of Fixtures:**

Fixtures shall be protected throughout the progress of the work from damage. Special care shall be taken to prevent damage and scratching of chromium-plated fittings. Tool marks on chromium fixtures etc. shall not be accepted.

##### **17.17.8.4 Sanitary-ware:**

Indian Type Water Closet Orissa Pan W.C. shall be 580 mm long, conforming to IS:2556 Part III. The closet shall be fixed I the floor with a 150 mm thick sand cushion and shall be connected with a 100 mm dia C.I.

or stone ware S or P trap. The closet shall also be fitted with a low-level earthenware cistern conforming to IS 774 of 12½ litres capacity with wiped solder joints, internal overflow arrangement, 40 mm dia C.P. flushing pipe. The cistern shall be fixed on MS or CI Brackets at a minimum height of 610 mm from top of the pan. All exposed metallic surfaces shall be painted with two coats of white enamel paint of approved quality over a coat of primer.

Orissa Pan type W.C. of size 580 mm long with concealed 32 mm dia flush valve push button/lever with regulator or 'Nelson', 'Orient' or approved equivalent, CP flush pipe and clamp with rubber joint to W.C. complete including cutting walls and floors and making good the same.

#### Wash Down Type Water Closet

Wash down water closet shall be pattern 1 conforming to IS:2556 Part II. This shall be fixed with a plastic seat and cover as per IS:2548 of 'Brite' or approved equivalent make, fixed with CP brass hinges and rubber buffers, and an integral 100 mm dia 'S' or 'P' trap with anti-syphonage vent horn.

A low-level earthenware cistern conforming to IS:774 of about 10 litres capacity, with a 15 mm dia PVC inlet pipe and brass union with wiped solder joint, internal overflow arrangement, a 40 mm dia CP brass flushing pipe, and CI or MS supporting brackets shall be fixed with the water closet. The closet shall be fixed firmly in the floor with matching cement mortar. All exposed metallic surfaces shall be painted with two coats of white enamel paint of approved quality over a coat of primer. The cistern shall be fixed at a height not exceeding 300 mm between the top of the pan and the underside of the cistern.

#### Urinals

Half stall type urinal shall conform to IS:2556 Part VI. These shall be mounted on walls. The flushing inlet pipe shall be of CP brass 15 mm dia and waste pipe 32 mm dia G.I. 750 mm long, with necessary unions and CP bottle trap.

Rawl plugs with CP brass screws shall be used for fixing the urinal. Fixing shall ensure that no liquid is left over in the pan after flushing. Unless otherwise indicated, height above finished floors shall be 650 mm.

Urinals shall be connected to an automatic flushing cistern either individually or in groups, where individually connected to a flushing cistern, the cistern capacity shall be 5 litres. For two urinals, one cistern of 10 litres capacity, and for three urinals, one cistern of 15 litres capacity shall be provided. Cistern inlet shall be a 15 mm dia PVC pipe with a brass union. The outlet pipe from the cistern shall be a 25 mm CP brass main, with a 15mm CP distributor pipe of sufficient length to reach each bowl. Where individual cisterns are provided, the outlet shall be of 15 mm CP brass. All exposed metallic surfaces shall be painted with two coats of approved white enamel paint over a coat of primer. The cistern interior shall be painted with two coats of anticorrosive paint of approved quality, wherever called for. The waste from urinals shall be collected and disposed of through concealed pipes, and suitable means to clean and maintain the system shall be provided.

#### Wash Basin

Wash basin shall be flat, back of 550 mm x 400 mm size with one tap or two tap holes conforming to IS:2556 Part -IV. This shall be fitted on CI or MS brackets conforming to IS:775. Brackets shall be given two coats of white enamel paint, or enamel paint, or aluminium paint, over a coat of primer.

The wall side shall be fixed well flush with the plaster of the wall, and the joint, if any, shall be properly stopped with mortar and painted white. Pillar cocks, PVC connecting pipe with brass union, a CP brass bottle trap with union, CP brass chain and rubber PVC stopper, 32 mm dia, GI waste pipe shall also be supplied and fitted with the wash basin, the top of the rim of the wash basin shall be fixed at 800 mm above finished floor level unless otherwise specified.

#### Mirrors

The mirror shall be of the best quality of 'Atul'/'Swastic' or equivalent approved make of size 600 mm x 650 mm x 5.5 mm thick. The mirror shall have ½" thick commercial board backing and shall be provided with aluminium beading all around. It shall be fixed to the wall on wooden blocks with CP brass screws and CP washers.

#### Sink

Providing and fixing a stainless steel sink of size 485 mm x 385 mm, 190 mm deep or nearest equivalent with R.S. or CI brackets, 40 mm CP waste, CP brass chain and rubber plug, 4 mm CP. Cast brass bottle trap, with pipe to wall and CP wall flange, rubber adapter for waste connection.

#### Towel Rail

Towel rail shall be of aluminium/C.P. brass pipe with suitable brackets. The towel rail shall be 20 mm dia and 1.25 mm thick, 600 mm long. It shall be approved by the Employer. It shall be fixed at specified locations shown in the drawing or as directed by the Employer.

#### Liquid Soap Container

The liquid soap container shall be of superior quality chromium-plated brass of 'PARCO', GEM make, or equivalent as approved by the Employer. It shall be fixed with CP brass screws on a wooden cleat.

#### Showers

The shower head shall be chromium-plated brass, 100/150 mm dia, with holes of one millimeter diameter each is sufficiently large for all ordinary requirements. It shall be fixed at a height of 2.0 m from floor level or as directed by SMPA. It shall conform to IS:2064.

#### Toilet Paper Holder

Toilet paper holders shall be of chromium-plated brass as approved by the Employer. It shall be 100 mm long. It shall be fixed on wooden cleats as directed by SMPA.

#### Coat and hat Hooks

Coat and hat hooks shall be chromium-plated brass of 'Ego' or equivalent as approved by SMPA. They shall be fixed on a teak wood plate of 75 mm x 75 mm and 12 mm thick. The teak wood plate shall be properly polished. Wooden cleats shall be inserted in the wall to fix the wooden plates. CP brass screws shall be used.

#### Bib and Stop Cocks

Bib and stop cocks of screw-down type shall conform to IS:781. All taps shall be of heavy grade. The taps shall be chromium-plated brass or ordinary brass, easy cleaning type as specified. The taps shall be chromium-plated brass or ordinary brass, easy cleaning type as specified.

#### HCI Nahni Trap (Floor Trap)

Nahni trap shall be of heavy cast iron as per IS:3989 with 100 mm inlet and 80/100 mm outlet with CP pressed steel grating. Nahni trap shall be of heavy cast iron as per IS:3989 with 100 mm inlet and 80/100 mm outlet with CP pressed steel grating. It shall be of self-cleaning design (Grating shall be of either hinged or screwed down type). It shall be of self-cleaning design (Grating shall be of either hinged or screwed down type). It shall be fixed in cement mortar 1:2 and as directed by SMPA.

#### Stoneware Gully Trap Chamber

The square mouth gully trap shall be of 100 mm dia, conforming to IS:651 of specified and/or approved quality stoneware, complete with cast iron grating, and shall be approved by the Employer. The size of the CI frame and cover shall be 300 mm x 300 mm. It shall be properly fixed as directed by the Employer. The size of the chamber shall be 300 x 300 x 675 mm (internal). It shall be constructed of brick masonry walls 115 mm thick in 1:4 cement mortar and M-15 concrete foundations. Inside and outside faces of the masonry walls shall be plastered with 1:3 cement mortar. The top of the chamber shall be provided with CI cover and frame.

#### Brick Masonry (Manholes/Inspection Chamber & Valve Chamber)

The size of the manholes and valve chambers shall be as specified in the drawings. It shall be constructed of brick masonry walls 230 mm thick in CM 1:4 (1 cement:4 sand) resting on M-15 concrete foundations. The inside and outside faces of the masonry wall shall be plastered with 13 mm thick plaster of cement mortar 1:3 (1 cement: 3 sand).

The top of the chamber shall be provided with a reinforced concrete M-20 grade slab as per drawing and directions of the Employer.

MS rungs made out of 16 mm dia MS bars shall be fixed inside the manhole as shown in the drawing after applying two coats of anticorrosive paint.

Valve chambers shall be provided and fixed with a light-duty CI cover and frame.

The top of the chamber shall be provided with reinforced concrete M-15 grade as per drawings and direction of the Employer.

The CI manhole covers and frames shall conform to IS:726. The type, size, and grade shall be as per the drawing and direction of the Employer.

The frame shall be fixed in position during the concreting of the top slab. The inside faces of the frame and cover shall be given two coats of approved anti-corrosive paint.

The specification for brick masonry, plastering, concreting, excavation, and back-filling, etc., as given under relevant clauses, shall also be applicable for this work.

#### Gun Metal Valve

All full-way and globe valves shall be heavy gunmetal and tested at 300 psi and shall be approved by the Employer. Valves shall conform to IS:778. The size of the valve chamber shall be as per the item description; the construction of the valve chamber shall be carried out as detailed above. Valve chamber shall be provided & fixed with a heavy-duty CI surface box conforming to IS:3950. The surface box shall be a hinged pin-open type & shall be fixed in the chamber slab. It shall have a hole for opening.

#### Marble Partitions

The marble partition shall be 25 mm thick and approved by the Employer. The edges of marble shall be cut by machine to have proper, smooth edges. Vertical face shall be fixed in position with cement mortar (1:3) as directed by the Employer for a minimum depth of 100 mm in the wall. It shall be polished after fixing. Two horizontal faces shall be supported by MS channels of size 35 mm deep embedded into the wall.

### **17.18 Water Supply and Distribution System**

#### **17.18.1 General:**

This specification covers the installation and commissioning of the complete water supply distribution system within the port area, including the supply of potable water to ships and buildings, and the supply of raw water for landscaping and greenery.

#### **17.18.2 Material:**

##### **17.18.2.1 Pipe:**

Piping for supply and distribution lines shall be HDPE pipes conforming to IS: 4984.

##### **17.18.2.2 Fittings and Specials:**

Fittings and specials shall be suitable for a 10-bar pressure rating, unless otherwise specified. Fittings and specials shall conform to Indian standards.

#### **17.18.3 Execution:**

##### **17.18.3.1 Installation:**

###### Cutting of Pipe

Cutting of the pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Employer, cutting shall be done with an approved type cutter.

###### Adjacent Facilities

###### Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

###### Joint Deflection

The maximum allowable deflection shall be as per Indian standards. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

Placing and Laying Underground pipes shall be laid in accordance with IS: 12288:1987. Pipe shall be laid to the grade calculated by the Contractor or as indicated by the Employer. Pipe alignment shall be straight between bends and curves within a tolerance of + 5 mm.

All bends of 11¼ degrees and greater shall be made with the proper fittings. Joint deflection shall be limited to the maximum recommended by the manufacturer. Pipe that has the grade or joint disturbed after laying shall be taken up and re-laid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored.

## Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 1.5 m outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m from the site of the proposed building at a point designated by the Employer. Such service lines shall be closed with plugs or caps.

### **17.18.3.2 Tests and Inspection:**

The mains shall be slowly filled with water to expel all air from the system and shall be left to stand full of water for a period of not less than 24 hours.

Test pressures shall be applied by means of a manually operated test pump or in the case of long mains, by a power-driven test pump, which shall not be left unattended. Adequate precautions shall be taken to ensure that the specified test pressure is not exceeded.

The specified test pressure shall be maintained for a period of 1 hour and if there is any leakage, it shall be measured by the quantity of water pumped into the main.

The main shall be deemed to be satisfactory if the loss of water does not exceed 3.5 litres per 100 mm nominal bore, per kilometre, per bar of test pressure per 24 hours.

Any defect or visible individual leak observed during the hydrostatic pressure testing shall be repaired by the Contractor at his own expense in the manner directed by the Employer.

Should losses from the main exceed the specified amount, testing shall be repeated until the main is deemed satisfactory and is accepted by the Employer. All labour, material, and equipment for testing shall be deemed to be included in the rates.

These tests shall be conducted on the entire water distribution system by sections of 500 meters as a maximum on the general circuit, and by building, for the distribution from the main network.

All of the installations must undergo the pressure tests.

### **17.18.3.3 Cleaning and Disinfection**

After the water distribution system has been tested, the Contractor shall proceed to clean the system with water, followed by disinfecting the entire network. This disinfecting shall be carried out according to a method proposed by the Contractor for approval by the Employer, and according to the provisions indicated above and the current regulations of the Government of Myanmar.

## **17.19 Masonry Boundary Wall**

### **17.19.1 General:**

This section of the specifications includes the requirements for furnishing and installing of masonry boundary wall and barbed wire fencing Y shape on top of the wall, and appurtenances as required, providing a complete security system.

### **17.19.2 Materials:**

Refer to specifications under 'Materials'.

### **17.19.3 Workmanship:**

The purpose of fencing is to provide a solid, uninterrupted stone masonry boundary wall around the port area and keep only openings, such as the road.

A stone boundary wall shall be erected and installed by a professional organization who are regularly engaged in this business, employing skilled labour in this type of work to provide a complete security fencing system.

Refer to specifications under Plain and Reinforced Concrete for the different concretes and reinforcing steel for the construction of the boundary wall. Refer to specifications under Stone Masonry Work for the construction of the boundary wall. Refer to specifications under Structural Steel Work for the construction of the fence and appurtenances as required.

**17.19.4 Construction:**

The Contractor shall submit for approval shop drawings of fencing and appurtenances and shall not proceed with fabrication and installation thereof before approval by the Employer. The location and alignment of the boundary wall shall be planned by the Contractor with the approval of the Employer. The wall shall be able to withstand the collision of a vehicle at a speed of 10 km/hr.

The masonry boundary wall shall have a stone masonry foundation with cement mortar 1:4 (1 cement: 4 coarse sand) on lean mix concrete 1:3:6 (1 cement: 3 coarse sands: 6 aggregates) base. Minimum height of the wall shall be 3.0 m. Reinforced Concrete (Grade M-25) coping beams shall be constructed on top of the stone masonry wall. Barbed wire fencing, Y shape on top of the wall with a minimum height of 1.0 m, shall be provided. Expansion joints shall be provided at 30 m c/c.

Barbered wire shall be fastened to the Y angles with wire ties at adequate spacing. Painting of the masonry boundary wall and structural steel shall be as per specifications under painting.

**17.19.5 Clean Up & Repair:**

Upon completion of the masonry boundary wall, the Contractor shall clean all soiled places and repair the damages if any damage to the satisfaction of the Employer.

## 18. SPECIFICATION (ELECTRICAL WORKS)

### 18.1 Electrical Equipment

The scope includes Design, supply, Installation, Testing, and Commissioning of Electrical, Communication, CCTV, and Access Control systems in complete to match the needs of the operation requirement as specified in the Tender document. However, specifications and tentative SLD are furnished herewith for bidding purposes. Hence, it is the responsibility of the contractor to design the electrical system as per the load list provided by the Employer.

#### 18.1.1 Diesel Generator (DG Set)

##### 18.1.1.1 Scope of Work

The scope includes Design, supply, Installation, Testing, and Commissioning of 1 No. of a 350 kVA DG set, including all accessories like control panels, power outlet panels, radiator, etc., at both locations. The DG set shall be supplied with a separate day tank.

The work also includes the supply and installation of a stack as per the local pollution control Board norms.

Approval from DGMS, other governing agencies, and approval from the Electrical inspector shall be under the contractor's scope.

Obtaining diesel engine manufacturer approval of the installation, with specific emphasis on alignment, exhaust piping, and ventilation, before commissioning.

-As-built drawing, supplier test certificate, catalogues, data sheets & other detailed engineering documents shall be submitted in four sets to the consultant and the client.

Any related work covering the supply of installation materials, consumables, etc., whether specified or not, to render the system fully functional and conforming to the best engineering standards.

The Bidder shall arrange for all design and civil construction works for making a foundation for DG sets, a Diesel tank, and making a trench in the panel room. The design of the foundation shall be approved by the Engineer.

##### 18.1.1.2 Design Basis:

Nominal voltage: 415V +/- 10% (without AVR)

Number of Phases: 3+Neutral

Frequency: 50Hz+3%

Neutral Earthing: Solidly earthed.

Control supply: 24V, 2-wire DC.

##### 18.1.1.3 Codes and Regulations:

- BS 5514
- BS649
- IS1000
- IS13364
- IS1962
- ISO 8528 all parts

##### 18.1.1.4 Component Specification

Diesel Engine

- Type: 4 strokes
- No: of Cylinders: 6 Cylinders
- Cooling: Water-cooled and turbocharged Diesel Engine
- Capacity: Minimum 600BHP @ 1500 RPM under NTP conditions

Engine designed to run continuously, conforming to BS: 5514/ DIN-6271/IS 10002/ ISO – 3046 with an overload capacity of 10% for one hour in any 12 hours continuous operation.

The engine shall be complete with the following accessories:

- Heat Exchanger
- Corrosion inhibitor coolant
- Paper element filters for fuel, lube oil, and bypass
- Flywheel to single bearing alternator with housing.
- Dry-type air cleaners and vacuum indicators.
- PT Self-Adjusting direct fuel injection system.
- Silencer.
- Stainless steel exhaust flexible bellows.
- Electronic Control panel with digital governor suitable for synchronization.
- Electric Starter
- Battery charging alternator
- Electronic instrument panel (Displaying the following)
  - o Battery Voltage
  - o Coolant Water Temperature
  - o Lubricating Oil Pressure
  - o Engine speed
  - o Engine running Hours
  - o RS 485 MODBUS Communication
- Safety & Control (Trip & Indication for):
  - o High Water Temperature
  - o Low lube oil pressure
  - o Over speed stop
  - o Low engine speed
  - o Low fuel level
  - o High fuel level
  - o High lubricating oil temperature
  - o Engine jacket water temperature is high
  - o Engine jacket water pressure is low

Air inlet system, Charging system, Control system, Exhaust system.

Alternator:

Alternator conforming to BS:5000/ IS:4722 with standard design with IP 23 Protection, suitably rated at 350kVA at 0.8pf, 415 Volts, 3 phase, 4 Wires, 50 Hz., 1500 RPM, self-excited (brushless excitation) and self-regulated, Band of Voltage Regulation +/-1.5% of rated voltage (from no load to full load) and Class “H” Insulation. Alternator should be mounted on a common single base frame and coupled directly to the engine.

Alternator shall be provided with the following items.

- Continuous damper winding
- 6 numbers of RTD and one anti-condensation heater wired to a separate terminal box.
- 3-phase sensing AVR with 0.5% voltage regulation
- A neutral CT of adequate ratio and class for REF relay for D.G protection
- Separately mounted adaptor box suitable for cable termination of aluminium XLPE cable of size as per approved SLD.

Alternator shall further meet the following specifications:

- The alternator shall be suitable for 20% over speed for 2 minutes
- The alternator shall be capable of carrying 50% overload for a duration of 1 minute.
- The alternator shall be capable of carrying 10% overload for one hour in any period of 12hours running.
- The alternator terminal voltage for any load variation should be maintained with +5%
- Both ends of each phase winding shall be brought to the terminal box.
- The alternator shall withstand the 3-phase short circuit at the terminals for a period of three seconds.
- The total harmonic distortion shall not exceed 3% and the design shall permit upto 30% unbalance between phases while in operation.

#### Acoustic Enclosure:

The acoustic enclosure shall be of free standing, floor-mounted type integral with the DG set. The enclosure shall be provided with a rugged, heavy-duty structural steel base frame with chequered plate flooring on which the DG set is to be mounted. The enclosure shall be prefabricated, factory-built and modular in construction, so that it can be easily assembled at the site around the DG set. The enclosure shall consist of acoustically treated panels housed in rugged steel frames, which shall be bolted together to form the body of the enclosure. The construction features of acoustic enclosures are as follows.

- The acoustic panels shall be filled with a special grade high-density mineral wool retained on the inside by perforated GI sheets specially designed for optimum sound attenuation.
- The outer surface of the acoustic panels shall be fabricated of performed 16G corrugated CRCA sheet steel of SAIL make only.
- All materials used for acoustic enclosure shall be fire-resistant/fire-retardant grade.
- The sheet steel treatment shall consist of degreasing, de-rusting, and phosphating, followed by two coats of zinc chromate primer, followed by two coats of zinpholite surface for superior corrosion resistance, and two coats of finish paint.
- Base frame shall be of Sturdy, fabricated/welded construction, made out of high-quality Steel section suitable for mounting the engine and alternator. The base frame shall be suitably designed to simplify transportation, handling, and slinging. It shall have provision for levelling adjustments, as required during installation.

#### Noise Level Outside Enclosure:

- 75 dBA at a distance of 1 meter under free field conditions and adhere to the guidelines of MOEF (Ministry of Environment and Forest) and CPCB (Central Pollution and Control Board) norms.
- Provision to log essential parameters at 1-minute intervals shall be provided along with the Optional Data logger (to be quoted separately)

#### DG LT Panel:

The panel shall be sheet steel construction and arranged for free-standing, cubicle-type floor mounting, and bottom entry with front and rear access. The interior wiring of the cubicle shall be looped and clipped, and all wire ends are to be clearly identified. The panel shall be dust and vermin-proof.

The panel shall accommodate the following:

- Suitable Moulded Case Circuit Breaker,
- Ammeter with Selector switch
- Voltmeter with Selector Switch, 500 Volts
- Frequency Meter
- KWH Meter
- KVAR Meter
- KW Meter
- Current Transformers
- Instrument fuses
- Battery voltmeter
- Power Factor Meter
- Excitation current Ammeter
- Excitation Voltmeter

The following protection Relays shall be provided in the DG LT Panel.

- IDMT relay (Over current and earth fault)
- Restricted earth fault relay
- Over voltage relay
- Under voltage relay
- Reverse power relay
- Field failure relay
- Differential relay
- Phase failure relay

The following protection Indication Lamps shall be provided in the DG LT Panel

- DG set on
- Load on DG set
- Start failure
- Generator overcurrent
- Generator high voltage
- Generator low voltage
- Earth fault
- Generator winding temperature is high
- High bearing temperature
- Reverse power
- Rotor diode failure

#### Fuel Tank:

The Fuel Tank should be located nearest to the DG set enclosure to ensure free flow of Diesel. The capacity of the Fuel tank shall be 900 Litres.

#### Battery:

The Battery shall be of heavy-duty, high-performance lead-acid type of Exide make. Each Battery shall be rated 12V. The number of AH capacity shall be selected to suit the engine requirements.

The Battery shall be suitable for six successive starting attempts, each of 10 seconds duration with a gap of 5 seconds between successive starts.

The Battery shall be supplied complete with electrolyte and accessories. The accessories shall include a battery stand, Battery leads with terminal ends acrylic top cover, and inter-battery connectors.

#### Lube Oil System:

Complete with a cooling system, oil temperature monitor, filtration system up to 20 microns, level indicator, and fume disposal system to be provided. Fuel system with a primary and secondary fuel filter, fuel pump to be provided.

The Supplier should attend to the Breakdowns within 24 hours of reporting the fault and put the DG set back in Operation. The supplier should provide the auto-recording COMMUNICATION number and any other contact number available for reporting the breakdown.

Training to the Staff involved in the Operation & Maintenance of the DG set to be imparted at the site.

#### Painting:

The outside enclosure shall have a factory-applied weatherproof powder-coated finish, while all other structures shall have appropriate corrosion-proof coating suitable for a coastal climate. Steel structures shall have a coat of zinc chromate primer and a coat of synthetic enamel paint of approved shade.

The exhaust pipe/duct and stack shall have appropriate high-temperature-resistant paint. Any paint or coating damaged during transportation and erection shall be rectified at the site to the satisfaction of the Engineer in charge.

#### Foundation:

The DG set shall be installed on a foundation of suitable height. The successful bidder shall determine the soil bearing capacity for designing the foundation for D.G Set. A PCC of weight 2.5times the operating weight of the Genset with enclosure or as recommended by OEM, whichever is higher required to be provided. 300mm of the foundation shall be above the ground level, and the breadth of the foundation should be at least 250mm more on all sides than the size of the enclosure. The generator set shall be mounted on anti-vibration mounts inside the enclosure.

All the civil works related to the foundation shall be on the contractor's scope.

#### Inspection:

The contractor shall arrange for the inspection of the set by the diesel engine manufacturer's authorised representative and obtain his approval before rolling the set.

#### Guarantee:

The DG set and accessories shall be guaranteed for satisfactory operation for a period of 24 months from the date of commissioning or 5000 running hours from the date of supply, whichever is earlier.

Any defects noticed during this period shall be rectified free of cost. The supplier shall indicate the type of record to be maintained so that the warranty claims, if any, are honoured by the manufacturer.

The design and installation of acoustic treatment shall ensure that the noise level at 1m from the DG set at any point shall not exceed 75 dBA while operating the set at rated load.

**Taking Over:**

The client will take over the DG set for operation on completion of the following.

1. DG sets are installed, tested, and commissioned as per the specification
2. Original Test certificates are furnished for the Engine, alternator, acoustic enclosure, etc.
3. Load trials are successfully conducted, including the acoustic enclosure and ventilation fan, if any.
4. Necessary approval from the Electrical inspectorate, DGMS, and any other approvals as required are obtained.
5. A 4 set of as-built documentation, spare part list, maintenance chart, and operation and maintenance manuals are to be submitted.
6. The set shall be handed over with the first fill of Lube oil and fuel tanks full of diesel oil, along with the spares mentioned.
7. Engraved tally indicating the starting, paralleling instruction (if any) etc. shall be provided.
8. Training to at least one Engineer and two technicians shall be provided for the operation and maintenance of the DG Set.

**SPARES:**

The DG Set shall be supplied with the following spares.

1. Two sets of renewable parts of oil, fuel & air filters.
2. Two numbers of Fan belts
3. Five numbers of spare fuses of each type & size used.
4. Two spare relays of each type, a set of fuel injectors.
5. One-number manual gear pump.

**Documents:**

As part of the equipment supply, the following documents shall be supplied.

1. General arrangement plan of the DG set
2. Piping schematic diagram
3. Layout of fuel and exhaust piping
4. Layout and construction detail of acoustic treatment
5. Calculation for ventilation system design
6. Engine wiring Diagram
7. Test certificate for Engine and alternator
8. Installation, operation, and maintenance instructions for the Diesel Engine and alternator
9. Spare part list
10. Approval from Pollution Control Board, DGMS, and CEA

**Technical Particulars of DG Set:**

Details to be furnished by the Tenderer during the bid submission:

Sl. No	Description	Specification
1	Generator KVA Rating / Model No.	350 KVA
<b>Engine</b>		
2	Make	
3	Model No.	
4	BHP Output	
5	Cooling	
6	Aspiration	
7	No. of Cylinders	
8	RPM	
9	Compression ratio	
10	Displacement (ltrs.)	
11	Fuel oil	

12	Fuel consumption at no load	
13	Fuel consumption at 25% load	
14	Fuel consumption at 50% load	
15	Fuel consumption at 75% load	
16	Fuel consumption at full load	
17	Capacity of fuel tank (litres)	
18	Governor	
19	Starting system	
20	Lube oil specification	
21	Lube oil sump capacity	
22	Lube oil consumption (litres per hour)	
23	Coolant capacity (Engine + Radiator)	
24	Lube oil change period (hrs.)	
25	Emission compliance	
26	Battery rating	
Alternator		
27	Make and Model No.	
28	Type	
29	Voltage	
30	Frequency	
31	Phase	
32	Rated current	
33	Power factor	
34	Enclosure	
35	Voltage regulation	
36	Class of Insulation	
Control Panel		
37	Make	
38	Type	
39	Overall dimensions (L X B X H)	
40	Finish	
41	Sheet metal size	
42	Make and type of contactors/circuit breakers	
43	Make and type of instruments	
44	Make and type of switch fuse units	
45	Other facilities incorporated	
Generator set		
46	Noise level	
47	Overall dimensions of the DG se	
48	Overall canopy dimension	
49	Approx. Total weight (Dry)	
50	Type of coupling/bearing details	

### 18.1.2 LT Switchboard:

#### 18.1.2.1 Scope of Work:

This specification covers design, manufacture, supply, installation, testing, and commissioning of L.T. Switch Boards for D.G and LT Panels at Workshop, Buildings, and Container Yard.

### **18.1.2.2 Design:**

Voltage: As shown in SLD

Frequency: 50 Hz +/- 3%

Fault Level: As shown in SLD.

Ambient Temperature: 50 °C.

### **18.1.2.3 Codes & Regulations:**

IS 2516(Part 1): AC Circuit Breaker requirement, voltages not exceeding 1000 Volts.

IS 2516(Part 2) : AC Circuit Breaker tests, voltages not exceeding 1000 Volts.

IS 4237: General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

IS 4047: Specification for Heavy-duty air break switch

IS 2208 : Specification for HRC cartridge fuses links up to 650 volts

IS 2705: Specification for current Transformer

IS 2067: Specification for aluminium bus bar

IS 1336: Recommendation for colour of Push Buttons

IS 1248: Specification for direct-acting electrical instruments

IS 2147: Degree of protection provided by enclosure for low voltage switchgear

IS 375: Specification for marking and general arrangement for switch gears, bus bars, main connections, and auxiliary wiring.

IS 722: Specification for AC electricity meters.

IS 3231: Electrical Relays for Power System Protection.

IS 5082: Wrought Aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes.

IS 2675: Specification for enclosed distribution fuse boards and cut-outs for voltage not exceeding 1000volts.

BS3871(Part 1): Specification for miniature circuit breaker

IEC 309-1: Plug and socket.

### **18.1.2.4 General Construction:**

This specification covers the requirements of D.G LT Panel, Reefer LT Panel, Workshop PDB Panel, complete with all accessories. The switchgear and its components shall be designed for a design ambient temperature of 50 °C. Switchgear shall be designed for natural air cooling. No forced cooling is acceptable. Short circuit withstand rating of the switchgear shall be as given in the SLD.

415V normal system shall be solidly grounded.

Bus bar, breaker, and other components shall be designed for continuous operation at rated current, considering the temperature inside the cubicle. The continuous current rating of the bus bars, incomers of the panel, shall be the maximum load on the bus due to all the running auxiliaries during any operating condition, plus a 20% margin, rounded off to the next higher standard rating.

Operating height of the handles/switches shall be limited to a maximum of 1800 mm and a minimum of 300 mm.

LT Switch Boards shall be of sheet metal enclosed, cubicle-type type floor-mounted, free-standing type. Switchboard frames and load-bearing members shall be fabricated using CRCA sheet steel of a thickness not less than 2.0 mm. Doors and covers shall also be of CRCA sheet steel of thickness not less than 1.6 mm. Thickness of gland plates shall not be less than 3.0 mm for sheet steel & 4.0mm for non-magnetic material. All switchboards shall be of dust-proof and vermin-proof construction and shall be provided following degree of protection.

- D.G LT Panel: IP 54
- Reefer LT Panel: IP 65
- Workshop PDB Panel: IP 54

All switchboards shall be of uniform height not exceeding 2450 mm. Switchboards shall be easily extendable on both sides by the addition of vertical sections after removing the end covers. The module size of switchboards shall not be less than 200mm. Cable entry for these panels shall be from the bottom.

Switchboards shall be divided into distinct vertical sections (Panels), each comprising the following compartments:

- Main bus bar compartment
- Switchgear/feeder compartment
- Cable alley
- Auxiliary busbar compartment
- Control compartment for relays for ACB feeder

The feeder compartment shall be sheet steel enclosed on all sides with the withdrawable units in position or removed. The front of the compartment shall be provided with a hinged single-leaf door with captive screws for positive closure. All circuit-breaker panels shall be of the single-front type. All single-front switchboards shall be provided with single-leaf, hinged, or bolted covers at the rear. The bolts shall be of captive type. The covers shall be provided with "DANGER" labels.

All ACB feeders shall be draw-out type, and non-ACB feeders shall be fixed type. ACB modules shall be of a fully drawn-out type having distinct 'Service' and 'Test' positions. The equipment pertaining to a draw-out type module shall be mounted on a fully withdrawable chassis, which can be drawn out without having to unscrew any wire or cable connection. Suitable arrangement with cradle/rollers and guides shall be provided for smooth movement of the chassis.

#### **18.1.2.5 Air Circuit Breakers:**

Air Circuit breakers shall be (TPN), air break, horizontal draw-out type, and shall have fault-making and breaking capacities as specified. These shall be microprocessor-based with an RS-485 communication facility. There shall be "SERVICE", "TEST", and "ISOLATED" positions for the breakers. In "Test" position, the circuit breaker shall be capable of being tested for operation without energizing the power circuits, i.e., power contacts shall be disconnected, while the control circuits shall remain undisturbed. Locking facilities shall be provided to prevent movement of the circuit breaker from the "SERVICE", "TEST", or "ISOLATED" position. It shall be possible to close the door in "Test" position.

Each breaker feeder shall be provided with the following as a minimum:

- Electrical anti-pumping feature
- Motor-charged spring operating mechanism.
- Manual spring charging
- Mechanical indication of spring charge
- Mechanical position indicator
- Closing coil
- Shunt trip coil
- Manual trip push button
- Operation counter
- Phase barriers
- Shutter assembly
- Door interlock kit

The closing coil and spring charging motor shall operate satisfactorily at all values of control supply voltage between 80 and 110 percent of the rated voltage. The closing coil & shunt trip coil shall be rated for 100% continuous duty. One Open-Closed-Open operation of the circuit breaker shall be possible after failure of the power supply to the motor. For breakers spring charging motor shall be provided with overcurrent protection. Motor windings shall be provided with class B insulation or better. The shunt trip coil shall operate satisfactorily, with all the values of control supply voltage between 70 and 110 percent of the rated voltage. Circuit breaker of the same type and ampere rating shall be wired alike and shall be mechanically interchangeable.

All Air Circuit Breakers shall be provided with the following interlocks:

- Movement of a circuit breaker between "SERVICE" and "TEST" positions shall not be possible unless it is in the open position.
- Closing of a circuit breaker shall not be possible unless it is in "SERVICE" position, "TEST" position, or in "ISOLATED" position.

- Once the closing springs are discharged, after one closing operation of the circuit breaker, it shall automatically initiate recharging of the spring.

A telescopic trolley or a suitable arrangement shall be provided for maintenance of the circuit-breaker module in a cubicle. The trolley shall be such that the topmost breaker module can be withdrawn from the trolley and can be lowered for maintenance purposes. ACBs shall have CT-operated relays for overcurrent and earth fault protection.

#### **18.1.2.6 Moulded Case Circuit Breaker (MCCB):**

MCCB shall, in general, conform to IS: 13947 Part-2. MCCBs shall be provided with thermo-magnetic type release for overcurrent and short circuit protection. These shall be microprocessor-based with an RS-485 communication facility. The setting of the thermal release shall be adjustable from 75% to 100% of the rated current. The MCCB shall have a breaking capacity of not less than 50kA. MCCBs used for incomers and Bus couplers shall be equipped with a stored energy mechanism for electrical closing and tripping. All MCCBs shall be manually operated. The operating handle should give a clear trip indication.

#### **18.1.2.7 Control and Selector Switches:**

Control and selector switches shall be of rotary type, with name plates clearly marked to show the function and positions. Circuit breaker control switches shall have three positions and shall be spring-return to "NEUTRAL" from "CLOSE" and "TRIP" positions, and shall have pistol grip handles. Circuit breaker selector switches shall have three stay put positions marked 'Test', 'Local', and 'Remote', respectively. They shall have black spade handles. Selector switches for starter modules shall have 'Test', 'Local', and 'Remote' positions as specified. Ammeter and voltmeter selector switches shall have four stay-put positions with an adequate number of contacts for a 3-phase 4-wire system. These shall have oval handles. Ammeter selector switches shall have make-before-break type contacts to prevent open circuiting of the CT secondary.

#### **18.1.2.8 Contactors:**

Motor starter contactors shall be air brake, electromagnetic type, rated for uninterrupted duty. Contactors shall be double-break, non-gravity type, and their main contacts shall be silver-faced. Direct-on-line contactors shall be of utilization category AC3. Reversing starters shall comprise Forward and reverse contactors, mechanically and electrically interlocked with each other. These contactors shall be of utilization category AC4. The contactor shall operate satisfactorily from 85% to 110% of the rated voltage. The contactor shall not drop out at 70% of the rated voltage, but shall definitely drop out at 20% of the rated voltage.

#### **18.1.2.9 Instrument Transformers:**

The CTs shall be mounted on the switchgear's stationary parts. For metering separate core shall be provided. The CTs shall be of cast resin, bar primary type, and of Class E or better insulation. CT secondary current shall be 1A. Accuracy class of Current Transformer shall be Class 5P20 for relaying and Class 0.5 and ISF < 5 for metering. CTs for current rating less than 50A shall be 'Wound primary' type, and above 50A shall be 'Bar primary' type.

Voltage Transformer shall be cast-resin, draw-out type and shall have an accuracy class of 1.0. The bus VTs shall be housed in a separate compartment. All VTs shall have readily accessible fuses and MCBs on the primary and secondary sides, respectively.

#### **18.1.2.10 Indicating Instruments:**

All indicating and integrating meters shall be flush-mounted on the panel front. The instruments shall be of at least 96 mm square size with 240-degree linear scales and shall have an accuracy class of 1.0. All instruments shall have white dials with black numerals & lettering. A black knife-edge pointer shall be provided for meters. Ammeters provided for motor feeders shall have a compressed scale at the upper current region to cover the starting current up to eight (8) times the CT current. No direct reading type

ammeters shall be used. All such meters shall be fed through suitable Current transformers for motors rated 10kW & above. All analog-type meters shall be of the Moving Coil type. All Multifunction meters shall have a digital display and a communication port with a true RMS measurement facility with a minimum 1% accuracy level.

#### **18.1.2.11 Push Buttons:**

Pushbuttons shall be of spring return, push-to-actuate type. Where specified, push buttons shall be stay-put type. Their contacts shall be rated to make, continuously carry, and break 6A at 110 V AC and 1A (inductive) at 110 V DC. All pushbuttons shall have two normally open and two normally closed contacts, unless specified otherwise. The contact faces shall be of silver alloy. All pushbuttons shall be provided with integral escutcheon plates marked with their function. All emergency push-buttons shall be stay-put/latching type. To detach, a master key provision shall be provided.

The colour of the button shall be as follows:

- Green for motor START, breaker CLOSE, valve/damper OPEN /CLOSE commands.
- Red for motor TRIP, breaker OPEN.
- Black for all annunciation functions, overloads, reset, and miscellaneous commands.

#### **18.1.2.12 Indicating Lamps:**

Indicating lamps shall be of the panel mounting, LED type. The lamps shall have escutcheon plates marked with their function, wherever necessary. All indicating lamps shall be rated for continuous operation at 85% to 110% of their rated voltage. Low Voltage Glow Prevention (LVGP) feature shall be provided for indication lamps. Lamps shall have translucent lamp-covers of the following colours, as warranted by the application:

- Red for motor ON, breaker CLOSE
- Green for motor OFF, breaker OPEN
- Blue for Service
- White for Test, Spring Charged, Spring Discharged, Lockout Relay Healthy
- Amber for auto trip

#### **18.1.2.13 Control Supply and Space Heater Supply:**

D.G LT Panel, Reefer LT Panel, Workshop PDB Panel shall have control transformers tapped from the incoming side of each incomer. The control circuit of the panel is designed for 230V AC. It shall be possible to isolate any panel without disturbing the power supply to other panels. Each subcircuit shall have a separate fuse. An under-voltage relay to monitor the control supply shall be provided. A contact of the relay shall be wired to the terminal for external use. In each module, the panel shall derive a 230V AC control supply through a control supply transformer. The control transformers shall be of insulation class `B' or better. The sizing of control transformers shall be carried out by the contractor, considering the actual load of power contactors, auxiliary contactors, indicating lamps, and other equipment, including remote auxiliary relays and lamps in the circuit.

A necessary switch and MCB to isolate and distribute the supply to each panel shall be provided. Each panel shall be equipped with the following, as required:

- Thermostatically controlled space heater(s).
- Illumination lamp with door switch
- 5A 3pin socket with MCB protection.

#### **18.1.2.14 Wiring:**

All switchboards shall be supplied completely wired internally up to the terminals, ready to receive external cables. All internal wiring shall be carried out with 1100 V grade, HR PVC/ XLPE insulated single core, copper conductor of minimum 2.5 sq.mm for CT circuits and 1.5 sq mm for other circuits. All internal wiring terminations shall be made with solderless crimping type tinned copper lugs. Insulation sleeves shall be provided over the exposed parts of lugs. Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire. Numbers 6 and 9 shall not

be used for wire identification. Control terminal blocks shall be of 1100 Volts grade, rated for 10 Amps, and in one-piece moulding. It shall be complete with insulating barriers, clip-on type terminals, and identification strips. Marking on the terminal strip shall correspond to the terminal numbering on wiring diagrams. Terminal blocks for CT & VT secondary leads shall be provided with test links & isolating facilities. CT secondary leads shall be provided with short-circuiting & earthing facilities. In all the panels, at least 20% spare terminals for external connections shall be provided, and these spare terminals shall be uniformly distributed on all terminal blocks.

#### **18.1.2.15 Power Cable Termination:**

Cable termination compartment and arrangement for power cables shall be suitable for heavy-duty, 1.1 kV grade, stranded aluminium conductor, PVC / XLPE insulated, armoured, and FRLS PVC sheathed cables. All power cable terminals shall be of stud type, and the power cable lugs shall be of tinned copper, solderless crimping ring type conforming to IS:8309. All lugs shall be insulated/sleeved.

#### **18.1.2.16 Nameplates and Labels:**

LT Switch Boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also. All name plates shall be of non-rusting metal or 3-ply Limacoid, with white engraved lettering on a black background. Suitable stenciled paint mark shall be provided inside the panel/module for identification of all equipment, in addition to the plastic sticker labels, if provided. These labels shall be positioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring drawings. Caution name plate "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live, and isolation is possible only at the remote end.

#### **18.1.2.17 Bus bars and Insulators:**

Each switchboard shall be provided with three-phase and neutral bus bars. All bus bars and jumper connections shall be of high-conductivity aluminium/copper of adequate size. The cross-section of the bus bars shall be uniform throughout the length of the switchboard. All bus bars shall be adequately supported by non-hygroscopic, non-combustible, track-resistant, and high-strength sheet moulded compound or equivalent type polyester fibre glass moulded insulators. All bus bar joints shall be provided with high tensile steel bolts, Belleville/ spring washers, and nuts. All copper-to-aluminium joints shall be provided with suitable bi-metallic washers. All bus bars shall have HR PVC sleeves and colour color-coded. Contact surfaces at all joints shall be silver-plated or properly cleaned, and anti-oxidized grease applied to ensure an efficient and trouble-free connection. Suitable bimetallic connectors shall be used for dissimilar metal connections.

The continuous rating of the main bus bars shall be the same as that of the incomer breaker, and the bus bar shall carry this continuous current without exceeding the temperature of 90°C. For silver-plated joints, the temperature shall not exceed 105°C. All horizontal and vertical bus bar joints shall be covered by insulating shrouds.

#### **18.1.2.18 Earthing:**

A copper earthing bus of adequate size shall be provided at the bottom and shall extend throughout the length of the switchgear. It shall be bolted to the framework of each panel and each breaker earthing contact bar. The earth bus shall be sized to withstand the specified short circuit current. The truck and breaker frame shall be earthed while the truck is being inserted in the panel, and positive earthing of the truck and breaker frame shall be maintained in all positions, i.e., 'Service', 'Test', and 'Isolated', as well as throughout the intermediate travel.

All non-current-carrying metal work of the switchboard shall be effectively bonded to the earth bus. All hinged doors shall be earthed through a flexible earthing braid. VT and CT secondary neutral point earthing shall be at one place only on the terminal block. All metallic cases of relays, instruments, and other panel-mounted equipment shall be effectively bonded to the earth bus by independent stranded copper wires of size not less than 2.5 sq mm

#### **18.1.2.19 Local Push Button Stations:**

The local push-button stations shall be with an FRP enclosure, suitable for outdoor mounting on a wall or steel structures. The local push button stations shall be dust and vermin-proof and shall have a degree of protection of IP55 as per IS:13947 Part-1. Local push button stations shall comprise Start/Stop push buttons as per the drive control philosophy. Emergency stop Push-buttons shall be stay-put/ latching type, requiring a master key for de-latching.

#### **18.1.2.20 PAINTING:**

All paint shall be applied on clean, dry surfaces under suitable atmospheric and other conditions in accordance with the paint manufacturer's instructions. All paints used shall be compatible with each other and capable of performing for five years in the environment specified without any need for maintenance. The minimum standards acceptable are.

1. Cleaning by shot blasting to grade as 2.5 OF ISO 8501-1
2. All sheet steel surfaces shall be degreased, pickled, and phosphate in accordance with IS 6005” Code of practice for phosphating of iron and steel.”
3. Immediately following phosphating, the surfaces shall be painted with two coats of high-quality zinc chromium primer.
4. All surfaces of coating shall be filled with approved two-pack filler and rubbed down to a smooth finish.
5. Interior surfaces of terminal boxes, after preparation, cleaning, and priming, shall be painted with one coat of zinc chromate primer, one coat of phenolic-based undercoating, followed by a final coat of phenolic-based finishing paint to white colour, followed by a final coat of anti-condensation white paint of a type and make to the approval of the project manager. A minimum overall paint thickness of 150 microns shall be maintained throughout. The first coat of primer is applied on the same day, preferably within two hours of shot blasting.
6. Exterior steel surfaces and metal work after preparation and priming shall be painted with one coat of zinc chromate primer, one coat of phenolic based undercoating and two coats of iron oxide paint, then painted with a final coat of phenolic based hard glass finishing paint of the light grey shade no.631 of IS 5 to provide an overall minimum paint thickness of 200 microns.

#### **18.1.2.21 Erection and Commissioning:**

All switch gear panels shall be installed on finished surfaces. The correct level shall be ascertained before final grouting. The contractor should take utmost care in delicate equipment, instruments, and relays. Dragging shall be avoided as far as possible. Whenever the instruments and relays are supplied separately, they shall be mounted only after the associated control panel has been erected and aligned.

#### **18.1.2.22 Testing and Inspection:**

Switchgear and all its components should have been type tested and proven type. Type test certificates shall be furnished for the Purchaser's review. Switchgear and its components shall be subjected to routine tests as per the applicable Indian Standard. In addition, any special test required shall also be performed. Test reports shall be submitted for approval.

#### **18.1.2.23 Spares List:**

The following spares shall be supplied with each LT switch Board. The price quoted by the bidders for equipment shall include the spares listed below, and no separate payment shall be made for them.

- MCBs: 2 of each rating
- MCCBs: 1 of each rating
- Indication Lights: 5 of each colour
- Cable end termination: 10 of each size being used in the panel
- ASS/VSS: 1 of each rating
- Ammeter: 1 of each rating
- Voltmeter: 1 of each rating

- CT/VT: 1 of each rating
- Panel door handle: 1 of each type
- ACB racking handle: 1 of each type
- Auxiliary relays: 1 of each type
- Auxiliary contactor: 1 of each type
- ACB Spring charge motor: 1 of each rating

#### **18.1.2.24 Drawing and Documents:**

The following drawings and documents shall be furnished.

1. General arrangement drawing of the panel showing
  - Overall dimensions
  - Terminal locations
  - Total Weight
  - Foundation details
  - Section details
  - Bill of Materials with make and quantity
2. Single line diagram and wiring diagram, including control circuit diagram with terminal block details.
3. Technical data sheet of ACB, MCCB, Relays, contactors, meters, and other associated equipment.
4. Calculation sheet for sizing of bus bar

#### **18.1.3 Reefer Gantry Panels:**

##### **18.1.3.1 Scope:**

Scope shall include design, supply, installation, testing, and commissioning of three Reefer Gantry Panels at each terminal as per the specification described below.

##### **18.1.3.2 Description:**

There will be a total 3 number of reefer gantry panels. The Reefer Gantry panels shall be located one at each level of the Reefer Gantry. Each Reefer Gantry panel shall feed 6 numbers of plug & sockets at each level.

The successful bidder shall be responsible for the design, supply, installation, testing, and commissioning of all reefer gantry panels.

The reefer gantry panel shall be provided with ingress protection in accordance with IEC 60529 Cat IP65 (minimum). The enclosure of the panel shall be manufactured from marine-grade steel.

Each reefer gantry panel shall receive 3 3-phase, 415V, 125A Power supply from the LT panel near the DG set. The reefer gantry panel shall have a 125A MCCB as an incomer.

Each reefer gantry panel shall have the following features. One 415V, 125A 4P MCCB Incoming switch and 8 numbers of 415V, 32A, TP MCB as shown in the drawing.

The general construction and bus bar arrangement of the reefer gantry panel shall be as follows.

- The cubicle shall be a sheet metal enclosed type suitable for wall mounting. It shall be totally enclosed, completely dust-proof, and vermin-proof.
- The cubicle enclosure shall be provided with a degree of protection not less than IP65.
- The enclosure shall be suitable for use in a highly saline environment.
- MCCB incomer feeder shall be a 4-pole thermal magnetic type release with adjustable overload and fixed short circuit setting.
- The bus bar shall be high-conductivity electrolytic copper, free from sharp edges and burs.
- The sheet steel work shall be of excellent quality and shall be free from burs.
- The sheet steel used for the panel construction shall be at least 1.6mm thick.
- Phase barriers and insulating sheets shall be provided in the panel as per the general practice.
- The doors shall have gaskets made of non-ageing material to make the module dust-tight.

Each door shall be provided with countersunk screws. All components, hinges, and gaskets used shall be suitable for the saline environment.

- Adequate space shall be available in the panel for the termination of incoming aluminium armoured cable.
- The switches, fuses, etc. shall be mounted on the rear plate of the module. Only switch drive, push buttons, indicating lamps, and meters shall be mounted on the module door with the switch in the closed position.
- The paint thickness shall be 150microns and shall be marine grade type.
- The cable entry to the panel shall be from the bottom.
- The Gland plate shall be 3mm thick
- The external paint shade shall be 631.

#### **18.1.4 Reefer Plug & Sockets:**

##### **18.1.4.1 Scope:**

Scope shall include design, supply, installation, testing, and commissioning of Eighteen (18) Reefer Plug & Socket as per the specification described below.

##### **18.1.4.2 DESCRIPTION:**

Plug and sockets shall be provided as per the ratings shown in the drawings. Plug and sockets shall conform to IEC 60309-1. It shall contain:

- Silver-tipped spring-loaded contacts and temperature rise as per the above IEC.
- Metal-clad/Polycarbonate type of construction
- Plug & Socket arrangement shall be push-pull type
- Outdoor type with IP67.
- Safety lid cover for the socket.
- Safety shutter shall be provided with a socket for the avoidance of insertion of wire without a plug.
- Earth pin should make first and break last.
- Mechanical interlocking on plug insertion.

Six numbers of plug and socket sets shall be provided in each level of Reefer Gantry. Hence total 18 numbers of Plug and socket shall be provided. The location of plug and socket for each reefer container shall be coordinated with the position of the containers on the side of the reefer gantry serving the container to minimize the potential tripping Hazard of cable across the walkway.

The Plug and sockets shall be of the polycarbonate construction 415V, 32A 3P+E industrial pattern sockets (Mennekes make/Equivalent) in accordance with IEC60309. The Plug & Socket arrangement shall be wall-mounted type. Each of these arrangements shall be fitted with a suitably rated RCBO with 100mA leakage sensitivity. Sockets shall provide ingress protection to IEC 60529 Cat.IP67 (minimum) regardless of whether a plug is inserted.

#### **18.1.5 Automatic Power Factor Control Panels:**

##### **7.1.5.1 Scope:**

Scope shall include design, supply, installation, testing, and commissioning of the automatic power factor control panel along with 415V shunt capacitor banks as required in this specification and in the Single Line diagram.

##### **18.1.5.2 Design:**

Voltage: 415V

Frequency: 50 Hz +/- 3%

Fault level: 50kA

##### **18.1.5.3 Codes & Regulations:**

- IS 2834
- IS 13340-1993
- IS13341-1992
- IEC 60831-1+2

#### **18.1.5.4 Construction:**

- 415 V Automatic Power Factor Control Panels shall comprise of MCCB / Switch Fuse, 1.1KV Air Break Contactor, PF Meter, Automatic PF Correction Relay with Capacitor Banks of suitable rating as indicated in the attached Single Line Diagram.
- Rating shown in the SLDs is indicative. Contractor shall perform their own calculations to verify the size and submit the same to Employer for verification. The number of steps shall be based on a 5 kVAR power step minimum. The capacitor bank ratings shall be finally selected to provide a power factor of 0.95 lag on the bus. Zero steps shall also be provided. Capacitor bank shall be a double-layer construction (film + paper + foil) gas gas-impregnated type.
- The sheet steel enclosure shall be of a minimum 14SWG thick CRCA sheet.
- APFC panel shall be of IP42, Indoor application.
- Free Standing Floor Mounting Non-Compartmentalized. The APFC enclosure should be compact in size for indoor application.
- Provision for manual and auto mode to be provided.
- Power factor indication, digital or analog, to indicate the actual system power factor.
- Power factor setting dial calibrated from 0.8 lag to 0.8 lead to be provided.
- APFC relay shall be a 6 Stage Microprocessor-based digital relay with the following features: a.) APFC relay Controller should sense the KVAR required to achieve the preset target PF by automatically switching ON / OFF the capacitor unit or stage.
- An emergency stay put type mushroom head push buttons, "Emergency OFF" shall be available to de-energise all the contactors and also switch OFF the incoming MCCB/ACB both in auto and manual mode.
- Control supply for the capacitor bank shall be tapped from the incoming side of the incomer breaker.
- APFC panel shall have the following features.
  - o Two-tone hooter
  - o Fault indication lamp
  - o APFC out of circuit indication lamp.

#### **18.1.5.5 Painting:**

All paint shall be applied on clean, dry surfaces under suitable atmospheric and other conditions in accordance with the paint manufacturer's instructions. All paints used shall be compatible with each other and capable of performing for five years in the environment specified without any need for maintenance. The minimum standards acceptable are.

- Cleaning by shot blasting to grade as 2.5 OF ISO 8501-1
- All sheet steel surfaces shall be degreased, pickled, and phosphate in accordance with IS 6005 "Code of practice for phosphating of iron and steel"
- Immediately following phosphating, the surfaces shall be painted with two coats of high-quality zinc chromium primer.
- All surfaces of coating shall be filled with approved two-pack filler and rubbed down to a smooth finish.
- Interior surfaces of terminal boxes, after preparation, cleaning, and priming, shall be painted with one coat of zinc chromate primer, one coat of phenolic-based undercoating, followed by a final coat of phenolic-based finishing paint to white colour, followed by a final coat of anti-condensation white paint of a type and make to the approval of the project manager. A minimum overall paint thickness of 150 microns shall be maintained throughout. The first coat of primer is applied on the same day, preferably within two hours of shot blasting.
- Exterior steel surfaces and metal work after preparation and priming shall be painted with one coat of zinc chromate primer, one coat of phenolic based undercoating and two coats of iron oxide paint, then painted with a final coat of phenolic based hard glass finishing paint of the light grey shade no.631 of IS 5 to provide an overall minimum paint thickness of 200 microns.

#### **18.1.5.6 Drawing and Documents:**

The following drawings drawing, and documents shall be submitted in two sets for consultant approval.

- Guaranteed Technical particulars
- Type Test certificates.
- General arrangement drawing of the panel showing
  1. Overall dimensions
  2. Terminal locations
  3. Total Weight
  4. Foundation details
  5. Section details
  6. Bill of Materials with make and quantity
  7. Single line diagram and wiring diagram, including control circuit diagram with terminal block details.
  8. Technical data sheet of ACB, MCCB, Relays, contactors, meters, and other associated equipment.
  9. Calculation sheet for sizing of bus bar

#### **7.1.6 Lighting System:**

##### **7.1.6.1 Scope:**

Scope shall include indoor and outdoor lighting design, supply, installation, testing, and commissioning of the lighting system in complete to match the required illumination level as indicated in the specification. Building lighting design and area lighting design shall be done by the contractor and submitted for the engineer's approval.

##### **18.1.6.2 Standards:**

The design, manufacture, erection, testing, and commissioning shall comply with the latest issue of the following standards and rules.

IS 9537: Specification for Rigid PVC conduit for electrical wiring.

IS 694: PVC insulated cables with copper conductor for voltage up to and including 1100V.

IS 732: Code of practice for electrical wiring and installation.

IS 1646: General code of practice for fire safety of building electrical installation.

IS 3043: Code of Practice for earthing.

IS3646: Code of Practice for internal illumination

IS 4615: Switch socket outlets.

IS 3854: Switches for domestic and similar purposes.

IS 5133: Boxes for enclosure of electrical accessories.

IS 1644: Code of practice for personal hazards for the safety of buildings.

CIE 129:1998: Technical Report, Guide for the lighting of Exterior work areas

##### **18.1.6.3 Lighting System Specification:**

This specification covers the requirements of the Illumination system.

The lighting system includes:

- 100% Normal AC lighting
- 20% High Mast Lighting and other lighting 100% on DG set
- Emergency lighting through battery-backed PL lamps in selected areas of the plant during plant emergency conditions.

Normal AC Lighting shall be energized from a 3-phase, 4-wire, 415 V main DG LT Panel. D.G LT Panel feeds to Lighting Panel-1 and Lighting Panel-2. These lighting panels further feed to Lighting Distribution Boards (LDB) for each individual area. Emergency lighting shall be provided in specific areas such as the D.G Room, Workshop Building, Areas near local panels, staircases, and other strategic areas during AC supply failure. Emergency lighting shall normally be "off," and upon loss of normal AC supply, emergency lights shall be turned "on" in auto mode. Emergency lighting units with integral batteries shall be used. The emergency lighting unit shall provide light for four hours when the normal power source is lost. Each emergency light unit shall be provided with a battery, a battery charger, and two 10-watt fluorescent lamps. Exit light fixtures shall be compact fluorescent and shall be provided in all the building at exit doors.

HPSV/HPMV/Fluorescent/ Incandescent lamps shall be used as light sources in the lighting system. Fixtures considered shall be energy efficient type with low-loss ballast & low harmonics with higher lumen/watt.

Emergency lighting luminaries shall be supplied to ensure a safe exit in the case of power failure. Enclosure shall be of weather & dust-proof construction and consist of a cast aluminium body with a polycarbonate diffuser, 1x13 W fluorescent tubes, an integral transistorized control gear, a charger, and a 24V battery. Each shall be connected to the 230 V supply system and shall automatically switch to the battery in case of power supply failure. The battery shall be able to supply power to the lamps for a minimum of 1.5 hours. All fluorescent fixtures shall have tri-phosphor fluorescent lamps. All GLS & HPSV/HPMV lamps shall be screw type.

All fittings shall be weatherproof and able to withstand direct exposure.

AC lighting fixtures and accessories shall be suitable for operation on a 240 V, AC, 50 Hz supply with supply voltage variation of +/- 10%, frequency variation of +3% to -5% and combined voltage and frequency variation of an absolute sum of 10%.

HPSV/HPMV/Fluorescent lighting fixtures shall be provided with a Power factor correction capacitor to achieve a high power factor.

Lighting level design shall include a Maintenance factor as follows to account for lamp lumen depreciation, luminaries' surface dirt, and room surface dirt, etc.

- Air-conditioned areas: 0.8
- Non-Air-conditioned areas: 0.7
- Dust-prone outdoor Areas: 0.6

Suitable number of 63 ampere, 3-phase, 415-volt AC welding receptacles shall be provided. Welding receptacles shall be placed near all major equipment and at an average of 30 meters in each building.

A 20A, 240V, single-phase convenience receptacle with switch shall be provided in all the rooms. The convenience outlets shall be spaced to provide access to any point with a 15-meter extension cord.

Receptacles shall be served from an earth leakage circuit breaker (ELCB).

Welding sockets shall be fed from PDB. The number of receptacles per circuit shall not be more than 2.

Each welding receptacle unit shall have a dedicated MCB installed adjacent to the receptacle with an IP55-type enclosure.

The light fixtures shall be circuited so that adjacent fixtures are connected to alternate phases of a 3-phase circuit. Auto-timed switching may be considered with manual bypass mode for an indoor lighting system.

The lighting for enclosed areas within the buildings shall be manually switched 'on' and 'off' at local light switches near personnel entrance doors. Wall-mounted switches shall be provided at the entrance to the battery room and equipment/office rooms.

Electric power to light fixtures located outdoors shall be switched with photoelectric controllers and timers. Outdoor lighting shall have an auto/manual mode of operation. Provision shall be made to bypass the photoelectric controller and timer.

Switches shall be sized maximum of 80 percent of the light switch ampere rating with enclosures suitable for the location in which they are installed.

The load on each lighting circuit and single-phase receptacle circuit shall be limited to 2000 W.

For areas illuminated by more than one circuit, the adjacent circuit shall be fed from a different phase.

Load balance on all three 3 phases to be envisaged for lighting as well as a 1-ph power distribution circuit.

Wiring for indoor lighting installation shall be carried with PVC-insulated wire with the following sizes laid in conduit.

- Lighting Panel to lighting Fixtures: 2.5 sq.mm copper
- Switch box to lighting Fixtures: 2.5 sq mm copper
- Lighting Panel to Sockets: 4 sq mm copper

For Area lighting, PVC insulated, PVC inner-sheathed, armoured, FRLS PVC outer-sheathed Copper conductor cables shall be provided.

Wiring for lighting circuits of the Normal AC system and the DC system shall run in separate conduits.

Wiring for Lighting fixtures and receptacle units shall be fed from different circuits and shall run in separate conduits. Two different phase circuits shall not be laid in the same conduit.

All conduits shall be surface-mounted in general. In Office rooms & Control rooms conduit shall be concealed type. Conduit fill criteria shall be 40%. Conduits should have the minimum number of bends in their run with pull boxes at suitable locations. Conduits shall be sloped & drained to avoid water accumulation & draining into the equipment at its end. Conduits shall be galvanized steel except in corrosive areas, where they shall be epoxy-painted.

#### **18.1.6.4 Lighting Panel -1 & Lighting Panel-2:**

Lighting Panel-1 & 2 shall be totally enclosed, sheet steel, indoor, dust-tight, vermin-proof proof and floor mounting type. The sheet metal thickness shall be 2mm. MLDBs shall be provided with separate chambers for (i) bus bars, (ii) outgoing feeders, (iii) incoming feeders (iv) cabling chamber. MLDBs shall have a degree of protection of IP-54 for indoor and IP-65 for outdoor installation.

AC distribution board (ACDB) shall be totally enclosed, sheet steel, indoor, dust-tight, vermin-proof proof and floor mounting type. The sheet metal thickness shall be 2mm. ACDB shall be provided with separate chambers for (i) bus bars (ii) outgoing feeders, (iii) incoming feeders, (iv) dry-type transformer (v) cabling chamber. ACDB shall have a degree of protection of IP-54 for indoor and IP-55 for outdoor installation. ACDB shall be provided with a 415/415V, 3-phase dry-type transformer of suitable capacity to obtain 3 3-phase, 4-wire system and to limit the fault level to 3KA. The capacity of the transformer shall be decided such that there is at least a 20% margin over the total lighting load.

MLDB & ACDB shall be provided with one TPN MCCB for the incomer feeder and the required number of 3-phase outgoing feeders with TPN MCBs and two Nos. Spare feeders. CT operated ammeters and a Voltmeter, and indicating lamps shall be provided for incomers.

#### **18.1.6.5 Lighting/Power Distribution Boards:**

For Lighting circuits, Lighting Distribution Boards (LDBs) shall be provided, and for welding receptacle circuits, separate Power Distribution Boards (PDBs) shall be provided.

LDBs shall be provided with one 63 Amp TPN MCB for the incomer and the required number of 20 Amp SPN outgoing feeders with MCBs with neutral links for each circuit distributed over three phases. Maximum lighting load on any one circuit shall be restricted to 1500 watts.

PDBs shall be provided with one 63 Amp TPN MCB with ELCB for the incomer and the required number of 32 Amp TPN outgoing feeders with MCBs with neutral links for each circuit distributed over three phases. Maximum welding receptacle load on any one circuit shall be restricted to 2000 watts.

#### **18.1.6.6 Receptacles:**

3-phase industrial-type welding receptacles shall be rated for 415V, 63 Amps with interlocking. switches, scrapping earth connection, male and female units, and cover. The protection class shall be IP-65.

1-phase Industrial type receptacles shall be rated for 240V, 20A Amps with interlocked switches, grounding earth connection, male and female units, and cover. The protection class shall be IP-65. 1-phase receptacles with switches shall be provided at each emergency portable lamp fitting.

All receptacles shall be provided with matching plug tops. All hardware shall be of Stainless steel type only, including the mesh of well glass luminaries, nuts, bolts, washers, etc.

#### **18.1.7 High Mast Lighting System:**

##### **18.1.7.1 General:**

The High Mast at the proposed locations in the plant area shall have adequate height to achieve the required illumination. The top level of high mast foundations shall be as per the approval from the engineer-in-charge. All High Masts of similar height shall be identical in construction to allow possible future relocation of High Masts within the area. A High Mast Switchboard is required to be installed at the base of each High Mast. The High Masts are expected to be fabricated out of steel.

The High Mast shall be designed for the number of light fittings determined by the Lighting Design based on the average 30 lux (with a minimum 20 lux) of illumination, plus two additional fittings to allow for possible future modifications/expansion. The High Mast shall be designed for the worst sail area resulting from the

most adverse configuration. The High Mast shall be designed to withstand loads from fabrication, handling, erection, and the dynamic loading outlined below.

#### **18.1.7.2 Design Criteria:**

The lighting design shall be in accordance with IS: 3646. The selection of lamps and luminaire types shall be based on high efficiency, good glare control, and the illuminance level required. Luminaires, mast, and brackets shall be selected to suit the harsh environmental conditions specified. Luminaires shall have a high power factor (0.85 or higher) control gear. Any apparatus, appliance, or material, or services which may be necessary to make the system complete and perfect in all respects, even if not particularly specified, shall be furnished, without any additional expense to the Employer. Details not usually shown or specified, but necessary for the proper installation and operation of the work, shall be included.

#### **18.1.7.3 Fittings:**

Lighting fittings selected shall be High Pressure Sodium type. Lighting fittings shall be full cut-off type to prevent stray light above 90 degrees.

#### **18.1.7.4 Light Switching Philosophy:**

Each High Mast shall have two separate circuits.

Security Lighting Circuit, controlling 20% of the light fittings on High Mast. This circuit shall be controlled by a photoelectric cell located in the substation so that the security lights turn on automatically depending on the preset solar radiation level. Manual override facility shall also be available in the switchboard located at the base of the high mast.

Main Lighting Circuit No. 1, controlling another 40% of the light fittings on High Mast. This circuit shall be push-button controlled from the system control panel. Manual override facility shall be available in the Switch Board located at the base of the High Mast.

Main Lighting Circuit No. 2, controlling another 40% of the light fittings on High Mast. This circuit shall be push-button controlled from the system control panel. Manual override facility shall be available in the Switch Board located at the base of the High Mast.

#### **18.1.7.5 Location of High Masts:**

High Mast locations shall be finalised by the contractor to match the lux level indicated in the specification. However, tentative locations of the High mast are shown in the Drawing attached to these specifications only for tender purposes.

#### **18.1.7.6 Detailed Lighting Plan:**

Detailed lighting distribution plans of the entire area, along with a Lux level plot plan, shall be provided for approval of the Employer by the successful contractor.

#### **18.1.7.7 High Mast Head frames:**

Each High Mast shall be fitted with a head frame, which shall be capable of being lowered and raised by means of a winch or other similar mechanical mechanism for the lowering and raising of the head frame. The winch shall be able to be operated by the use of a power tool. Each High Mast shall be provided with an internal power tool complete with a drive motor and drive assembly of suitable rating. The power for the drive motor of the power tool shall be from the respective high mast switchboard. The head frame shall be of durable steel construction fitted with light and gear fixings and a junction box. It shall be in a single piece for maximum strength. The head frame shall also act as an electrical conduit with cable holes protected by grommets. The head frame shall incorporate arrangements to prevent damage to the galvanizing of the High Mast.

#### **18.1.7.8 Mechanical Arrangement – Lowering and Raising Head frame (Ring) System:**

For installation and maintenance purposes, it is required that the head frame (ring) be able to be raised or lowered using a winch or approved lowering device to the base of the High Mast. The steel wire rope supporting the head frame shall be kept in balance and horizontal at all times. A device, suitably protected from corrosion, shall be incorporated to ensure that the tension rope cannot accidentally or manually be released without a service tool.

#### **18.1.7.9 Top Pulley Assembly – Lowering and Raising Head frame (Ring) System:**

The pulleys for the lowering and raising of the head frame system shall be of non-corrodible material and shall run on self-lubricating bearings with stainless steel axles. They shall be of sufficient diameter so as to enable multi-core flexible cables to be used. Arrangements shall be provided to ensure that the electric cables and steel wire ropes are separated before passing over their respective pulleys, and close-fitting guides shall protect the pulleys to prevent ropes and cables from leaving the pulley grooves. It is intended that there will be 2 cables from the High Mast Distribution Board at the base of the High Mast to the junction box on the head frame. Individual cables will then run from the junction box to each light fitting. This cabling arrangement will need to be considered in the design.

The pulleys shall be housed in a chassis integral with a sleeve which slips over the top of the High Mast and is secured axially and in azimuth. Guides and stops shall be provided for locking the head frame, and an anchor point shall be securely welded to the assembly to receive the safety maintenance equipment. The complete chassis assembly shall be hot-dip galvanized after fabrication.

The pulley assembly shall consist of safety brakes capable of immediately stopping the raising and lowering device, even in the extreme case of hoisting cables breaking.

The pulley assembly shall be protected by a galvanized steel/aluminium or other approved weatherproof cover.

#### **18.1.7.10 Winches – Lowering and Raising Head frame System:**

Winches shall be completely self-sustaining without the need for brakes, springs, or clutches that require adjustment, and shall be designed to be installed or removed through the door opening. Termination of the winch ropes shall not involve distortion or twisting of the rope structure. A minimum of four turns of the rope shall remain on the drum when the lantern carriage is fully lowered. Winch drums shall be grooved to ensure a tidy rope lay. A test certificate issued by an independent test house shall be supplied with each winch. The capacity and operating speed of the winch shall be clearly marked on each winch on an indelible label together with the Specification of the recommended lubricant. Each winch shall be supplied with a fitted canvas cover.

#### **18.1.7.11 Lightning Protection and Earthing System of High Mast:**

Each high mast shall be provided with a lightning protection and earthing system, which shall be installed and tested as per BS: 6651, BS:7430 and TR7, ILE, UK, and IS:2309 & IS: 3043.

#### **18.1.7.12 Openings:**

Any openings in the High Mast for the feeding of cables/stainless steel rope in and out of the High Mast require coverings/capping so as to prevent the intrusion of rainwater into the High Mast.

#### **18.1.7.13 Dynamic Loading:**

All High Masts shall be designed for maximum reaction arising from basic wind speed of 180 km/hr and factors K1, K2, K3 as per IS:875 (Part III) for design wind speed. The minimum design life shall be 30 years. High Masts shall be designed in accordance with the relevant Indian earthquake standard.

The design shall be such that wind-excited oscillations are damped as much as possible, and an adequate allowance shall be made for the stress due to these oscillations. The method of damping shall be stated. Full calculations of the forces involved shall be submitted for approval. The analysis shall show the resultant loadings, deflection, and stresses in all three principal axes at a minimum of 500 mm increments

over the total length of the High Mast. In addition, the High Mast structures shall have adequate strength to resist fabrication, handling, and erection loads without becoming overstressed or deflecting excessively.

#### **18.1.7.14 High Mast Construction:**

All steel used in the construction of the High Mast, including welding, shall comply with relevant Indian or British standards for Structural Steelwork. High Mast shall be constructed from mild steel plates of the grade and thickness as determined in the design. The minimum steel plate thickness shall be 6 mm. An appropriate corrosion allowance shall be used in the design. High mast shall be cut and folded to form a polygonal/circular section. Adjoining sections of the High Mast shall be joined by taper slip fit jointing. No site-welded joints will be permitted.

All High Masts shall have a close-fitting weatherproof door at the base with hinges and a heavy-duty lock. The lighting distribution board shall be placed inside the High Mast base at this location. The size of the door is expected to be approximately 1.00 m x 0.50 m in size but may vary according to each design. The bottom of the door shall be located at a height of 0.50 m from the underside of the base plate of the High Mast. The door opening shall be reinforced where required to prevent buckling.

The reinforcement being designed to suit the width of the door opening under the designing loading specified. Ten (10) sets of keys shall be provided for each type of lock.

The base plate shall be free from laminations, and the welded connection to the High Mast shall fully develop the strength of the section. In addition, supplementary gussets shall be provided between bolt holes. On the completion of fabrication, all High Masts and head frames shall be hot-dipped galvanized both internally and externally to a minimum thickness of 100 microns.

#### **18.1.7.15 Foundations:**

The design and layout of each type of High Mast shall be furnished. The design shall be based on the foundations not resting on bedrock & shall be carried to a depth of at least 2.0 m below final grade. Settlement shall not exceed 25 mm, unless specified otherwise, and the structural arrangement and design shall be such as to withstand such settlements. The top level of the concrete pedestal shall be as per the approval of the engineer-in-charge. The footings for the High Mast, including holding down anchor bolts with nuts and washers, shall be supplied and installed under this contract.

#### **18.1.7.16 Wire Ropes:**

The wire rope system shall be suitable for maintaining the lighting fixtures/control gear from the ground level in spite of the crash barriers around the mast. Wire ropes shall be flexible stainless-steel type. Thimbles and terminals shall be of compatible material. Ropes with hemp cores will not be permitted. In the event of failure of one rope, the other rope shall hold the lantern carriage.

#### **18.1.7.17 Materials:**

All materials shall comply with the relevant Indian or British Standards. All steel conduits, metal work, angle iron brackets, suspension rods, etc, shall be hot-dipped galvanized to a minimum thickness of 100 microns. Where galvanizing has been damaged, this shall be repaired with an approved two-pack zinc-rich epoxy finish.

#### **18.1.7.18 Luminaires:**

Luminaires shall be standard industrial type suitable for high-pressure sodium vapour SON-T lamps of 2x400 W/1x1000 W/1x400 W and shall have not less than 55000 lumens per 400 W lamp. The lighting fixture shall be waterproof, dust-proof, and suitable for a highly corrosive atmosphere. It shall be manufactured with die-cast aluminium, MBV-treated reflector, electronically brightened and anodized, IP 54 degree of protection, and conform to relevant IS specifications. The lamp shall be easily replaced from the rear without disturbing the aiming position. It shall be provided with stainless steel toggles, heat-resistant & toughened glass cover. Hardware used to install the fittings, control gearboxes, and for other

purposes shall be of stainless steel. The luminaries shall be tested as per the Indian Standard and shall be suitable for installation on a high mast.

#### **18.1.7.19 Aviation Light:**

GLS/LED-type aviation light shall be provided at each mast.

#### **18.1.7.20 Power Tools:**

This is a geared motor with a suitable torque limiter, industrial duty type. The motor is mounted on an MS hot-dip galvanized plate inside the mast, with the possibility of adjusting its position. However, the adjustment shall be so arranged that it cannot be altered easily during normal use of the tool at the site.

#### **18.1.7.21 High Mast Switch Boards (HMSB):**

These boards shall be free-standing pad-mounted type. The boards shall be designed for the number of circuits as required. The boards shall include miniature circuit breakers/ELCB, Contactor, ON-OFF Control Switch, and all other required accessories as required. The cubicle shall be designed for mounting over an RCC pad of 300 mm thickness minimum and shall be capable of withstanding the vibrations normally experienced due to vehicular traffic. The top cover of the enclosure shall have a slope to prevent the accumulation of rainwater. A gland plate shall be provided at the bottom of the switchboard. An incandescent lamp shall be provided inside the switchboard, with door switches on both doors, so as to switch 'ON' when the door is open.

The circuit wiring shall be as required. System control panel shall be fabricated out of CRCA sheets –2 mm thick for structural components and 1.6 mm thick for covers and doors & hot dip galvanized after fabrication. HMSB shall be fabricated out of stainless-steel grade 316 to prevent corrosion. HMSB shall be sized to allow for heat generated, and the design includes dissipation of heat and shall be IP 65 degree of protection plus canopy, whereas the system control panel shall have a minimum IP54 degree of protection. Each board/panel shall be provided with a hinged door with gaskets.

230V AC auxiliary and control supply, aluminium bus bars shall be provided through the control transformer of adequate capacity in HMSB. The Board/Panel shall have an earth bus bar running through the whole length of the board. All equipment mounted on the board shall be directly connected to this earth bus.

#### **18.1.7.22 Wiring:**

Wiring shall be complete in all respects so as to ensure proper functioning of control, protection, and interlocking schemes. Control wiring shall be of PVC-insulated stranded copper conductor of 2.5 sq mm cross-section. Each control wire shall be identified at both ends with wire designations in accordance with the relevant Indian Standards. All wire terminals shall be with compression or clamp-type connectors. Wires shall not be spliced or tapped between terminal points. Designation ferrules will be an interlocking type with the designation engraved with indelible ink. Not more than two wires shall be connected to one terminal. Power and control wires shall be neatly bunched, separately, and adequately supported so as to prevent sagging and strain on termination. Terminal blocks for power and control wiring shall be provided with adequate clearances.

#### **18.1.7.23 Component Specification of HMSB:**

##### **a) Contactors**

Contactors for AC shall be 3-pole air-break electromagnetic type suitable for making and breaking locked rotor current of the motor, which is equal to around six (6) times the full load current. Contactor shall have a minimum of 2 Nos. auxiliary contacts. Minimum rating of the power contactor shall be 16 Amps.

Contactors shall be suitable for uninterrupted duty as per IS 2959, and the utilization category shall be AC3 as per IS:4064. The contact material of the contactors shall have anti-weld properties. Insulation class of the operating coils shall be class E or better. Operating coils of AC contactors shall be suitable for 230 V +10%, 50 +3% Hz, AC supply. The contactors in general shall not drop out at voltage on and above 65% rated control supply voltage.

b) Photoelectric Switch

A photoelectric cell/switch operating on 230 Volt AC shall be provided for automatic group control switching operation based on solar radiation levels.

c) Auxiliary Contactors

The auxiliary contactors and no-volt relay will be provided as per the circuit requirement. The contact rating shall be 10 Amp for AC. The auxiliary contactors shall have at least 8 contacts in contact combinations as per the requirement.

d) Control Terminal Blocks

Control terminal blocks shall be of 650 volts grade, rated for 10 amps, and in one-piece moulding. It shall be complete with insulation barriers, clip-on type terminals, and identification strips. Marking on the terminal strip shall correspond to the terminal numbering on wiring diagrams. At least 20% spare terminals for connections shall be provided, and these spare terminals shall be uniformly distributed on all terminal blocks. All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5 mm<sup>2</sup> size stranded copper conductors. All terminals shall be numbered for identification and grouped according to function. Engraved white-in-black labels shall be provided on the terminal blocks. Wherever duplication of a terminal block is necessary, it shall be achieved by solid bonding links. Self-aligning, spring-loaded, silver-plated, sliding contacts for proven design shall be provided as control terminals for withdrawable / draw out modules. Detachable plug and socket-type control terminals shall also be acceptable.

e) Indicating Lamps

The indicating lamps shall be panel-mounted mounting large industrial cluster LED type and shall be interchangeable. Indicating lamps shall be with translucent lamp covers. The lamp covers shall be mounted flush on the front panel door and shall be replaceable from the front of the cubicle.

**18.1.7.24 Installation of Light Fittings:**

Mounting height of the centre line of the various lighting equipment from FFL/Working platforms or finished grade level shall be as noted below unless otherwise specified in the corresponding lighting layout drawings.

Lighting panels/control gear boxes: 1500 mm

Switch boxes: 1500 mm

Receptacle boxes (Indoor): 500 mm

Receptacle boxes (Outdoor): 1000 mm

JB on poles/Masts: 750 mm

Lighting fixtures to be mounted on ceilings/platforms having considerable vibrations, which can cause damage to the fixtures, shall be suitably supported with rubber pads to limit vibrations in the fixtures.

Where conduit wiring is adopted, an earth continuity conductor of 12 SWG galvanized steel wire shall be provided for earthing the lighting fixtures, switch boxes, etc. The earthing conductors shall be run along the entire length of the conduits and shall be securely connected and terminated at the junction boxes/control gear boxes/lighting panels. The earth connection shall be properly secured with bolts, nuts, and washers.

For outdoor lighting installations, an earth continuity conductor of at least 25 x 3 mm galvanized steel flat shall be used for earthing the lighting masts/poles.

While designing the lighting circuit, the cables shall be sized such that the farthest loop from the supply receives no less than 95% of its nominal voltage. In addition, it must be assumed that all the light fittings are energized while this design calculation is made. Fluorescent lights should be chosen & located carefully where they illuminate rotating shafts, so as to avoid the stroboscopic effect. Fittings made from Aluminium and its alloys should be avoided because the oxide that invariably forms after a time is considered a potential source of sparks caused by mechanical impact. All fittings shall be installed at a safe height for maintenance & effective illumination. All lighting controls shall be from a non-hazardous area, using double-pole switches; the supply neutral should be switchable along with the phase.

**18.1.7.25 Testing and Inspection:**

Equipment of the Illumination system should be type tested and a proven type. Type test certificates shall be furnished for the Purchaser's review. Equipment shall be subjected to routine tests as per the applicable Indian Standard. Test reports shall be submitted for approval.

#### **18.1.7.26 Spares:**

10% of the light fittings of various sizes used shall be supplied as spares.

#### **18.1.8 Power and Control Cables:**

Power cables shall be sized to satisfy the following Criteria:

- Short circuit withstand capacity for applicable fault current and duration.
- Full load current carrying capacity under installation conditions, considering Site ambient temperature & site installation (Grouping) conditions based on Manufacturer's recommendation.
- Permissible voltage drop limits under steady state/transient state as applicable.

Power cables shall withstand fault current of the circuit for a duration not less than the maximum time taken by the primary protective system to isolate the fault. Cables shall be sized for the following short circuit rating.

- Incoming cables to 415 V Panels (Breaker operated): 50 kA for 1 sec.
- Incoming cables to 415 V Panels (Breaker operated): 50 kA for 0.5 sec.
- Incoming cables to 415 V Panels (MCB protected): Fuse cut-off current for 10 m.sec
- Cables from 415 V Panels to Motors: 50 kA for 0.16 sec ACB operated
- Feeders from DB (MCB protected): Fuse cut-off current for 10 m.sec

To maintain voltage at motor terminals/equipment end within in desirable limit, it is proposed to limit the voltage drop in the cables within the following limits:

- Steady state Voltage drop (Continuous running condition): 2.5%
- Transient state voltage drop (During Motor Starting): 10 %

All cables shall be suitable for laying on racks, in ducts, trenches, with chances of flooding by water, and shall also be suitable for direct buried installation. All the cables shall be flame-retardant low-smoke (FRLS) type designed to withstand mechanical, electrical, and thermal stresses developed under steady-state and transient operating conditions.

The minimum size of LV power cable shall be 2.5 Sq.mm for Copper. Power cables shall have copper conductors for sizes up to 10 sq mm. For higher sizes, an aluminium conductor shall be provided. The minimum size of control cable shall be 1.5 Sq.mm copper. For CT/VT circuits, a minimum of 2.5 sq mm copper cable shall be provided. Conductor of Copper cables shall have plain annealed copper.

All the conductors shall be multi-stranded.

Power cables shall be XLPE-insulated. Control cables shall be PVC-insulated. PVC insulation shall be suitable for a continuous conductor temperature of 70°C and a short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for a continuous conductor temperature of 90°C and a short circuit conductor temperature of 250°C.

The cable cores shall be laid up with fillers between the cores wherever necessary. All the cables shall have a distinct extruded PVC inner sheath. For single-core armoured cables, armouring shall be of aluminium wire. For multicore armoured cables, armouring shall be of galvanized steel strip/wire as per applicable IS. Outer sheath shall be of PVC black in colour, having the following FRLS properties.

- Oxygen index of not less than 29.
- Acid gas emission of max. 20%
- Smoke density of not more than 60%

The cables shall meet the flammability test as per IEEE-383. All the cables shall be protected against rodent and termite attack. Necessary chemicals shall be added to the PVC compound of the outer sheath.

#### **18.1.8.1 Construction:**

HT Cables:

Cables shall be XLPE insulated, screened, PVC inner sheathed (extruded), armoured, FRLS PVC outer sheathed, compacted aluminium conductor conforming to IS: 7098 Part-II. 11kV cables shall be suitable

for an unearthed system. The conductor screen and insulation screen shall both be of extruded semi-conducting compound and shall be applied along with the XLPE insulation in a single operation of the triple extrusion process. The metallic screen of each core shall consist of copper tape with a minimum overlap of 20% copper screen, which shall be capable of carrying the system earth fault current for 2 seconds. Outer sheath shall be FRLS PVC.

LV Power Cables:

LV Power cables shall be of 1.1 kV grade, XLPE insulated, PVC inner sheathed (extruded), armoured, FRLS PVC outer sheathed, compacted aluminium conductor conforming to IS: 7098 Part-I.

Control Cables:

Control cables shall be of 1.1 kV grade, multi-core, PVC-insulated, PVC inner-sheathed, armoured, FRLS PVC outer-sheathed stranded copper conductor conforming to IS:1554 Part-I. Up to 5 cores shall be colour-coded, and above 5 cores shall be numbered.

Trailing cables:

Trailing cables / Flexible cables shall be rubber-insulated with copper conductor as per applicable standards. The minimum size of LV power cable shall be 4 Sq.mm for Copper.

#### **18.1.8.2 Cable identification system:**

In addition to the manufacturer's identification on cables as per IS, the following marking shall also be embossed over the outer sheath.

- Cable size and voltage grade.
- Word 'FRLS' at every 5 meters.
- Sequential marking of the length of the cable in meters at every meter.

The embossing shall be progressive, automatic, in line, and marking shall be legible and indelible.

#### **18.1.8.3 Cable Drums:**

Cables shall be supplied in wooden or steel drums of heavy construction. The surface of the drum and the outermost cable layer shall be covered with a waterproof layer. Both ends of the cables shall be properly sealed with heat-shrinkable PVC/rubber caps, secured by 'U' nails so as to eliminate ingress of water during transportation, storage, and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS 10418.

#### **18.1.9 Cabling, Earthing & Lightning Protection System:**

This specification covers the requirements of cable trays, support structures, cable laying, termination, earthing, and lightning protection systems.

While finalizing Cable routing layouts, consideration shall be given to the requirements of Safety, Reliability and Convenience of cable laying and termination. Where duplicate drives/auxiliaries are provided for reliability, cable routing shall be segregated to the extent practically possible.

In cable trenches, the distance between the bottom-most tier and the bottom of the trench shall be 150 mm, and the clearance from top top-most tray to the top of the trench cover shall be 400 mm. The distance between two tiers shall be a minimum of 250 mm. PCC flooring of built-up trenches shall be sloped in longitudinal and also in transverse directions for an effective drainage system. Cables should not be laid directly on the trench floor. Cable trenches should be provided with strong & effective covers with water & fireproof sealing arrangement at trench entry & exit points.

Other than cable vaults & cable trenches, Cable trays shall be laid in vertical formation to avoid dust accumulation in areas. In the cable spreader room, a clear access passage of at least 800 mm wide shall be provided along the cable ways. Wherever passage is through cable routes, a clear height of not less than 2.0 M shall be provided.

Cables of different voltages shall be laid in separate racks. Minimum distance of 250 mm shall be maintained along the routes between various types of cables. In case of horizontal formation, the highest voltage cables shall be laid in the top-most position in the tray stack, followed by other grades as follows in descending order.

- 1.1kV Power cables (Top Tier)

- Electrical Control Cables (Below LT Tier)
- Instrumentation/Signal cables (Bottom-most tier)

On cable trays, all the multi-core power cables can be laid in a touching formation. Single-core cables shall be laid in trefoil formation with the spacing equal to twice the diameter of the cable. Control cables shall be laid in not more than two layers. Power & Control cables shall be laid on ladder-type trays. Instrumentation & Signal cables shall be laid on perforated type trays. Cable trays shall be of galvanized steel. Cable trays shall be supported at an interval of approximately 1500 mm. Vertical runs shall be supported at an interval of approximately 1000 mm. Cable tray support system shall be of site-fabricated, welded, and painted steel supports. Cable tray support system shall consist of ISMC channel as vertical support & ISA as a horizontal arm. The horizontal arm is welded to the vertical support MS channel. Cables shall be terminated using double compression cable glands suitable for the voltage grade of cables. Cable glands shall be heavy-duty brass. Cable lugs for power and control cables shall be tinned copper, solderless crimping type conforming to IS 8309.

Fire barriers/ Fire stops shall be provided for all fire-rated wall and floor penetrations and for all direct cable entries into electrical Switchgear / Panels from the Cable Vault. Fire barriers/ Fire stops shall provide a fire endurance rating of at least 2 hours. The fire sealing material shall be non-hygroscopic, mechanically steady, non-toxic, and physically & chemically stable under fire conditions. Fire barriers/ Fire stops shall be either of the following methods:

- Panel sealing method comprising Encasing Panels, Cavity fill material & Sealant
- Mortar sealing method comprising Mixing Mortar with water.

#### **18.1.9.1 Design and Construction of Cable Trays:**

Cable trays shall be ladder/perforated type as specified prefabricated made out of Fibre Reinforced Plastics (FRP) complete with matching fittings (like elbows, bends, reducers, tees, crosses, etc.), accessories (like side coupler plates, Tray cover etc.) and hardware (like bolts, nuts, washers, GI strap, hook, etc.) as required. The size of the trays shall be selected on the basis of a maximum 50% fill criterion. Cable trays shall be standard widths of 150mm, 300mm, 450mm & 600mm. The thickness of side coupler plates shall be a minimum of 2.5mm, and of tray covers shall be a minimum of 1.6mm. A Cable Trough shall be required for branching out a few cables from the main cable route. These shall also be fabricated of FRP of a minimum thickness of 3mm. Troughs shall be of standard width of 50mm & 75mm, and 25mm height.

#### **18.1.9.2 Design and Construction of Conduits/Pipes, Fittings & Accessories:**

Conduits/pipes offered shall be complete with fittings and accessories (like tees, elbows, bends, check nuts, bushings, reducers, enlargers, coupling caps, nipples, etc.). The size of the conduit/pipe shall be selected based on a maximum 40% fill criterion. Hume pipes shall be of reinforced concrete conforming to class NP3 for road crossings as per IS: 458. GI pipes shall be of medium duty as per IS: 1239.

Rigid steel conduits conforming to IS: 9537 Part I & II shall be suitable for heavy mechanical stresses, threaded on both sides, and the threaded length shall be protected by zinc-rich paint. Conduits shall be smooth on the inside and outside. Fittings and accessories shall also be hot-dip galvanized.

Flexible conduits where required, near equipment terminations, shall be made with bright, cold-rolled, annealed, and electro-galvanized mild steel strips. Flexible conduits shall be supplied with a suitable end coupler nipple and check nut. In corrosive areas, epoxy-coated conduits shall be provided.

#### **18.1.9.3 Cabling Installation:**

The work shall be carried out in the best workmanlike manner in conformity with the relevant specifications/code of practices of the Bureau of Indian Standards. In addition, work shall also conform to the requirements of the latest editions/amendments of the following:-

Indian Electricity Act and rules framed thereunder.

- Fire Insurance Regulations
- Regulations laid by the office of the Chief Electrical Inspector to the Government.

- Any other regulations laid down by the local authorities.

Support system shall be so designed that it is able to withstand the weight of the cable trays, the Weight of the cables (75 Kg/metre run of each cable tray), Concentrated load of 75 Kg between every support span without any permanent deflection. Factors of safety of at least 1.5 shall be considered. Cable tray mounting structure shall be welded/bolted to the plate inserts or to the steel structure, and the type of welding shall be of fillet type of at least 6mm size.

All cable way sections shall have identification, designations as per cable way layout drawings, and be painted/stencilled at each end of the cable way and where there is a branch connection to another cable way. Minimum height of letter shall be not less than 75mm. For long lengths of trays, the identification shall be painted at every 10 meters. Risers shall additionally be painted/stencilled with identification numbers at every floor. Tray covers shall be provided for overhead cable trays on top top-most tier. The cable risers or vertical raceways shall also be covered by cable tray covers up to 1.5 metres from the respective floor for mechanical protection. The sheet cover shall be of a removable type.

#### **18.1.10 Lightning Protection System:**

A lightning protection system shall be provided for all the buildings and structures covered under the Scope as per the provisions contained in the latest issues of the Indian Electricity Rules and IS 2309. Lightning protection system shall comprise air terminations, down conductors, test links, earth terminations & earth electrodes.

Material for the lightning protection conductor shall be as follows:

- 75 x 8 mm Galvanized steel strip for interconnection between the various earth pits and riser.
- 50 x 6 mm Galvanized steel strip for Horizontal Air termination & Down Conductors.
- 20 mm dia 1000 mm long Galvanized steel rod for Vertical air termination.
- 40 mm dia 3 m long Galvanized Steel pipe of 6mm thickness with an earth pit for Earth termination.
- 25 x 6 mm Galvanized steel strip for horizontal conductor on the roof along the periphery of the parapet wall.

Air termination network shall consist of vertical or horizontal conductors or a combination of both. Down conductors should follow the most direct path possible between the air terminal network and the earth termination network. The down conductors should be arranged as evenly as practicable around the outside walls of the structure. Each down conductor shall be provided with a test link for testing. An earth electrode with a treated earth pit shall be connected to each down conductor.

#### **18.1.11 Closed Circuit Television:**

The contractor shall design, supply, install, test, and commission of Closed-Circuit Television as per the requirements. The Closed-Circuit Television (CCTV) System shall provide video surveillance and recording functions for the operators to monitor all the sensitive areas. Two types of cameras shall be provided: (i) Fixed cameras with a fixed focal length lens and fixed orientation. (ii) Pan/Tilt/Zoom (PTZ) cameras with a variable focal length lens with adjustable orientation in both the vertical and horizontal directions.

#### **18.1.12 Data Network:**

The contractor shall design, supply, install, test, and commission of data and networking for the plant as per the requirements. Data Network 13.4.1 Ethernet IP network as per IEEE 802.11, including both wired and wireless components, and redundancy for high reliability and availability shall be designed and maintained across the Port for data transmission between different equipment, control centres, administration, and gate systems. 13.4.2 Fast Ethernet/Ethernet Network – the characteristics of LAN and WAN cables shall follow ISO/IEC 88023.

#### **18.1.13 List of Recommended Spares:**

List and item-wise prices for recommended spares and special tools for both external and internal illumination, Spares for Panel Boards, HT/LT and control cables, Internal wiring, lightning protection, CCTV, and Data network shall be submitted by the contractor. The purchaser shall purchase only those that are considered necessary.

#### **18.1.14 Testing and Inspection:**

Equipment offered shall be of a type tested and proven. Type test certificates for tests conducted earlier on a similar rating shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards.

##### **18.1.14.1 D. G Set:**

###### **1. Test at Manufacturer Works:**

The routine Tests and Full load test on the Engine, Alternator shall be carried out at the manufacturer's works in accordance with applicable Indian and international standards in the presence of the Engineer/Client Representative.

###### **2. Test at Site:**

The following test shall be conducted at the site in the presence of the Client representative before tenderisation. The contractor shall provide all testing equipment, labour, and consumables required for the testing.

Testing of the DG test shall be strictly in accordance with ISO 8528, all parts.

Checking the alignment by the engine manufacturer's representative and obtaining approval.

Insulation resistance on alternator, control panel, and cabling/Bus bar trucking.

Checking the AMF operation both on auto and manual mode.

Checking AVR operation.

Checking the engine safety for satisfactory operation.

Checking the vibration level.

Testing of individual protective devices on the engine and alternator, and ensuring that the wiring is carried out properly.

Full load run test for 8 hours continuously. All the readings shall be logged to evaluate the fuel consumption, lube oil pressure, water, and oil temperature vis-à-vis the electrical load.

The noise level at one meter from the enclosure and the temperature rise inside the enclosure shall be measured.

Any deviation from the guaranteed technical particulars shall be made good, and these performance parameters shall be measured once again till the required results are achieved.

The DG set is deemed to be commissioned after satisfactory performance of all associated equipment.

##### **18.1.14.2 LT Panels:**

###### **1. Test at Manufacturer Works:**

###### **Type Test:**

Bidder shall furnish copies of type test certificates for all tests indicated below, along with the bid conducted on switch boards.

Short-term current test.

Temperature rise test.

One minute power frequency voltage with a stand test.

###### **Routine Test:**

Mechanical operation test

Dielectric test

###### **Inspection Test:**

The inspection shall consist of the following, but shall be limited to the same.

Appearance and construction.

Dimension and mounting details.

Feeder arrangement and feeder details.

Door alignment and gaskets, etc.

Alignment of switch drive and handle.

Bus bar Resistance: Bus bar joint resistance shall be measured with a calibrated joint resistance tester as per the relevant IS.

Insulation Resistance: The insulation resistance shall be measured between phases to earth. The insulation resistance shall be measured with a 1000V megger. The insulation resistance shall not be less than 50 Mega Ohms in any case.

High Voltage Test: The test shall be carried out by applying a voltage of 2.5KV for one minute.

- Between all phases and earth
- Between the phases

Operation test:

- ON/OFF operation of switches, contactors, indication lamps, tripping of contactors, etc., shall be checked.

- Breaker testing and Breaker details: Breaker operation shall consist of, but not be limited.

- 1. Manual closing/Tripping
- 2. Electrical closing and tripping
- Breaker tripping through releases.

2. Test at Site: The breaker operation shall be checked in test position as follows.

Manual closing and tripping,

Breaker tripping through releases/relays,

Interlocks-protective releases/relays and breaker tripping time shall be set as specified,

Emergency trip,

ON/OFF Indication,

Breaker annunciation and indication,

Scheme interlocks checks,

#### **18.1.14.3 APFC Panels:**

Inspection Test

The inspection shall consist of the following, but shall not be limited to the same.

- Appearance and construction.
- Dimension and mounting
- Meter ranges and name plates etc.
- Wiring etc.

The following routine test shall be carried out as per IS 2834.

- Test for output and capacitance
- Voltage test between the terminal and the container (for the capacitor unit).
- Voltage test between the terminal and earth (for the capacitor bank).
- Insulation resistance test.
- Test for the efficiency of the discharge device

#### **18.1.14.4 Lighting Power and Distribution Board:**

Inspection and Testing

Inspection shall consist of the following, but shall not be limited to the same.

- Appearance and construction.
- Dimension and mounting
- Meter ranges and name plates etc.
- Feeder arrangement and feeder details
- Door alignment and gasket etc.

Test:

The following test shall be carried out.

Insulation Resistance: The insulation resistance shall be measured between phases to earth. The insulation resistance shall be measured with a 1000V megger. The insulation resistance shall not be less than 5 Mega Ohms in any case.

High Voltage Test: The test shall be carried out by applying a voltage of 2.5KV for one minute.

- Between all phases and earth
- Between the phases
- Between phases and neutral
- Routine test as per IS and heat run test (type test) shall be carried out on the panel.

#### 18.1.14.5 Lighting Installation:

Testing of Installation:

Before installation is put in service, the following tests shall be completed.

Insulation Resistance: The insulation resistance shall be measured between phases to earth. The insulation resistance shall be measured with a 1000V megger. The insulation resistance shall not be less than 5 Mega Ohms in any case.

Testing earth continuity path:

The earthing conductor shall be tested for electrical continuity, the electrical resistance of the same, along with the earthing lead from connection with the earth electrode to any point, in earth continuity conductor in the complete installation shall be less than one ohm.

Testing of the polarity of a single-pole switch:

The test shall be made to verify that all single-pole switches have been fitted between the phase conductors and the light/fan/socket outlet:

#### 18.1.14.6 Cables:

Cables offered shall be of type-tested and proven type. Type test certificates for tests conducted earlier on a similar rating shall be furnished. Routine tests, Acceptance tests, and all special tests for FRLS properties shall be carried out for all the cables as per applicable standards. The sample shall be drawn at the rate of one per type and size for every lot offered for inspection.

Special Tests

The following tests as applicable to FRLS sheathed cables, shall be conducted as type tests on each size of each lot.

- Oxygen index test
- Temperature index test
- Acid gas generation during fire
- Smoke generation test under fire
- Swedish chimney test for class F3 as per SS: 4220 14: 75
- Under fire conditions for bunched cables as per IEEE std. 383 / 74

#### 18.1.14.7 Earthing:

SITE TEST:

The following earth resistance values shall be measured with an approved and calibrated earth tester and recorded.

- Each earth grid, earth mat, earth pit, piles earth
- Earth continuity and bonding conductors
- Earthing system as a whole

#### 18.2 List of Approved Makes:

S. No.	Equipment / Component	Preferred Makes
1	LT Switchgear	ABB / Siemens / Schneider / L&T
2	Distribution Boards	L&T / Siemens / Schneider / ABB / Indo Asian Technocommerce / Milestones / Pyrotech
3	HT & LT Power cables	Universal / Nicco / CCI / Fort Gloster
4	Copper Wires PVC FRLS	Skytone / Echo Cables / BatraHenlay / National / Finolex / Polycab

5	Cable Glands/Lugs	Jainsons / Dowells / Gripwell / SMF
6	Cable Trays	Ercon / Indiana / Industrial Perforation / Sintex / MM Engineering / Pilco / Parekh
7	LT Capacitor Bank	L&T / Siemens / Epcos / Mehar / ABB / Crompton / Asian / Universal / Madhav
8	Battery	Exide / Amco / Amara Raja / Chloride / Standard
9	Battery Charger with DCDB	Chhabi Electricals / Caldyne / Mastek / DB Electronics
10	Diesel Generator Set	Powerica / Jakson / Kohler / Greaves
11	Lighting fixture	Bajaj / Philips / Crompton / GE Lighting / Wipro
12	High mast	Bajaj / CGL
13	Plate-Switches & Sockets, Boxes	MK / Crabtree (Havells) / Anchor
14	GI Conduit with accessories	BEC / AKG / SENCO / Jindal
15	MCCB	Siemens / L&T / ABB / Schneider
16	MCB / ELCB / RCB / MPCB	Siemens / L & T / MDS / Schneider / Havells
17	Fuse/Link	Siemens / L&T / Alstom / Schneider / C&S / Areva
18	Switch Fuse Units	Siemens / L&T / Havell's
19	Contactors	Siemens / L&T / ABB / Schneider
20	Indicating Lamps / Push buttons	Siemens / Schneider / Teknik / Kaycee / L&T / Essen / Vaishnav / BCH / C&S
21	Push button stations	Siemens / Schneider / Teknik / Rishabh / L&T / BCH / Control Group
22	Meters(digital) MFM	Schneider (Conzerv) / L&T / Secure
23	Voltmeter / Ammeter / PF Meter / Frequency Meter/ KWH Meter	AE I/ IMP / MECO / INDCOIL / Enercon / L&T / Rishab / Siemens / Industrial Meters
24	Selector Switch	L&T / Siemens / Schneider / Kaycee / Salzer / C&S / Vaishnav
25	Auxiliary Contactors/ Relays	L&T / Siemens / BCH
26	Overload Relays (Hand Reset Type)	L&T / Siemens / BCH / Telemachanique
27	Protective / Auxiliary Relays	Alstom / Schneider / Siemens / EasunReyroll / ABB / Telemachanique / L&T
28	Time Delay Relays	BCH/Siemens/L&T/English Electric
29	Power Contactor with 2NO+2NC	L&T / Siemens / Telemachanique
30	Timer	Siemens / L&T / BCH / Schneider
31	Terminal Blocks	Elmex / Connect Well
32	Current Transformer/ Potential Transformer	AE / Kappa / L&T / Siemens / Pragati / C&S / Jyoti
33	Plugs & Sockets	Havells / Legrand / Hense
34	Welding Sockets	B&C / BCH
35	COMMUNICATION System	BPL / Siemens / Bharti / Tata Telecom
36	PVC Conduit and accessories	BEC / Polypack / Precision /AKG
37	Cable Termination Kits & Straight Through Joints	Raychem / M-Seal (3M)

## 20. ANNEXURES

### Annexure-I

**Guidelines of the Department of Disinvestment** (Refer clause 3.2.1)  
Government of India, Department of Disinvestment No. 6/4/2001-DD-II  
Block 14, CGO Complex, New Delhi.  
Dated 13th July, 2001.

Sub: Guidelines for qualification of Bidders seeking to acquire stakes in Public Sector Enterprises through the process of disinvestment

The government has examined the issue of framing comprehensive and transparent guidelines that define the criteria for Bidders interested in PSE disinvestment, so that the parties selected through competitive bidding can inspire public confidence. Earlier, criteria like net worth, experience, etc., were prescribed. Based on experience and in consultation with concerned departments, the Government has decided to prescribe the following additional criteria for the qualification/ disqualification of the parties seeking to acquire stakes in public sector enterprises through disinvestment:

- (a)** Regarding matters other than the security and integrity of the country, any conviction by a Court of Law or indictment/ adverse order by a regulatory authority that casts a doubt on the ability of the Bidder to manage the public sector unit when it is disinvested, or which relates to a grave offence, would constitute disqualification. Grave offence is defined to be of such a nature that it outrages the moral sense of the community. The decision in regard to the nature of the offence would be taken on a case-by-case basis after considering the facts of the case and relevant legal principles, by the Government of India.
- (b)** Regarding matters relating to the security and integrity of the country, any charge-sheet by an agency of the Government/ conviction by a Court of Law for an offence committed by the Bidding party or by any sister concern of the Bidding party would result in disqualification. The decision in regard to the relationship between the sister concerns would be taken based on the relevant facts and after examining whether the two concerns are substantially controlled by the same person/ persons.
- (c)** In both (a) and (b), disqualification shall continue for a period that the Government deems appropriate.
- (d)** Any entity that is disqualified from participating in the disinvestment process would not be allowed to remain associated with it or get associated merely because it has preferred an appeal against the order based on which it has been disqualified. The mere pendency of the appeal will not affect the disqualification.
- (e)** The disqualification criteria would come into effect immediately and would apply to all Bidders for various disinvestment transactions, which have not been completed as yet.
- (f)** Before disqualifying a concern, a Show Cause Notice explaining why it should not be disqualified would be issued to it, and it would be allowed to explain its position.
- (g)** Henceforth, these criteria will be prescribed in the advertisements seeking Expression of Interest (EOI) from the interested parties. The interested parties would be required to provide the information on the above criteria, along with their Expressions of Interest (EOI). The Bidders shall be required to provide with their EOI an undertaking to the effect that no investigation by a regulatory authority is pending against them. In case any investigation is pending against the concern or its sister concern or against its CEO or any of its directors'/Managers/ employees, full details of such investigation including the name of the investigating agency, the charge/ offence for which the investigation has been launched, name and designation of persons against whom the investigation has been launched and other relevant information should be disclosed, to the satisfaction of the Government. For other criteria, also, a similar undertaking shall be obtained along with EOI.

sd/-

(A.K. Tewari)

Under Secretary to the Government of India

**Letter comprising the technical bid (Refer to clause 3.2.1)**

To  
The Chief Engineer  
Syama Prasad Mookerjee Port,  
6, Strand Road  
Kolkata – 700 001

**Sub:** : Tender For Engineering, Procurement and Construction for Development of Off- Dock Container Stacking Yard at Loco Shed Area of KDS , Syama Prasad Mookerjee Port, Kolkata.

Dear Sir,

1. With reference to your Tender document, I/we, having examined the Bidding Documents and understood their contents, hereby submit my/our Bid for the aforesaid Project. The Bid is unconditional and unqualified.

2. I/ We acknowledge that the Authority will be relying on the information provided in the Bid and the documents accompanying the Bid for the selection of the Contractor for the aforesaid Project, and we certify that all information provided in the Bid, along with the supporting documents, are true and correct; nothing has been omitted which renders such information misleading; and all documents accompanying the Bid are true copies of their respective originals.

3. This statement is made for the express purpose of our selection as EPC Contractor for the development, construction of the aforesaid Project and rectification of defects in the Project during the Defect Liability Period.

4. I/ We shall make available to the Authority any additional information it may find necessary or require to supplement or authenticate the Bid.

5. I/ We acknowledge the right of the Authority to reject our Bid without assigning any reason or otherwise, and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.

6. I/ We certify that in the last three years, we/ any of the {Consortium/Joint Venture} partners have neither failed to perform for the works of any Authority, as evidenced by imposition of a penalty by an arbitral or judicial authority, nor a judicial pronouncement or arbitration award against us, nor been expelled or terminated by any Ministry or its implementing agencies for breach on our part.

7. I/ We declare that:

(a) I/ We have examined and have no reservations about the Bidding Documents, including any Addendum issued by the Authority; and

(b) I/We do not have any conflict of interest in accordance with Clauses 4.2.1 (c) and 4.7.4 of the Tender documents; and

(c) I/We have not directly or indirectly or through an agent, engaged or indulged in any corrupt practice, fraudulent practice, coercive practice, undesirable practice or restrictive practice, as defined in Clause 8.3 of the Tender document, in respect of any tender or request for proposal issued by or any Agreement entered into with the Authority or any other public sector enterprise or any government, Central or State; and

(d) I/ We hereby certify that we have taken steps to ensure that in conformity with the provisions of Section 8 of the Tender, no person acting for us or on our behalf has engaged or will engage in any corrupt practice, fraudulent practice, coercive practice, undesirable practice, or restrictive practice; and

(e) The undertakings given by us along with the Bid in response to the Tender for the Project were true and correct as on the date of making the Bid and are also true and correct as on the Bid Due Date, and I/we shall continue to abide by them.

8. I/ We understand that you may cancel the Bidding Process at any time and that you are neither bound to accept any Bid that you may receive nor to invite the Bidders to Bid for the Project, without incurring any liability to the Bidders, in accordance with Clause 4.7,5 of the Tender document.

9. I/We believe that we/our {Consortium/Joint Venture} satisfy(s) the Technical Capacity, Financial Capacity and meet(s) the requirements as specified in the Tender document.

10. I/ We declare that we/ any member of the {Consortium/Joint Venture} or our/ {Consortium/Joint Venture member}, are not a member of any other Consortium/Joint Venture submitting a Bid for the Project.

11. I/ We certify that regarding matters other than security and integrity of the country, we/ any member of the {Consortium/Joint Venture} or any of our/their {Consortium/Joint Venture} member have not been convicted by a Court of Law or indicted or adverse orders passed by a regulatory authority, which could cast a doubt on our ability to undertake the Project, or which relates to a grave offence that outrages the moral sense of the community.

12. I/ We further certify that, regarding matters relating to the security and integrity of the country, we/ any member of the {Consortium/Joint Venture} or any of our/their {Consortium/Joint Venture} member have not been charge-sheeted by any agency of the Government or convicted by a Court of Law.

13. I/ We further certify that no investigation by a regulatory authority is pending either against us/any member of {Consortium/Joint Venture}, or against our CEO or any of our directors/ managers/ employees.

14. I/ We further certify that we are not disqualified in terms of the additional criteria specified by the Department of Disinvestment, a copy of which forms part of the Tender at Annexure-I thereof.

15. I/ We undertake that in case of any change in facts or circumstances during the Bidding Process, we are attracted by the provisions of disqualification in terms of the guidelines referred to above, we shall inform the Authority of the same immediately.

16. I/We further acknowledge and agree that in the event such a change in control occurs after signing the Agreement, up to its validity. It would, notwithstanding anything to the contrary contained in the Agreement, be deemed a breach thereof, and the Agreement shall be liable to be terminated without the Authority being liable to us in any manner whatsoever.

17. I/ We hereby irrevocably waive any right or remedy which we may have at any stage at law or howsoever otherwise arising to challenge or question any decision taken by The Authority in connection with the selection of the Bidder, or in connection with the Bidding Process itself, in respect of the above-mentioned Project and the terms and implementation thereof.

18. In the event of my/ our being declared as the Selected Bidder, I/we agree to enter into an Agreement in accordance with the Tender condition that has been provided to me/us before the Bid Due Date. We agree not to seek any changes in the aforesaid Tender and agree to abide by the same.

19. I/ We have studied all the Bidding Documents carefully and also surveyed the [project]. We understand that, except to the extent as expressly outlined in the Tender, we shall have no claim, right or title arising out of any documents or information provided to us by the Authority or in respect of any matter arising out of or relating to the Bidding Process, including the award of the Agreement.

20. I/ We offer a Bid Security of **Rs. XXXXXXXXX (Rupees. XXXXXXXX)** (the "Bid Security") to the Authority in accordance with the Tender Document.

21. The Bid Security in the form of a Bank Guarantee/Bank Draft/Banker's Cheque/Demand Draft/Pay Order, etc., and a scanned copy is attached.

22. The documents accompanying the Technical Bid, as specified in the Tender, have been submitted in separate files.

23. I/ We agree and understand that the Bid is subject to the provisions of the Bidding Documents. In no case, I/we have any claim or right of whatsoever nature if the project/Contract is not awarded to me/us, or our Bid is not opened or rejected.

24. The Bid Price has been quoted by me/us after taking into consideration all the terms and conditions stated in the Tender, our own estimates of costs, and after a careful assessment of the site and all the conditions that may affect the project cost and implementation of the project.

25. I/ We agree and undertake to abide by all the terms and conditions of the Tender document.

26. I/We, the {Consortium/Joint Venture} agree and undertake to be jointly and severally liable for all the obligations of the EPC Contractor under the Contract Agreement.

27. I/ We shall keep this offer valid for 120 (one hundred and twenty) days from the Bid Due Date as specified in the Tender.

28. I/ We hereby submit our Bid for undertaking the aforesaid Project in accordance with the Bidding Documents.

29. I/We have read the clause regarding restriction on procurement from a bidder of a country which shares a land border with India and certify that I am/We are not from such a country or, if from such a country, have been registered with the competent Authority. I/We hereby certify that I/we fulfil all the requirements in this regard and am/are eligible to be considered (evidence of valid registration by the competent authority is enclosed).

30. I/we certify that I/we, the tenderer(s) is/are not blacklisted or debarred by Port or any other Organization/Department of the Government of India from participation in the tender on the date of submission of bids either in individual capacity or as a HUF/ member of the partnership firm LLP/JV/Society/Trust.

31. I/we understand that if the contents of this Appendix submitted by us or found to be forged/false, or incorrect at any time during the process for evaluation of tender, it shall lead to forfeiture of the Bid Security and may also lead to any other action provided in the contract, including banning of business for a period of up to two years. Further, I/we (insert name of the tenderer) and all my/our constituents understand that my/our offer shall be summarily rejected.

32. I/we also understand that if the contents of this Appendix submitted by us are found to be false/forged or incorrect at any time after the award of the contract, it will lead to termination of the contract, along with forfeiture of Bid Security/ Security Deposit and Performance guarantee and may also lead to any other action provided in the contract including banning of business for a period of up to two years.

In witness whereof, I/we submit this Bid under and in accordance with the terms of the RFP document.

Yours faithfully,

Date:

(Signature, name, and designation  
of the Authorised signatory)

Place:

Name & seal of Bidder/Lead Member

**Tenderer's credentials (bid capacity) (Refer clause 4.2.2.3)**

For tenders having an advertised value more than Rs 20 crore wherein the eligibility criteria include bid capacity also, the tenderer will be qualified only if its available bid capacity is equal to or more than the total bid value of the present tender. The available bid capacity shall be calculated as under:

Available Bid Capacity =  $[A \times N \times 2] - 0.33 \times N \times B$  Where,

A = Maximum value of construction works executed and payment received in any one of the previous three financial years or the current financial year (up to date of inviting tender), taking into account the completed as well as works in progress.

N Number of years prescribed for completion of work for which bids have been invited.

B = Existing commitments and balance amount of ongoing works with the tenderer as per the prescribed proforma of the Tender for statement of all works in progress, and also the works which are awarded to the tenderer but have not yet been started up to the date of inviting of tender.

Note:

(a) The Tenderer(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 or the current financial year (up to date of inviting tender) for calculating A, and

(ii) Existing commitments and balance amount of ongoing works with the tenderer as per the prescribed proforma of the Tender for statement of all works in progress and also the works which are awarded to the tenderer but have not yet been started up to the date of inviting of tender for calculating B. In case of no work in hand, a 'NIL' statement should be furnished.

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

(b) In case a bidder is a JV, the tenderer(s) must furnish the details of

(i) Maximum value of construction works executed and payment received in any one of the previous three financial years or the current financial year (up to date of inviting tender) by each member of JV for calculating A, and

(ii) Existing commitments and balance amount of ongoing works with each member of JV either in individual capacity or as a member of other JV as per the prescribed proforma of the Tender for statement of all works in progress and also the works which are awarded to each member of JV either in individual capacity or as a member of other JV but yet not started up to the date of inviting of tender for calculating B. In case of no work in hand, a 'NIL' statement should be furnished. The submitted details for (i) and (ii) above should be duly verified by a Chartered Accountant

(c) Value of a completed work/work in progress/work awarded but yet not started for a Member in an earlier JV shall be reckoned only to the extent of the concerned member's share in that JV for the purpose of satisfying his/her compliance with the above-mentioned bid capacity in the tender under consideration.

(d) The arithmetic sum of the individual "bid capacity" of all the members shall be taken as JV's "bid capacity".

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

(f) The available bid capacity of the tenderer shall be assessed based on the details submitted by the tenderer. In case the available bid capacity is less than the estimated cost of work put to tender, his offer shall not be considered even if he has been found eligible in other eligibility criteria/tender requirements

**Details of existing commitments and the balance amount of ongoing works with the Tenderer:**

(Refer to clause 4.2.2.3)

Name of the works in progress/ awarded but not yet started	Contract Agreement No./ LOA No.	Name & address of client/Deptt /Orgn. For whom executed	Contract value in cost lakhs of Rs.	Date of completion of work/contract	Value of executed work and payment received (Financial year wise)	Balance the amount of ongoing works to be completed in the next - ---- years

**(Bid Security)****Bank Guarantee Bond from any scheduled commercial bank of India**

*(On non-judicial stamp paper, which should be in the name of the Executing Bank).*

Name of the Bank: -----

President of India,

Acting through the Chief Engineer

Syama Prasad Mookerjee Port

Beneficiary FA & CAO

Date: .....

Bank Guarantee Bond No.: Date: -----

In consideration of the President of India acting through xxxxxxxxxxxx (*Designation & address of Contract Signing Authority*), Syama Prasad Mookerjee Port....., .... (hereinafter called "The SMPA"), having invited the bid for

..... through Tender No....., We have been informed that. . .... [*Insert name of the Bidder*] .....

(hereinafter called "the Bidder") intends to submit its bid (hereinafter called "the Bid"). WHEREAS, the Bidder is required to furnish Bid Security for the sum of [*Insert required Value of Bid Security*], in the form of Bank Guarantee, according to the conditions of the Bid.

AND

WHEREAS, .....[*Insert Name of the Bank*], with its Branch .....[*Insert Address*] having its Headquarters office at..... [*Insert Address*], hereinafter called the Bank, acting through .....[*Insert Name*

and Designation of the authorised persons of the Bank], have, at the request of the Bidder, agreed to give a guarantee for Bid Security as herein after contained, in favour of the SMPA;

1. KNOW ALL MEN that by these presents 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 guarantees to pay to the SMPK the full amount in the sum of [*Insert required Value of Bid Security*] as above stated.

2. The Bank undertakes to immediately pay on presentation of demand by the SMPA any amount up to and including the afore-mentioned full amount without any demur, reservation, or recourse. Any such demand made by the SMPA on the Bank shall be final, conclusive and binding, absolute and unequivocal on the Bank, notwithstanding any disputes raised/ pending before any Court, Tribunal, Arbitration or any Authority or any threatened litigation by the Bidder or Bank.

3. The Bank shall pay the amount as demanded immediately on presentation of the demand by the SMPA without any reference to the Bidder, and without the SMPA being required to show grounds or give reasons for its demand of the amount so demanded.

4. The guarantee hereinbefore shall not be affected by any change in the constitution of the Bank or in the constitution of the Bidder.

5. The Bank agrees that no change, addition, or modification to the terms of the Bid document or to any documents, which have been or may be made between the SMPA and the Bidder, will in any way absolve the Bank from the liability under this guarantee; and the Bank, hereby, waives any requirement for notice of any such change, addition or modification made by SMPA at any time.

6. This guarantee will remain valid and effective from..... *[insert date of issue]* till ..... *[insert date, which should be a minimum of 90 days beyond the expiry of the validity of the Bid]*. Any demand in respect of this guarantee should reach the Bank within the validity period of the Bid Security.

7. The Bank Guarantee is unconditional and irrevocable.

8. The expressions Bank and SMPA, herein before used, shall include their respective successors and assigns.

9. The Bank hereby undertakes not to revoke the guarantee during its currency, except with the previous consent in writing of the SMPA. This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No.758.

10. The Guarantee shall be valid in addition to and without prejudice to any other security Guarantee(s) of Bidder in favour of the SMPA. The Bank, under this Guarantee, shall be deemed as Principal Debtor of the SMPA.

Date.....

Place.....

Bank's Seal and authorized signature(s)

*[Name in Block letters]*

.....

*[Designation with Code No.]* .....

*[P/Attorney] No.*

Witness:

1 Signature, Name & Address & Seal

2 Signature, Name & address & Seal

Bank's Seal

*[P/Attorney] No.*

Note: All italicized text is for guidance on how to prepare this bank guarantee and shall be deleted from the final document.

**Financial Capacity of the Bidder.** (Refer to clause 4.2.2.2)

Each Bidder or each member of a JV must fill in this form separately:

Name Of Bidder/JV Partner:

Annual Contractual Turnover Data for the Previous 3/4 Years (Contractual Payment only)			
Year	Amount Currency	Exchange Rate	Indian National Rupees Equivalent
<b>Average Annual Contractual Turnover for the last 3 years</b>			

1. The average annual contractual turnover shall be calculated as an average of “total contractual payments” in the previous three financial years. However, in case the balance sheet of the previous year is yet to be prepared/ audited, the audited balance sheet of the fourth previous year shall be considered for calculating average annual contractual turnover.
2. The information supplied shall be substantiated by data in the audited balance sheets and profit and loss accounts for the relevant years in respect of the bidder or all members constituting the bidder.
3. Contents of this form should be certified by a Chartered Accountant, duly supported by an Audited Balance Sheet, duly certified by the Chartered Accountant.

**Seal and signature of the bidder**

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 Chartered Accountant) Name of CA:** \_\_\_\_\_

**Registration No (Seal):** \_\_\_\_\_

**Statement of Legal Capacity** (Refer to clause 4.3)

(On the letterhead of the Bidder/Lead Member of {Consortium/Joint Venture})

Ref. Date:

To

Chief Engineer,

Syama Prasad Mookerjee Port, Kolkata

Dear Sir,

We hereby confirm that we/ our members in the {Consortium/Joint Venture} (constitution of which has been described in the Bid, satisfy the terms and conditions laid out in the Tender document.

We have agreed that ..... (insert member's name) will act as the Lead Member of our {Consortium/Joint Venture}.\*

We have agreed that ..... (insert individual's name) will act as our representative/will act as the representative of the {Consortium/Joint Venture} on its behalf\* and has been duly authorized to submit the Tender. Further, the authorised signatory is vested with the requisite powers to furnish such a letter and authenticate the same.

Thanking you,

Yours faithfully,

(Signature, name, and designation of the authorised signatory)

For and on behalf of.....

**Note:** Paragraphs in curly parentheses may be omitted by the Bidder if not applicable to it, and 'Deleted' may be indicated there

**Format for Power of Attorney for the signing of the Bid**

(Refer to clause 4.1.5)

Know all men by these presents, We..... (Name of the firm and address of the registered office) do hereby irrevocably constitute, nominate, and appoint and authorize Mr./ Ms (name), ..... son/daughter/wife of ..... and presently residing at ....., who is presently employed with us/ the Lead Member of our {Consortium/**Joint Venture**} and holding the position of ....., as our true and lawful attorney (hereinafter referred to as the “Attorney”) to do in our name and on our behalf, all such acts, deeds, and things as are necessary or required in connection with or incidental to the submission of our Bid for the Project proposed or being developed by the [Syama Prasad Mookerjee Port] (the “**Authority**”), including but not limited to signing and submission of all Bids and other documents and writings, participate in other conferences and providing information/ responses to the Authority, representing us in all matters before the Authority, signing and execution of all contracts including the EPC agreement and undertakings consequent to acceptance of our Bid, and generally dealing with The Authority in all matters in connection with or relating to or arising out of our Bid for the said Project and/ or upon award thereof to us and/or until the entering into of the EPC Contract with the Authority.

And, we hereby agree to ratify and confirm, and do hereby ratify and confirm all acts, deeds, and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

In witness whereof we, ....., the above-named principal, have executed this power of attorney on this ..... day of ..... 2.... For .....

(Signature, name, designation, and address)  
of a person authorized by Board Resolution  
(in case of Firm/ Company)/ partner in case of

Witnesses: Partnership firm

1.

2.

Accepted

.....

(Signature)

(Name, Title, and Address of the Attorney)

(Notarized)

Person identified by me/ personally appeared before me/  
Attested/ Authenticated\*

(\*Notary to specify as applicable)

(Signature Name and Address of the Notary)

Seal of the Notary

Registration No. of the Notary

Date.....

**Notes:**

- 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.
- Wherever required, the Bidder should submit for verification the extract of the charter documents and documents, such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.
- For a Power of Attorney executed and issued overseas, the document will also have to be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have signed the Hague Legislation Convention 1961 is not required to be legalized by the Indian Embassy if it carries a conforming Apostille certificate.

**Note:** Paragraphs in curly parentheses may be omitted by the Bidder if not applicable to it, and 'Deleted' may be indicated there

**Format for Power of Attorney for Lead Member of {Consortium/Joint Venture}**

(Refer to clause 4.1.6)

Whereas the [SMPA] (the “**Authority**”) has invited Bids for the \*\*\*\*\* Project (the “**Project**”).  
Whereas, ....., ....., and ..... (Collectively the  
“**{Consortium/Joint Venture}**”) being Members of the **{Consortium/Joint Venture}** are interested in bidding  
for the Project in accordance with the terms and conditions of the Tender and other Bid documents,  
including an agreement in respect of the Project, and

Whereas, the Members of the **{Consortium/Joint Venture}** must designate one of them as the Lead Member  
with all necessary power and authority to do for and on behalf of the **{Consortium/Joint Venture}**, all acts,  
deeds and things as may be necessary in connection with the **{Consortium’s/Joint Venture}** Bid for the  
Project and its execution.

Now therefore know all men by these presents

We, ..... having our registered office at ....., M/s. .... having our registered office at ..., M/s... having our  
registered office at ....., and .... having our registered office at ....., (hereinafter collectively referred to as  
the “**Principals**”) do hereby irrevocably designate, nominate, constitute, appoint, and authorize M/s...  
having its registered office at ....., being one of the Members of the **{Consortium/Joint Venture}**, as the  
Lead Member and true and lawful attorney of the Consortium/Joint Venture (hereinafter referred to as the  
“**Attorney**”). We hereby irrevocably authorize the Attorney (with power to sub-delegate) to conduct all  
business for and on behalf of the **{ Consortium/Joint Venture}** and any one of us during the Bidding process  
and, in the event the **{Consortium/Joint Venture}** is awarded the contract, during the execution of the  
Project and in this regard, to do on our behalf and on behalf of the **{Consortium/Joint Venture}**, all or any of  
such acts, deeds or things as are necessary or required or incidental to the pre-qualification of the **{**  
**Consortium/Joint Venture}** and submission of its Bid for the Project, including but not limited to signing and  
submission of all applications, Bids and other documents, signing bank Guarantee for Bid security and  
writings, participate in other conferences, respond to queries, submit information/ documents, sign and  
execute contracts, and undertakings consequent to acceptance of the Bid of the **{Consortium/Joint**  
**Venture}** and generally, to represent the **{Consortium/Joint Venture}** in all its dealings with the Authority,  
and/ or any other Government Agency or any person, in all matters in connection with or relating to or  
arising out of the **{Consortium/Joint Venture}** Bid in all respects for the Project and/ or upon award thereof  
till the EPC Contract is entered into with the Authority & Completed.

And hereby agree to ratify and confirm, and do hereby ratify and confirm all acts, deeds, and  
things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred  
by this Power of Attorney, and that all acts, deeds, and things done by our said Attorney in exercise of the  
powers hereby conferred shall and shall always be deemed to have been done by us/ **{Consortium/Joint**  
**Venture}**).

In Witness Whereof, We, The Principals Above Named, Have Executed  
This Power of Attorney on This ..... Day Of ..... 2.....

For .....	For .....	For .....
(Signature)	(Signature)	(Signature)
.....	.....	.....
(Name & Title)	(Name & Title)	(Name & Title)

(Executants)

(To be executed by all the Members of the {Consortium/Joint Venture})

Witnesses:

- 1.
- 2.

**Notes:**

- 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.
- Also, wherever required, the Bidder should submit for verification the extract of the charter documents and documents, such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.
- For a Power of Attorney executed and issued overseas, the document will also have to be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Bidders from countries that have the Signed Legislation Convention 1961 is not required to be legalized by the Indian Embassy if it carries a conforming Apostille certificate.

**Note:**

Paragraphs in curly parentheses may be omitted by the Bidder if not applicable to it, and 'Deleted' may be indicated there

**(This certificate is to be given by an attorney/authorized signatory/each member of Partnership firm/Joint venture (JV)/Hindu Undivided Family (HUF)/Limited Liability partnership (LLP, etc.) (Refer to clause 5)**

I/ we..... (Name), attorney/ authorized signatory of the ..... (constituent firm/ constituent partner) and member/partner of the ..... (tendering firm) hereby solemnly affirm and state under:

1. I/we certify that ..... (constituent firm / constituent partner) is not blacklisted or debarred by SMPKs or any other Ministry / Department of Govt of India from participation in tender on the date of submission of bids, either in individual capacity or as an HUF / member of the partnership firm / LLP/JV/Society/Trust.

2. I /we have read the clause regarding restriction on procurement from a bidder of a country which shares a land border with India and certify that I am/ we are not from such a country or, if from such a country, have been registered with the competent Authority. I/ We hereby certify that I/We fulfil all the requirements in this regard and am /are eligible to be considered (evidence of valid registration by the competent authority is enclosed)

Seal and signature of  
the Constituent Firm/ Partner

Place:

Dated:

**Format for Joint Bidding Agreement for {Consortium/Joint Venture}**  
(To be executed on Stamp paper of appropriate value) (Refer to clause 4.1.6)

This joint Bidding Agreement is entered into on this the ..... day of ..... 20...

**Amongst**

1. {..... Limited, and having its registered office at .....} (Hereinafter referred to as the “**First Part**”, which expression shall, unless repugnant to the context, include its successors and permitted assigns)

**And**

2. {..... Limited, having its registered office at .....}and (hereinafter referred to as the “**Second Part**” which expression shall, unless repugnant to the context, include its successors and permitted assigns)

**And**

3. {..... Limited, and having its registered office at .....} (Hereinafter referred to as the “**Third Part**” which expression shall, unless repugnant to the context, include its successors and permitted assigns)

The above-mentioned parties of the first, second, and third parts are collectively referred to as the “**Parties**” and each is individually referred to as a “**Party**”

**Whereas,**

(A) The President of India, represented by the SMPA, Chief Engineer,(the “**Authority**”), having its principal office at Kolkata (hereinafter referred to as the “**Authority**” which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns) (the “**Authority**”), having its Principal office at 6, Strand Road, Kolkata, 700001, India is engaged in the development of Syama Prasad Mookherjee Port and related infrastructure, and as part of this endeavour, has invited Bids (the **Bids**) by its Tender No. .... dated ..... for award of contract **for Development of (off Dock)Container Stacking Yard at Loco Shed Area, Sonapore Road, Kolkata, on the Engineering Procurement and Construction Agreement (EPC) mode.**

(B) The Parties are interested in jointly bidding for the Project as members of a {Consortium/Joint Venture, and in accordance with the terms and conditions of the Tender document and other Bid documents in respect of the Project, and

(C) It is a necessary condition under the Tender document that the members of the {Consortium/Joint Venture} shall enter into a Joint Bidding Agreement and furnish a copy thereof with the Application.

**Now it is hereby agreed as follows:**

**1. Definitions and Interpretations**

In this Agreement, the capitalized terms shall, unless the context otherwise requires, have the meaning ascribed thereto under the Tender.

**2. {Consortium/Joint Venture}**

2.1 The Parties do hereby irrevocably constitute a Consortium/Joint Venture (the “{**Consortium/Joint Venture**}”) for jointly participating in the Bidding Process for the Project.

2.2 The Parties hereby undertake to participate in the Bidding Process only through this {Consortium/Joint Venture} and not individually and/ or through any other {Consortium/Joint Venture} constituted for this Project, either directly or indirectly.

### **3. Covenants**

The Parties hereby undertake that in the event the {Consortium/Joint Venture} is declared the Selected Bidder and awarded the Project, it shall enter into an EPC Contract with the Authority for performing all its obligations as the Contractor in terms of the EPC Contract for the Project.

### **4. Role of the Parties**

The Parties hereby undertake to perform the roles and responsibilities as described below:

(a) Party of the First Part shall be the Lead member of the {Consortium/Joint Venture} and shall have the power of attorney from all Parties for conducting all business for and on behalf of the {Consortium/Joint Venture} during the Bidding Process and for performing all its obligations as the Contractor in terms of the EPC Contract for the Project;

(b) Party of the Second Part shall be {the member of the Consortium/Joint Venture}; and

(c) Party of the Third Part shall be a member of the Consortium/Joint Venture.}

(d) Party of the 4th Part shall be a member of the Consortium/Joint Venture.}

### **5. Joint and Several Liability**

The Parties do hereby undertake to be jointly and severally responsible for all obligations and liabilities relating to the Project and in accordance with the terms of the Tender and the EPC Contract, till the completion of the Project is achieved under and in accordance with the EPC Contract.

### **6. Share of work in the Project**

The Parties agree that the proportion of construction in the EPC Contract is to be allocated Among the members shall be as follows:

First Party:  
{Second Party:}  
{Third Party:}  
{Fourth Party:}

Further, the Lead Member shall itself undertake and perform at least 30 (thirty) percent of the total value of the project, if the Contract is allocated to the {Consortium/Joint Venture}

### **7. Representation of the Parties**

Each Party represents to the other Parties as of the date of this Agreement that:

(a) Such Party is duly organized, validly existing, and in good standing under the laws of its incorporation and has all requisite power and authority to enter into this Agreement;

(b) The execution, delivery and performance by such Party of this Agreement has been authorized by all necessary and appropriate corporate or governmental action and a copy of the extract of the charter documents and board resolution/power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the {Consortium/Joint Venture} Member is annexed to this Agreement, and will not, to the best of its knowledge:

(i) require any consent or approval not already obtained;

(ii) violate any Applicable Law presently in effect and having applicability to it;

(iii) violate the memorandum and articles of association, by-laws, or other applicable organizational documents thereof;

(iv) violate any clearance, permit, concession, grant, license, or other governmental authorization, approval, judgment, order, or decree, or any mortgage agreement, indenture, or any other instrument to

which such. Party is a party or by which such Party or any of its properties or assets are bound or that is otherwise applicable to such Party; or  
 (v) create or impose any liens, mortgages, pledges, claims, security interests, charges or Encumbrances or obligations to create a lien, charge, pledge, security interest, encumbrances or mortgage in or on the property of such Party, except for encumbrances that would not, individually or in the aggregate, have a material adverse effect on the financial condition or prospects or business of such Party to prevent such Party from fulfilling its obligations under this Agreement;

(c) this Agreement is the legal and binding obligation of such Party, enforceable in accordance with its terms against it; and

(d) There is no litigation pending or, to the best of such Party's knowledge, threatened to which it or any of its Affiliates is a party that presently affects or which would have a material adverse effect on the financial condition or prospects or business of such Party in the fulfilment of its obligations under this Agreement.

**8. Termination**

This Agreement shall be effective from the date hereof and shall continue in full force and effect until the Project completion (the “Defects Liability Period”) is achieved under and in accordance with the EPC Contract, in case the Project is awarded to the {Consortium/Joint Venture} However at a later stage if, it is found that the {Consortium/Joint Venture} was not pre-qualified for the Project or not eligible for the award of the Project, the agreement will stand terminated. It may return the Bid Security to the Bidder at per discretion of the Authority.

**9. Miscellaneous**

9.1 This Joint Bidding Agreement shall be governed by the laws of {India}.

9.2 The Parties acknowledge and accept that this Agreement shall not be amended by the Parties without the prior written consent of the Authority.

In Witness Whereof, the Parties Above Named Have Executed And Delivered This Agreement as of the Date First Above Written. Signed, Sealed, And Delivered

For and on behalf of Lead member by:

	SECOND PART	THIRD PART
(Signature)	(Signature)	(Signature)
(Name)	(Name)	(Name)
(Designation)	(Designation)	(Designation)
(Address)	(Address)	(Address)

In the presence of:

**Notes:**

1. The mode of execution of the Joint Bidding Agreement should be in accordance with the procedure, if any, laid down by the Applicable Law and the charter documents of the executants(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.
2. Each Joint Bidding Agreement should attach a copy of the extract of the charter documents and documents, such as a resolution/power of attorney, in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the {Consortium/Joint Venture} Member.
3. For a Joint Bidding Agreement executed and issued overseas, the document shall be legalized by the Indian Embassy and notarized in the jurisdiction where the Power of Attorney has been executed.

**Insurance Surety Bond for Performance Security** (Refer to clause 4.7.6)

Name of the issuer of the surety bond:

President of India,  
Acting  
Through The Chief Engineer  
Syama Prasad Mookerjee Port,  
6, Strand Road  
Kolkata – 700 001

Date:.....

Surety Bond No:..... Issue Date .....

Amount of Bond:..... Expiry Date:.....

WHEREAS, In consideration of the President of India acting through  
.....(Designation & address of contract signing  
authority),.....SMPK,....., (hereinafter called “The SMPK”) having  
accepted the bid of M/S XXXXX, hereinafter called the contractor, for the work of XXX” under  
invitation of bids No XXXX Dated XXXXX, vide Letter of Acceptance No.....

AND

WHEREAS, the contractor is required to furnish Performance Security for the sum of ₹.XXXX  
(Rupees XXXX Only), in the form of a Surety Bond, being a condition precedent to the signing  
of the contract agreement.

SB No: Date:

WHEREAS, we, \_\_\_\_\_, (Name of insurance company ) hereinafter called the Surety,  
acting through [Designation(s) of the authorised person of the Surety], have, at the request of the  
M/s. XXXX contractor agreed to give Bond for performance security/ additional performance security  
as hereinafter contained:

1. KNOW ALL MEN by these presents that I/We, the undersigned [ *Insert name(s) of*

*Authorized representatives of the Surety*, being fully authorized to sign and incur obligations for and on  
behalf of the Surety, confirm that the Surety, hereby, unconditionally and irrevocably, Bond to pay the SMPK  
the full amount in the sum of XXXX)( Rupees XXXX Only)as above stated.

2. The Surety undertakes to immediately pay on presentation of demand by the SMPK any amount up to  
and including the aforementioned full amount without any demur, reservation, or recourse. Any such  
demand made by the SMPK on the Surety 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 Bidder or Bank.

3. On payment of any amount less than the aforementioned full amount, as per the demand of SMPA, the  
Bond shall remain valid for the balance amount, i.e., the aforementioned full amount less the payment  
made to the SMPK.

4. The Surety shall pay the amount as demanded immediately on presentation of the demand by SMPA  
without any reference to the contractor and without the SMPK being required to show grounds or give  
reasons for its demand or the amount demanded.

5. The Surety Bond shall be unconditional and irrevocable.

6. The Bond hereinbefore shall not be affected by any change in the constitution of the Surety or in the  
constitution of the Contractor.

7. The Surety 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 SMPK and the Contractor, will in any way  
release us from the liability under this Bond; and the Surety, hereby, waives any requirement for notice of  
any such change, addition or modification to the Surety.

8. This Bond is valid and effective from the date of its issue, which is [insert date of issue]. The Bond and our obligations under it will expire on XXXX (Expiry Date). All demands for payment under the Bond must be received by us on or before that date.

9. The Surety agrees that the SMPA right to demand payment of the 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 SMPA or the Bond is released by SMPK before the Expiry date.

10. The Surety agrees that its obligation to pay any amount demanded by the SMPK before the expiry of this Bond will continue until the amount demanded has been paid in full.

11. The expressions Surety and SMPK hereinbefore used shall include their respective successors, administrators, and assigns.

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12. The Surety hereby undertakes not to revoke the Bond during its currency, except with the previous consent in writing of the SMPK. This Bond is subject to the Uniform Rules for Demand Bonds, ICC Publication No. 758.

13. We, the Surety Insurer, further agree that the Authority shall be the sole judge to decide as to whether the Bidder is in default of due and faithful fulfilment and compliance with the terms and conditions contained in the Bidding Documents including, inter alia, the failure of the Bidder to keep its Bid open during the Bid validity period set forth in the said Documents, and the decision of the Authority that the Bidder is in default as aforesaid shall be final and binding on us, notwithstanding any differences between the Authority and the Bidder or any dispute pending before any Court, tribunal, arbitrator or any other authority.

14. The Bond shall be in addition to and without prejudice to any other security Bond (s) of the contractor in favour of the SMPK available with the SMPK. The Surety, under this Bond, shall be deemed as the Principal Debtor of the SMPA.

Notwithstanding anything to the contrary contained in these presents,

a. Our liability under this Surety Bond shall not exceed XXXX (Rupees XXXX Only).

b. This Surety Bond shall be valid up to XXXX (being the date of expiry);

c. Unless the bank is served a written claim or demand on or before XXXX [date of expiry], all rights under this Bond shall be forfeited and the Surety shall be relieved and discharged from all liabilities under this Bond, irrespective of whether or not the original Surety bond is returned to the Surety.

Dated the day of 2024

15. The Insurance Surety Bond shall be verified by sending mail to [customer. care@ sbigeneral. in].

Place..... Bank's Seal and authorized signature(s)

[Name in Block letters].....

[Designation with Code No.].....

[P/Attorney] No.

Witness

1.

2.

\*\*\*\*\*

[Note: All italicized texts are for guidance on how to prepare this Insurance Surety Bond and shall be deleted from the final document.]

**Format for the certificate to be submitted/uploaded by the tenderer along with the tender documents**

(Refer to clause 5)

I..... (Name and designation)\*\*appointed as the attorney/authorized signatory of the tenderer (including its constituents), M/s \_\_\_\_\_ (hereinafter called the tenderer) for the Tender documents for the work of \_\_\_\_\_ as per the tender No. \_\_\_\_\_ of \_\_\_\_\_ (SMPK)\*\*; do hereby solemnly affirm and state on the behalf of the tenderer including its constituents as under:

1. I/we, the tenderer (s), am/are signing this document after carefully reading the contents.
2. I/We, the tenderer(s), also accept all the conditions of the tender and have signed all the pages in confirmation thereof.
3. I/we hereby declare that I/we have downloaded the tender documents from the Indian SMPK website www.ireps.gov.in. I/we have verified the content of the document from the website, and there is no addition, no deletion, or no alteration to the content of the tender document. In case of any discrepancy noticed at any stage, i.e., evaluation of tenders, execution of work, or final payment of the contract, the master copy available with the SMPK Administration shall be final and binding upon me/us.
4. I/we declare and certify that I/we have not made any misleading or false representation in the forms, statements, and attachments in proof of the qualification requirements.
- 5. I/We also understand that my/our offer will be evaluated based on the documents/credentials submitted along with the offer, and the same shall be binding upon me/us.**
- 6. I/We declare that the information and documents submitted along with the tender by me/us are correct and I/we are fully responsible for the correctness of the information and documents submitted by us.**
7. I/we certify that I/we the tenderer(s) is/are not blacklisted or debarred by SMPKs or any other Ministry / Department of Govt. of India from participation in the tender on the date of submission of bids, either in individual capacity or as a HUF/ member of the partnership firm/LLP/JV/Society/Trust.
8. I/we understand that if the contents of the affidavit certificate submitted by us are found to be forged/false or incorrect at any time during the process for evaluation of tenders, it shall lead to forfeiture of the Bid Security and may also lead to any other action provided in the contract including besides banning of business for a period of up to five two year. Further, I/we (*insert name of the tenderer*) \*\* \_\_\_\_\_ and all my/our constituents understand that my/our offer shall be summarily rejected.
9. I/we also understand that if the contents of the affidavit certificate submitted by us are found to be false / forged or incorrect at any time after the award of the contract, it will lead to termination of the contract, along with forfeiture of Bid Security/Security Deposit and Performance guarantee and may also lead to besides any other action provided in the contract including banning of business for a period of up to five two year.
10. I/We have read the clause regarding restriction on procurement from a bidder of a country that shares a land border with India and certify that I am/We are not from such a country or, if from such a country, have been registered with the competent Authority. I/We hereby certify that I/we fulfil all the requirements in this regard and am/are eligible to be considered (evidence of valid registration by the competent authority is enclosed)

Seal and signature of the tenderer

Place:

Dated:

\*\*The contents in Italics are only for guidance purposes. Details as appropriate are to be filled in suitably by the tenderer.

**This affidavit certificate is to be given by each member of JV, or partners of a Partnership firm /LLP/etc. .**

**Annexure-XIV**

**Declaration By an Existing Partnership Firm (Refer to clause 5)**

1.0 I..... S/o Shri ....., the authorized signatory of partnership firm M/s .....do hereby solemnly affirm and declare as under:

1.1 That we are an existing Partnership Firm in the name and style of M/s -----  
 ----, since -----(MM/YY), having GST Registration no, PAN/TAN No.----- . There has been no change in the Partner(s) of our firm during the last 07 (Seven) years ending last day of the month previous to the one in which the tender is invited.

Or

1.2 That, we are an existing Partnership Firm in the name and style of M/s -----  
 ---, since -----(MM/YY), having GST Registration no....., PAN/TAN N ---. Following of our partner(s) has/have quit the Partnership firm during the last 07 (Seven) years ending last day of the month previous to the one in which the tender is invited, with details as under:

S. No	Name of quitting Partner(s)	Share of Partner(s) who has/have quit	Date of quitting (MM/YY)

And/or

1.3 That we are an existing Partnership Firm in the name and style of M/s -----, since -----  
 -----(MM/YY), having GST Registration no. -----, PAN/TAN No.----- . The following partner(s) has/have joined our Partnership Firm during the last 07 (Seven) years ending last day of the month previous to the one in which the tender is invited, with details as under:

SL. No.	Name of joining Partner(s)	Share of joining Partner(s)	
		In the present firm	In the previous firm from which he/they have/have quit and joined the present firm

1.4 In case of Para 1.2 and 1.3, the following documents, as applicable, are required to be submitted along with the bid: -

- (a) Copy of previous Partnership Deed(s).
- (b) Copy of Dissolution Deed(s) of previous partnership deed(s).
- (c) Proof of surrender of PAN No(s) (in case of dissolution of previous partnership firm).

Declaration by the Tenderer: -

I hereby declare that the information given above is true. If any of the above information is found to be wrong at any time, my tender will be liable to be rejected.

Name and signature of tenderer along with the Seal

**Annexure- XV**

**Declaration By Newly Formed Partnership Firm (Refer to clause 5)**

I..... S/o Shri, the authorized signatory of the partnership firm M/s,..... do hereby solemnly affirm and declare as under:

(a) That we are the newly formed partnership firm in the name and style of M/s..... Registered with Registrar of firm vide Registration No....., dated .....

(b) In this newly formed Partnership Firm, we are .....no. of partners. The details of the previous proprietary firm or previous dissolved partnership firm or previous spitted partnership firm(s) wherein any of the partners of the present firm was a proprietor/partner and proposed to use credentials obtained in such previous proprietary firm (s) / partnership firm(s) are as under: -

S.N.	Name of the person in the newly formed partnership firm	Details of Previous proprietary/ Partnership firm	Share in the newly formed Partnership firm	Share in previous partnership firm in previous partnership firm	Remarks
1					
2					
3					

(i) That, following relevant documents are annexed with bid: -

(ii) Copy of previous Partnership Deed(s).

(iii) Copy of previous Dissolution/splitting Deed(s) of previous partnership deed(s).

(iv) Proof of surrender of PAN No(s) (in case of dissolution of partnership firm).

Declaration by the Tenderer: -

I hereby declare that the information given above is true. If any of the above information is found to be wrong at any time, my tender will be liable to be rejected.

Name and signature of tenderer along with the Seal

**Details of Bidder (Refer to clause 5)**

1. (a) Name:  
 (b) Country of incorporation:  
 (c) Address of the corporate headquarters and its branch office(s), if any, in India:  
 (d) Date of incorporation and/ or commencement of business:
2. Brief description of the Bidder, including details of its main lines of Business and proposed role and responsibilities in this Project:
3. Details of individual(s) who will serve as the point of contact/ communication for The Authority:
  - (a) Name:
  - (b) Designation:
  - (c) Company:
  - (d) Address:
  - (e) COMMUNICATION Number:
  - (f) E-Mail Address:
  - (g) Fax Number:
4. Particulars of the Authorised Signatory of the Bidder:
  - (a) Name:
  - (b) Designation:
  - (c) Address:
  - (d) Phone Number:
  - (e) Fax Number:
  - (f) Class III Digital Signature Certificate ID number
5. In case of a {Consortium/Joint Venture}:
  - (a) The information above (1-4) should be provided for all the Members of the {Consortium/Joint Venture}
  - (b) A copy of the Jt. Bidding Agreement, as envisaged in Clause 4.1.11(f), should be attached to the Application.
  - (c) Information regarding the role of each Member should be provided as per the table below:

Sl.	Sl. Name of Member	Role* {Refer Clause 4.1.11(d)} \$	Shareholding of members in Consortium/Joint Venture {Refer Clauses 4.1.11(a), (f)}
1.			
2.			
3.			

\* The role of each member, as may be determined by the Bidder, should be indicated.

All provisions contained in curly parentheses shall be suitably modified by the Bidders to reflect the particulars relating to such Bidder.

(d) The following information shall also be provided w.r.t para 4.1.13 for each member of the {Consortium/Joint Venture}:

**Name of Bidder/ member of Consortium/Joint Venture:**

Sl. No.	Criteria	Yes/No
1.	Has the Bidder/ constituent of the {Consortium/Joint Venture} been barred by the Ministry of SMPK or its implementing agencies for the works of SMPA, from participating in Bidding?	
2.	If the answer to 1 is yes, does the bar subsist as on the Bid due date?	

6. (a) I/ We certify that in the last three years, we/ any of the {Consortium/Joint Venture partners have neither failed to perform the works of the SMPA as evidenced by imposition of a penalty by an arbitral or judicial authority or a judicial pronouncement or arbitral award against us, nor been expelled or terminated by Ministry of SMPK or its implementing agencies for breach on our part.

(b) I/ We certify that we/ any of the {Consortium/Joint Venture} partners do not fall in any of the categories of being a non-performing entity given at Clause 2.1.14 of Instructions to Bidders in the projects of the Ministry of SMPKs or its implementing agencies, and furnished the complete details.

7(a) I/ We further certify that no investigation by a regulatory authority is pending either against us/any member of {Consortium/Joint Venture} or our sister concern or against our CEO or any of our directors/managers/employees.

(b) I/ We further certify that no investigation by any investigating agency in India or outside is pending either against us/ any member of {Consortium/Joint Venture} or our sister concern or against our CEO or any of our directors/managers/employees.

I/ We certify that the list is complete and covers all the projects of SMPKs or its implementing agencies and that we/ any of the {Consortium/Joint Venture} partners do not fall in any of the above categories of being a non-performing entity. (Signature, name, and designation of the authorised signatory) For and on behalf of.....

Note: Paragraphs may be omitted by the Bidder if not applicable to it, and 'Deleted' may be indicated there

**Annexure-XVII****Details of Technical Personnel Available on Hand** (Refer to clause 5)

<b>SL NO.</b>	<b>Name</b>	<b>Age</b>	<b>Technical qualifications</b>	<b>Commencement of present employment</b>	<b>Total experience.</b>	<b>Emoluments</b>
1	2	3	4	5	6	7

**Annexure-XVIII****Details Of Technical Personnel Proposed to be Engaged** (Refer to clause 5)

<b>Sl no.</b>	<b>Name</b>	<b>Age</b>	<b>Technical qualifications</b>	<b>Commencement of present employment</b>	<b>Total experience</b>	<b>Emoluments</b>
1	2	3	4	5	6	7

**Annexure-XIX**

**Details of existing commitments and the balance amount of ongoing works with the Tenderer:**  
(Refer to clause 5)

<b>Name of the works in progress/ awarded but not yet started</b>	<b>Contract Agreement No./ LOA No.</b>	<b>Name &amp; address of client/Deptt. /Orgn. For whom executed</b>	<b>Contract value in lakhs of Rs.</b>	<b>Date of completion of work/contract</b>	<b>Value of executed work and payment received (Financial year-wise)</b>	<b>Balance amount of ongoing works to be completed in next ----- years</b>

**Annexure XX**

**Value of completed works/Executed works and payment received during the current and/or last three financial years immediately preceding the current financial year, up to the date of inviting of tender:**

(Refer to clause 5 and 4.2.2.1)

<b>Name of the completed works</b>	<b>Contract Agreement No./LOA No.</b>	<b>Name &amp; address of client/Deptt /Orgn. For whom executed</b>	<b>Contract value in lakhs of Rs.</b>	<b>Date of completion of work/contract</b>	<b>Value of executed work and payment received in any one financial year during the current and/or last three financial years immediately preceding the current financial year, up to the date of opening of tender</b>

## **Annexure XXI**

### **Letter comprising the Financial Bid (Refer to clause 4.2.2.2)**

To  
The Chief Engineer  
Syama Prasad Mookerjee Port,  
6, Strand Road  
Kolkata – 700 001

Sub: Tender For Engineering, Procurement and Construction for Development of Off- Dock Container Stacking Yard at Loco Shed Area of KDS, Syama Prasad Mookerjee Port, Kolkata.

Dear Sir,

1. With reference to your RFP document, I/we, having examined the Bidding Documents and understood their contents, hereby submit my/our Financial Bid for the aforesaid Project. The Bid is unconditional and unqualified.
2. I/ We acknowledge that the Authority will be relying on the information provided in the Bid and the documents accompanying the Bid for selection of the Contractor for the aforesaid Project, and we certify that all information provided in the Bid are true and correct; nothing has been omitted which renders such information misleading, and all documents accompanying the Bid are true copies of their respective originals.
3. The Bid Price has been quoted by me/us after taking into consideration all the terms and conditions stated in the RFP, draft EPC Agreement, our own estimates of costs, and after a careful assessment of the site and all the conditions that may affect the project cost and implementation of the project.
4. I/ We acknowledge the right of the Authority to reject our Bid without assigning any reason or otherwise and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.
5. In the event of my/ our being declared as the Selected Bidder, I/we agree to enter into an Agreement in accordance with the draft that has been provided to me/us before the Bid Due Date. We agree not to seek any changes in the aforesaid draft and agree to abide by the same.
6. I/ We shall keep this offer valid for 120 (one hundred and twenty) days from the Bid Due Date specified in the RFP.
7. I/ We have quoted the Bid Price on the e-portal for undertaking the aforesaid Project in accordance with the Bidding Documents and the draft EPC Agreement.

Yours faithfully,

Date:  
Signatory)

(Signature, name, and designation of the Authorised

Place:

Name & seal of Bidder/Lead Member: .....  
Class III DSC ID of Authorised Signatory: .....