

Scope of Work for the work of Design, Supply and Erection of Pre-Fabricated Steel Shed at Anik Chembur Yard, MDL.

Location – Left side of shed T3 & 7C

Requirements: - Pre-Fabricated Shed consists of following: -

- Shed Size-Length- 20m, Width-18.00m, Height-10.0m at Ridge Point
- Rolling shutter of Size 4m x 6m
- Door shall be openable at Rear side for man movement of size-1.50m x 2.50m
- Suitable Lighting to be provided

Scope of Work (Civil)-:

- 1) Appointment of Licensed Structural Designer for design of all the Structural Members including Geotechnical Investigation for Shed, proof checking & approval from third party like IIT/VJTI/NT/IRS, submission of design calculations, submit the method statement for execution, Issue of GFC drawings, Supervision for Steel Shed work & Electrical work by appointed Structural Engineer, issue of stability certificate.
- 2) Excavation of required foundation as per design
- 3) Providing & laying Rubble Soling for foundation
- 4) PCC M-20 for Bedding Concrete & below VD Flooring
- 5) Providing & fixing Steel reinforcement for Foundation as per structural design incl. required Shuttering
- 6) Providing & laying RCC M-40 grade concrete for all the requisite Foundation incl. footing, columns, plinth beams etc.
- 7) Providing & fixing Anchor rods into the RCC Footing/Columns, Base plates for fixing structural member etc.as per design
- 8) Providing & laying RCC M-40 for Vacuum Dewatered Flooring inside the Shed incl. application of Nitoflor hardener
- 9) Providing & Fixing of Structural Steel / Tubular member like ISMB/ISMC, Tie Beams & Crossings, inside Ladder and Platform for carrying out Maintenance etc.as per structural design & drawing
- 10) Providing & fixing with manual & Electrically operation GI Rolling shutter for movement of loaded Trucks etc. inside the shed
- 11) Providing & fixing Structural MS Door with all fittings & fixtures on Rear side for man movement
- 12) Supply & Painting with Epoxy Paint to Structural Steel Members incl. primer
- 13) Providing & fixing 0.50mm thick Corrugated Galvalume Roofing Sheets along with transparent sheets & Turbo ventilators along with Structural arrangement
- 14) Providing & fixing 0.50mm Corrugated Galvalume Cladding Sheets along with all the vertical and corner flashings required for closure of gaps
- 15) Providing & fixing Galvalume Ridge
- 16) Providing & fixing 2mm thick Aluminium Gutter with FRP coating on the joints along with all accessories
- 17) Providing & Fixing 150mm dia. PVC rainwater down take pipe along with all the accessories
- 18) Construction of Cross trench across the road for laying of Fire line & Water Supply line
- 19) Providing & Laying GI Fire Pipe Line from existing Main line along with Fire Hydrant & Water "C" class GI Water Supply connection to the Shed entry point
- 20) Construction of RCC SWD at Front and sides with Structural Steel Grating incl. painting with epoxy paint & primer.

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SCOPE OF WORK

Fire Fighting System at Anik Chembur Yard:

1. Supply / Fabrication / Installation / Testing & Commissioning (SFITC) 'C' class GI Pipe as per IS3589 / IS 1239 for underground pipes with welded / flanged connection with saddles, supports (all with screwed/welded joints) as required including GI pipe of shorter lengths, tapering connecting pieces, short or long bends, specials like sockets, union nuts, elbows, reducers, plugs, Tees, flanges, gasket, bolting, nipples, branch connection fitting & other fitting supports etc, complete. To make the system operative as required by LPA /TAC authorities. The work shall be including painting works as per specifications [One Coat of ETCH Primer (DFT -6.0 micron) + One Coat of Zinc Phosphate Epoxy Primer or Equivalent (DFT 40-50 micron). Zinc Rich Primer on Weld Joint Surface in place of ETCH Primer (DFT 75-100 micron) and two coats of enamel paint (Post office red, DFT 100 -150 micron) over-coat of approved primer for over ground pipes along with the clamps required at suitable distances for fixing the pipes on pedestal /civil foundation. Corrosion protection tape/ spiral Wrapping coating for underground piping (wrapping should have overlap of 15 to 20 mm). The rate shall include cost of jointing, welding, scaffolding & all temporary supporting for access work/ inspection / safety/ tools/tackles/ equipment's/ machinery & any other required accessories for completion the works etc.

Make of GI pipes: (Jindal/ TATA steel/SAIL

Make of Wrapping/Coating: IWL/Rustek/PYPKOT

- (a) 150 mm nominal bore - 45 meter (approx.)
- (b) 80 mm nominal bore – 10 meter (approx.)

2. Supply and fixing Single headed hydrant valve 63 mm dia. Stainless Steel 304 (Make: NEWAGE/SAFE GUARD/SAFEX/WINCO) and cast-iron wheel, ISI marked with blank PVC cap and GI chain as required with companion flanges, nut bolt and gaskets.

- (a) Quantity 4 nos.

3. Ventilation and Exhaust fan, Roof Ventilation (Turbo type), Control room sealing to be provided.

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SCOPE OF WORK

Project: Electrical work for proposed new shed at west side of Shed T-3 at Anik Chembur Yard.

Shed size (reference): 20 m × 18 m, ridge height 10 m

Purpose: Design, supply, installation, testing, commissioning and handover of lighting and associated electrical works for a flammable explosives material storage shed in compliance with applicable mandatory standards.

1. Light Fixtures & Luminaires: SITC of Flame Proof Light Fixtures

Supply, Installation, Testing and Commissioning of NPFA /IEC /NEC/PESSE /BIS - certified explosion-protected luminaires suitable for the assigned hazardous zones). Fixtures to be high-efficiency LED with rated life ≥50,000 hours (L70), CRI ≥70, and suitable photometric distribution for high-bay application at 10 m ridge.

Ingress protection rating minimum: IP66 (or higher) and corrosion-resistant finish.

Minimize suspended or chain-hung fittings that can cause snagging; use robust mounting suitable for high-bay environment.

2. Exhaust Fans for Ventilation

Supply, Installation, testing & commissioning of NPFA /IEC /NEC/PESSE /BIS - certified flame proof exhaust fan: Flame proof exhaust fans to be provided of suitable size and quantity based on calculation in CFM.

3. Power Distribution & Cabling

- **Cabling:** Use Heavy duty armoured FR XLPE LSZH cable armoured / metallic sheathed cables (tray or conduit) rated for hazardous zones, with cable glands/seals at zone boundaries to prevent vapour migration. All cables to be flame retardant and low smoke (as applicable).
- **Conduits & Trunking:** Metallic conduit/sealed systems; where required, use explosion sealed cable glands and flameproof junction boxes.
- **Distribution Board:** Distribution board shall be located at shed adjacent to main shed near main entrance in non-hazardous area.
- **Glanding & Sealing:** All entries into hazardous zones must be sealed per PESO-approved sealing methods.
- **Cable Trays:** Cable Trays of adequate size to be provided for laying multiple cables.
- **Flat Bar Support :** Support fabricated from flat bar to be provided where ever there is single cable is running.
- **No cable /flame proof accessories to be kept hanging without any support.**
- **All cable entries inside flame proof junction box and fittings to be filled with explosion proof sealing compound.**

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4. Earthing Protection: Provide an earthing system sized for fault currents, with earth pits. Ensure equipotential bonding of structural steel, racks, metallic cable trays, and any conductive tanks. Target earth resistance should meet project specifications (contractor to validate; common industrial target is $\leq 1 \Omega$ — to be confirmed with client and standards).

5 . Installation Requirements

Workmanship to industry best practice by certified electricians experienced in hazardous area installations.

All explosion-protected equipment to be installed per manufacturer instructions and certified installation procedures.

Maintain segregation of hazardous-area wiring from other services where required.

All penetrations through walls/floors to be properly sealed and fire-stopped as necessary.

6. Main Power Supply: Main power supply to be tapped from available nearby power source by supplying, erecting and terminating FR XLPE insulated, galvanised steel formed wire armoured (strip) cable 1100 V, aluminium conductor complete erected with glands and lugs, on walls /trusses/pole or laid in provided trench /pipe/support.

If dedicated feeder is not available at nearby power source, then switch gear with enclosure to be erected.

Size/ Rating of the switch gear is 125% of continuous load. Breaker size should be less than cables ampacity.

7. Testing, Inspection & Commissioning

Factory Acceptance Test (FAT)&Site Inspection Tests: insulation resistance, continuity, polarity, protective device operation, earth resistance, loop impedance, lighting levels measurement (lux readings) at finished conditions.

8. Documentation & Deliverables

Contractor to supply (hard & soft copies):

- Detailed lighting design report and calculations;
- Single-line diagrams, schematic wiring diagrams, GA drawings showing luminaire locations and zoning;
- Equipment schedules, datasheets and certificates (Ex marking, IP rating, manufacturer test reports);
- Hazardous area classification report (from competent consultant);
- Test & commissioning reports and certificates, As-built drawings and single-line diagrams.

9. Schedule & Milestones

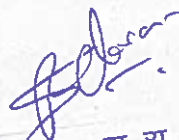
Submit initial design, lighting and load calculation: within 1 week of award (contractor to propose realistic schedule).

Procurement of long-lead items after design approval.

Installation, testing & commissioning: schedule to be agreed with client.



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**Design, Supply & Erection of Pre-Fabricated
Structural Steel Shed for in between T3 & 7C at
Anik Chembur Yard,MDL**

VOLUME-I

**Technical Specification
&
Preferred Make**

I N D E X

TECHNICAL SPECIFICATIONS

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1. GENERAL

1.1. Materials

All materials required to complete the works shall be procured by the contractor including steel and cement unless specified. All materials shall be of Indian origin of the best quality of their respective kinds as specified and shall conform strictly to the stipulations laid down by the latest Indian Standards. Standards issued elsewhere may be used only if approved by the Engineer-In-Charge and for those materials only for which appropriate Indian Standard does not exist.

1.2. Sampling and Testing

The Contractor shall submit adequate number of samples of materials to the Engineer-In-Charge for approval giving all relevant information like source of supply, availability, etc. The approved samples shall be deposited with the Engineer-In-Charge whenever so instructed.

The Engineer-In-Charge shall order such tests and analysis of all materials before leaving the manufacturer's premises or the source of supply and/or when brought on site as considers necessary and the Contractor shall bear the cost of all sampling and testing which is in consonance with the Indian Standards.

If tests on materials lead to rejection of the particular consignment, notwithstanding the results of the tests at the manufacturer's works or elsewhere or of test certificates or of any approval given earlier, such materials shall be removed forthwith from the site by him at his own cost and replaced by other proper consignment. All charges in connection with of the new materials shall be borne by the Contractor.

Samples required for approval and testing must be supplied well in time to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected, further samples may be required. Delay to the Works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the Works.

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1.3. Storage of Materials

Generally stacking and storage of construction materials at site shall be as per recommendations in IS: 4082. All materials required to be incorporated in the Works shall be stored in racks in bins, under cover etc. as appropriate and as amplified in the succeeding clauses to prevent deterioration or damage from any cause whatsoever to the satisfaction of the Engineer-In-Charge.

1.4. Records & Usage of Materials

The Contractor shall maintain detailed records of all materials received at Site or in his workshop and also about the consumption, balance in stock etc. and shall make such records available to the Engineer-In-Charge at all times as the latter may reasonably require.

Depending on the types of materials the same should be used in the order in which they arrive at site and as directed by the Engineer-In-Charge.

1.5. Contractor's Responsibility

The Contractor shall be responsible for keeping the material in sound and acceptable condition from the time of consignment of any material is received at site and till its consumptions. Any material not approved for use shall be removed from the site at Contractor's cost.

1.6. Workmanship

In all cases the work shall be carried out in accordance with the latest Indian Standard Specifications and the best Engineering practice. In the absence of such specifications, work shall be executed in accordance with any other relevant standards issued elsewhere as approved by the Engineer-In-Charge or as per the instructions and directions of the Engineer-In-Charge.

1.7. Constructional Plant (s)

The Contractor shall be responsible for the supply, use and maintenance of all Constructional Plant and Equipment so as to ensure smooth and efficient working of the job at his own cost. The Engineer-In-Charge shall have access to the Plant at all times.

1.8. Workmen and Staff

The Contractor shall ensure that they employs only capable and experienced labour force, foremen, other tradesmen and supervisory staff on the job capable of handling the types of work assigned to them in a workmanlike and efficient manner to the satisfaction of the Engineer-In-Charge. They shall also ensure that his Sub-contractors or nominated Sub-contractors also employ all workmen and supervisory staff capable of delivering work of a high standard.

For all concrete work, a fully qualified and experienced Quality Control Engineer shall be employed by the Contractor and he shall be available on Site at all times when concreting operations are in progress. Operators for mixers, mechanical vibrators and personnel in-charge of placing of concrete shall be fully trained and experienced for their type of work.

1.9. Method of Measurement

Mode of measurement shall be in accordance with the relevant parts of IS: 1200 "Method of Measurement of Building and Civil Works" only, unless otherwise specified in various item wise specifications describes herein below.

1.10. Rates and Prices

Unless otherwise mentioned, the rates and prices set against items in the bill of quantities or which can be reasonably inferred there from complete as a functioning entity shall include all costs and expenses which may be required in and for the construction of the work such as material to be incorporated in the works (permanent/ temporary), labour required for all operations, temporary works, tools and equipments as required, all operations required for the completion and or maintenance of the relevant items as per specifications, all leads and lifts unless otherwise specifically mentioned in the items, including all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.

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2.9.2 List of Bureau of Indian Standard Codes (BIS)

Following is the consolidated list of various Indian Standards relevant to the civil works appearing in this specification.

GENERAL

S. No	IS Code No	Particulars
1	IS : 4082-1977	1. Carriage of materials. Recommendation of stacking and storage of construction materials at sites. (1 st revision) (Reaffirmed-1990)
2	IS:1200 (Part 22)-1988	Method of Measurement of Building & Civil Engineering Works-Part 22-Materials
3	IS : 17293-1974	Safety code for working with construction machinery
4	IS : 7969-1975	Safety code for handling & storage of building materials
5	IS : 8989-1978	Safety code for erection of concrete framed structures
6	IS : 4014 (part 2) 1967	Code of practice for steel tubular scaffolding – Part 2 – Safety regulations for scaffolding
7	IS:13416 (Part 1) 1992	Preventive measures against hazards at work places – Part 1 – Falling material hazard prevention.
8	IS : 13416 (Part 2)1982	Preventive measures against hazards at work places recommendations – Fall prevention.
9	IS: 13416 (part 3) 1994	Preventive measures against hazards at work places – Recommendations – Part 3 – Disposal of debris (MULBA)
10	IS : 13416 (Part 5) 1994	Preventive measures against hazards at work places – Recommendations – Part 5 – Fire protection

STEEL WORK

S. No	IS Code No	Particulars
1	800-1984	Code of practice for use of structural steel in general in steel construction (2 nd revision) (Amendments 2) (Reaffirmed 1991)
2	806-1968	Code of practice for use of steel tubes in general building construction (1 st Revision) (Amendment 1) (Reaffirmed 1991)
3	812-1978	Glossary of terms relating to welding and cutting of metals (Reaffirmed 1991)
4	813-1986	Scheme of symbols for welding (revised) (Reaffirmed 1991)
5	816-1969	Code of practice for use of metal arc welding general construction in mild steel (1 st revision) (Amendments 2) (Reaffirmed 1992)
6	818-1968	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations (1 st revision) (Reaffirmed 1991)
7	822-1970	Code of procedure for inspection of welds (Reaffirmed 1991)
8	1200-1993	Method of measurements of building and civil

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FINISHING

S. No	IS Code No	Particulars
1.	104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming (Reaffirmed 1993) (2 nd Revision)
2.	109-1968	Ready mixed paint, brushing, priming plaster to Indian Standard colour No.361.631 white and off white (Reaffirmed 1993) (1 st Revision)

DISMANTLING AND DEMOLITION

S. No	IS Code No	Particulars
1	1200-1974	Method of measurements of building and civil engineering works: Part XVII: Demolition and dismantling (Reaffirmed 1992) (3 rd Revision)

NOTE: INCASE OF ANY VARIANCE OF TECHNICAL SPECIFICATIONS WITH THE LATEST BIS CODES, RELEVANT LATEST BIS CODES SHALL BE APPLICABLE.

3 PRE FABRICATED STRUCTURAL SHED:**General****A. Structural Members**

- Supply of Primary (Built-up) sections which are fabricated from hot rolled steel plates conforming to ASTM A 572M Grade 50 Type 2(or equivalent) with a minimum yield strength of 345 MPa. Flanges are welded to the web by a continuous fillet weld deposited by an automatic submerged arc welding process. The Built up frame shall have shot blasted with one coat of primer paint applied as per standards.
- Supply of Primary (Built-up) sections which are fabricated from hot rolled steel plates conforming to ASTM A 572M Grade 50 Type 2(or equivalent) with a minimum yield strength of 345 MPa. Flanges are welded to the web by a continuous fillet weld deposited by an automatic submerged arc welding process. The Built up frame shall have shot blasted with one coat of primer paint applied as per standards.
- Supply of Hot rolled sections are mill produced according to ASTM A36 M with minimum yield strength of 345Mpa (50 ksi).
- Supply of Galvanized secondary members are cold-formed from steel coils conforming to ASTM A 653M (or equivalent), with zinc coating to Z275 designation (275 g/m²) having minimum yield strength of 450 MPa

B. Roofing panel:

- Supply of double-lock standing seam system, of nominal effective cover width with two major corrugations, as per manufacturer's specification. This panel should be supplied in single piece of any length by moving the roll former to the site. The feed material is manufactured from 0.60 mm Base Metal thickness (BMT), min. 345 MPa yield strength coated with hot dip metallic Aluminum/Zinc alloy coating, GALVALUME AZ150 as 150 gms/sq.mt total on both sides of Aluminium (55%) & Zinc (45 %), confirms to ASTM 792 or AS 1397. The paint finish thickness shall have a total coating thickness of nominal 25 µm, comprising of nominal 20 µm on exterior face and over nominal 5 µm epoxy primer coat on exterior surfaces of approved colour shade by concern authority. The interior face will not have paint. The steel manufacturers test certificate for the chemical and mechanical properties of steel must be submitted for approval by the concerned authority prior to installation. Specially designed roof clips shall be used to hold double-lock standing seam panels to the supporting structure member. The clip

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shall be design to move freely in both directions to take care of thermal expansion and contraction. The insulation shall be polynum of 8 mm thick with double bubble as approved by concern authority. The panel end lap shall be joined by mean of a two piece clamped connection consisting of a bottom reinforcing plate and top panel strap. Manufacturers recommended specially designed ridge capping, flashing; trims, gutter and downpipe shall be used for fixing double-lock standing seam system which shall be approved by concern authority. Fastener shall be used for fixing double-lock standing seam system as per manufacturer's recommendation. The measurement shall be based on finished / covered surface area.

C. Wall Panels:

- i) Panels are roll formed from nominal 26 Guage / 24 Guage as Total Coated Thickness with minimum yield strength of 550 MPa, coated with an aluminum /zinc alloy (i.e. GALVALUME), AZ150 (min 150 gm/m² total on both side), conforms to USA standards, pre-painted with quality paint coat as per AS/NZS 2728 Class 3. The paint finish thickness shall have a total coating thickness of nominal 35 µm, comprising of nominal 20 µm on exterior face and nominal 5 µm reverse coat on interior face over nominal 5 µm epoxy primer coat on both surfaces of approved colour shade by concern authority. The steel manufacturer's test certificate for the chemical and mechanical properties of steel must be submitted for approval by the concerned authority prior to installation.

D. Profile dimensions:

- i) Trapezoidal type rib as per manufacturer's specification to be provided. The end rib shall be designed for anti-capillary action, to avoid any seepage of water through the lateral overlap.

E. Trims & Gutters:

- i) **Wall flashing** and trims (gable, corner, framed opening, accessories, etc.) are manufactured from same color, finish and thickness as wall panels.
- ii) **Roof flashing** and trims (parapet flashing, transition trims, expansion joint trims and ridge caps) are manufactured from same color, finish and thickness as roof panels.
- iii) **Eave gutters** are cold-formed from the same material as wall panels and downspouts will be of PVC.

3.1 PVC RAINWATER PIPE:

3.1.1 MATERIALS:

- F. The low density PVC pipes of specified diameter with 6 Kg /Sq. Cm. working pressure shall conform to I.S. 3076 – 1968. The fittings required shall be of best quality.

3.1.1 WORKMANSHIP:

- G. The P.V.C. pipes of specified diameter shall be fixed as directed. Due to thermal expansion of rigid P.V.C Pipes, due allowance shall be made in pipe lines for any change in length of pipe line which may occur during installation or when pipe line is in service. P.V.C pipe should be undertaken after precautions are observed for their protection against dirt, sun rays and mechanical damage. P.V.C pipes shall be supported at an interval of 2000 mm.
- H. Closer support spacings shall be provided, if recommended by the manufacturer.
- I. The guide line indicated by the manufacturer regarding handling, transportation, storing, laying and jointing of pipes shall be kept in view during execution.

3.1.2 Jointing the pipes:

- J. The pipes end shall be accurately cut. The ends of the pipes and fitting should be absolutely free from dirt and dust. The outside surface of the pipes and the inside of the fittings shall then be roughened with emery paper, and then solvent cement shall be applied to the matching surface and pushed home and joined. Since solvent cement is aggressive to P.V.C care must be taken to avoid applying excessive cement to the inside of

pipe sockets as any surplus cement cannot be wiped off after jointing. Empty solvent cement tins, brushes, rags of paper should be gathered, not left scattered about.

3.1.4 If any manufacturer recommends its own methods of jointing, the same shall be adopted after necessary approval from the Engineer -in-charge.

3.2 Accessories:

3.2.1 **Anchor bolts** are manufactured from rods conforming to ASTM A 36M (or equivalent) with a minimum yield strength of 250 MPa and an ultimate strength of 400 MPa.

3.2.2 **Bracing rods**, used in sidewalls of buildings supporting cranes are solid plain round steel bars conforming to ASTM A36 M (or equivalent) with minimum yield strength of 250 MPa.

3.2.3 **Flange braces** used to stabilize the inner flanges of main frame columns and rafters of cold formed steel angles conforming to ASTM A 653M (or equivalent) with a minimum yield strength of 345 MPa

3.2.4 **Base / gable angles** shall be supplied as required by the design requirements, cold-formed from galvanized steel conforming to ASTM A 653M (or equivalent), with zinc coating to having a minimum yield strength of 345MPa.

3.2.5 **Roof Fixing Clip**: Specially designed roof clips shall be used to hold double-lock standing seam system to the supporting structure member. The clip shall be designed to move freely in both directions to take care of thermal expansion and contraction.

3.2.6 **Panel Endlap**: The panel lap shall be joined by means of a back-up plate provide at the lap. All other special accessories should also be factory fabricated including flashings, ridge cap, gutter, downpipe or any other covering shall be as per manufacturer's recommendations.

3.2.7 **Sealant**: Special grade of silicon sealant non-hardening, neutral cure type of approved make and grade shall be applied at all side laps and endlaps (with flowable mastic) as per manufacturer's recommendation and approval by engineer-in-charge.

3.2.8 **Metal closures at eave & ridge**: The inside closure at eave and outside closure at ridge shall be made of steel only (of same material as roof sheet).

3.2.9 **Bead mastic**: is an extruded elastomeric butyl rubber based sealant supplied in rolls on silicon release paper conforming to Federal Specification TT-C-1796 A Type II Class B (or equivalent).

3.2.10 **Flowable mastic** (caulking sealant) is a neutral cure silicone rubber sealant that is chemically inert and non-corrosive. It is UV resistant and suitable for exterior applications against weathering and rainwater. When cured it is non-toxic and will accommodate high thermal and shrinkage changes in structural movement joints.

3.2.11 **Foam closures** should be to match the panel profile for wall panels wherever necessary.

3.2.12 **Fasteners**: The panel clip shall be fastened to structural members with self drilling fastener as per manufacturer's recommendation. The size of the fastener shall be calculated as per the design load and approved by concern authority.

3.2.13 **Insulation**: The insulation material shall be Polynum™ Double Bubbles fibre-free, thermo-cellular reflective insulation 8.0mm thick, consists of two layers of 4.00mm bubbles each, and two reflective layers, with low Emissivity (0.03 to 0.05 for each reflective surface), manufactured by Polyon Industries.

3.2.13.1 The insulation material shall comply with AS/NZS 4859.1 and, and be tested and certified to the following:

- AS/NZS 4859.1
- AS/NZS 4859.1 Appendix 1
- ASTM-E408
- ASTM-C1371: 1998
- AS 1530.3
- ASTM-E96
- ASTM C - 1338
- ASTM C 1136-92
- ASTM E84-97a
- BS476 Part 7
- ASTM 384-90

3.2.13.2 The insulation material shall be installed as recommended at Polynum™


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3.2.13.3 Submittals:

- 3.2.13.3.1 Product Data: Manufacturer's descriptive literature for reflective insulation material; indicate compliance to specified product characteristics, including documentation of code compliance, if documentation is required.
- 3.2.13.3.2 Verification Samples: Two samples, minimum size 8 inches (203 mm) square, of actual products to be installed.
- 3.2.13.3.3 Quality Assurance Submittals: Manufacturer's printed installation instructions for each indicated project condition; include recommended fastening materials and techniques.
- 3.2.13.3.4 Delivery Storage and Handling: Store products of this section in manufacturer's unopened packaging until installation; maintain storage conditions recommended by manufacturer. Store in clean & dry area. Do not expose to rain, dew, or snow while still in roll form.

3.3 Polynum Double Technical Specification

Property	Units	Dir	Value
Nominal thickness	mm	Down	8
Emmisivity (ASTM C 1371)			0.05
Reflectivity (ASTM C 1371)			0.95
Heat resistance (R)-under roof	m ² .°C/W		3.06
Noise Reduction Coefficient (ASTM E-384)	%		55%
Sound Transmission Class (ISO 171-1)	dB		-6
Tensile strength @peak (ASTM C-1136)	g/cm-width	MD	2650
		TD	2750
Elongation @peak (ASTM C-1136)	%	MD	18.7
		TD	18
Tear strength (ASTM D-1938)	N	MD	12.5
		TD	13.5
Puncture resistance (TAPPI T 803)	Joule		4
Surface Flame Spread (BS 476:Part 7)			Class 1
Water Vapor Transmission (ASTM E-96)	g/ft ² -hr		0.018 (method A)
Fungal Resistance Test (ASTM C 1338)			No fungal growth
Corrosion Resistance (Internal Test)	Conc.HCl		High Resistance
Yield (nominal)	g/m ²		320
Standard Roll Size	m x m		1.20 x 40
Standard Roll Weight (Gross)	kg		±15.4

3.4 Erection and Fixing:

- 3.4.1 The installation shall be done in accordance to the standard practices as specified by the manufacturer and as approved by the concerned authority. All sheets and accessories must be stored and finally erected without any damage.
- 3.4.2 The Contractor shall also submit methodology for fixing and also a maintenance manual for routine maintenance.
- 3.4.3 Special flashing, ridge capping and trims shall be fixed as per manufacturer's recommendation. The shape and girths shall be as per design requirement and shall be approved by the concern authority.
- 3.4.4 Panel clips shall be positioned by means of an alignment strap used for drilling holes in the secondary structural members.
- 3.4.5 Panel shall be positioned and properly aligned with the panel end with alignment strap in the eave structural member and by aligning the panel with the panel clip.
- 3.4.6 Panel sidelap shall be field-seamed by a self-propelled and portable electrical lock-seaming machine. The machine field forms the final 180 degrees of a 360 degree double-

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lock standing seam system; all side lap sealant shall be factory applied.

3.4.7 Panel endlap, when required, shall be at least 150mm sealed with neutral-cure sealant and fastened together by clamping plates. Sealant shall contain hard nylon beads which prevent it from flowing out due to clamping actions. The panel lap shall be joined by means of back-up plate provided. The panel endlap shall be located directly over, but not fastened to, a supporting secondary roof structural member.

3.4.8 The Contractor shall ensure that panel erector is familiarized with the erection procedure and all the supporting members are straight, level and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings by the consultant/ client.

3.5 Measurement:

3.5.1 No separate payment will be made for the laps of sheet and accessories, bolts, nuts, washers, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the quoted rates.

Notes:

Specification language for Skylight Translucent sheeting-

DESCRIPTION	POLYCARBONATE
GENERAL PROPERTIES	
Material	Polycarbonate
Conforming to standard	-
Thickness	2.0 mm
Light Transmission (Max)	95%
Heat Transmission	-
UV Protection	99.90%
Chemical Resistance	Moderate
Diffused Light	No
Cracking Resistance	Poor
Appropriate Length	< 6m
Max. Span at 1 kPa	1.0 m
Silicon Sealant	Special Silicon containing Polycarbonate
PHYSICAL PROPERTIES	
Tensile Strength	65 MPa
Impact Strength	20 Joules
Shear Strength	41 MPa
Modulus of Elasticity	2400 MPa
Compressive Strength	-
Flexural Strength	87 MPa
Specific Gravity	1.2
Thermal Conductivity	0.21 watt / m °C
Water Absorption	0.36% in 24 hrs / 23 °C
Fire Spread	Self-extinguishing
Recommended Service Temperature Range	-40 ° to + 110 °C
MATERIAL EXPANSION 0 °C TO 40 °C TEMPERATURE VARIATION, SHEET LENGTH 6 METERS	
Thermal Expansion	16.2 mm
Thermal Co-efficient	6.75 x 10-5 cm / cm / °C

Note: Poly Carbonate sheets shall be seamed along with the roofing sheet.

3.6 PAINTING:

3.7 General conditions

3.7.1 Standards, codes and regulations

3.7.2 The painting work is to be executed according to the valid standards, codes and regulations on their latest revision.

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- 3.7.3 The following standards, codes and regulations shall be taken into consideration:
- IS standards

3.8 General:

3.8.1 The supplier has to deliver all the materials and work tools which are needed for performing the job. For instance, painting, cleaning solvents, dilution solvents, brushes, special equipment, scaffolding, ladders, rigging material, collective protection material.

3.8.2 The specifications shall be respected and it is only the client/ consultant who can issue a waiver.

3.8.3 The specifications, recommendations, HSE recommendations mentioned on the technical Specifications of the painting supplier shall be respected. Special attention is drawn on the HSE aspects when working in confined objects, such as the interior of the tanks. A prevention plan according to this issue is set up before start of the work. Painting jobs are considered as high risk jobs and a safety and environment prevention plan has to be set up by the Contractor before start of the work.

3.9 Storage of the coatings and solvents:

3.9.1 The coatings and solvents shall be stored in a ventilated container or storage room and in an ambient temperature which is never lower than 1°C.

3.10 Method of appliance of the layers:

3.10.1 On the surfaces shall the layer been applied one after each other and between the appliance of each layer shall a drying time been respected according to the technical specification of the coating supplier. Each layer shall have a different colour. The minimum thickness as stated in the technical specifications of the supplier and in this specification shall be respected.

3.10.2 All surfaces which have a skin temperature of $\geq 60^\circ\text{C}$ shall not be painted.

3.11 Atmospheric conditions :

3.11.1 Painting is not admitted when:

3.11.1.1 Ambient temperature is lower than 5°C .

3.11.1.2 If the circumstances are too humid (rain, fog, snow, heavy showers) or/and if the relative humidity exceeds 85 %.

3.12 General precautions:

3.12.1 Bolts, nuts, stud bolts, screws shall not been painted and temporarily protected for accidental paint, unless otherwise asked by the Client. Tag plates, name plates shall not been painted and temporarily protected for accidental paint.

3.12.2 The Contractor collects all removed dust, rust, spilled solvents and paints and any leftovers of paint and solvents and removes them from the site of the Contractor. All these materials are destroyed or deposit conform the local regulations.

3.12.3 The Contractor shall avoid any spill of paint and / or solvent on parts or surfaces belonging to the site of the client. To avoid spills on these parts, the Contractor shall cover during the execution of the painting work (when needed) the parts.

3.13 Cleaning and removal of rust or other foreign matters:

3.13.1 Cleaning of steel and removal of rust:

3.13.1.1 All the surfaces which shall be protected by a coating shall thoroughly be cleaned and prepared with as objective to remove dust, mill scale, protective coating applied during the rolling process, rust, greases, oil, humidity and other foreign matters to assure that the coating adhere on the surface and that should last as long as the normal lifetime is expected.

3.13.2 New steel surfaces:

3.13.2.1 Preparation: Surface preparation according to ISO 8501-1 degree of primary surface preparation ISO-SA 2.5 (comparable with British standards BS 4232 - 2nd quality or American Standards SSPC-Vis 1 - Near White SP 10)

3.13.2.2 Cleaning method:

3.13.2.2.1 Blast cleaning by any method is permitted only if method of blasting is dust free. Alternative cleaning methods should be applied (water cleaning or hydro jetting, wire rushing, disc sanding, Needle hammering) can also be resorted to.

3.13.2.2.2 All blasted surfaces shall be applied with a primer coat within 4 to 6 hours after blasting. No blasting/painting shall be carried out if the relative humidity is in excess of 85%.

3.13.2.2.3 Special requirement for pipes, flanges: the interior of the pipes shall be free of any foreign matters after applying of the primer on the exterior of the pipes. The Contractor shall take adequate measures in this regard.

3.14 Painting systems:

For new surfaces: Painting to PEB structure with Epoxy paint

In the Workshop:		
1 st Layer	Zinc Silicate Epoxy Primer	Thickness of the layer after drying (DFT): 50 microns
2 nd Layer	Epoxy paint 1 st Coat	Thickness of the layer after drying (DFT): 100 microns
3 rd Layer	Epoxy paint 2 nd Coat	Thickness of the layer after drying (DFT): 100 microns
On Site :		
Repair of damaged surfaces	Epoxy finish coat	Thickness of the layer after drying (DFT): 50 microns


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4 STEEL WORKS

Structural Work in built-up section (Welded/ bolted)

Although Broad Specifications for Structural Steel Works are as indicated below, the entire work shall be executed strictly in keeping with the working methodology, sequence of operations, safety and security etc. as approved by the Engineer-In-Charge, in best workmanship in conformity with relevant IS codes and the specifications of this tender document.

The Tenderer shall submit his own fabrication / erection methodology comprising sequence of operations to suit the works requirement such as -

- a) Material movement / storage of material
- b) Fabrication scheme considering space constraints
- c) Scheme for erection to be done at about 30 mtr. height for trusses
- d) Retractable Roof work
- e) Sliding Motorized Doors work
- f) Structural steel work of Blasting Chamber.
- g) Necessary Safety precautions as per prevailing rules.
- h) Security formalities to be maintained being a MDL area.

General

In addition to the requirements contained in this Specification, all materials shall conform to the latest edition of the relevant Indian Standard or its equivalent standard approved by the Engineer-In-Charge and shall, if required, be tested as prescribed therein.

In the event of conflict between this Specification and recognized standards, then the requirement of this Specification shall govern.

The work shall be carried out by competent personnel skilled in their various trades. All work shall be of the highest quality and the work shall be the subject of inspection and approval of the Engineer-In-Charge and the Employer.

All material shall be obtained from an approved supplier and manufacturer's appropriate test certificates shall be available upon request by the Engineer-In-Charge or the Employer.

All Steelwork shall be straightened or curved as necessary by pressure and not by hammering.

When bolt heads or nuts bear upon bevelled surfaces they shall be provided with square tapered washers to afford seating for the nut square with the axis of the bolt.

All nuts and bolts specified on the Drawings shall be to the required size with correct threaded length, and be supplied with matching nuts and washers also of the same material, except where electrolytic action is to be avoided.

Where small parts such as bolts and nuts etc. are to be sherardized, they shall be treated to receive a coating of finished thickness not less than 30 microns.

Where bolts, nuts and washers etc. are to be hot dip galvanized, they shall be treated to receive a finished thickness of zinc coating of not less than 80 microns thickness.

The Contractor shall give due notice to the Engineer-In-Charge in advance of the materials or workmanship getting ready for inspection.

The Engineer-In-Charge shall have free access at all reasonable times to those parts of the contractor's work which are concerned with the fabrication of the steel work and those portions of the site where assembly or erection is being carried out. The contractor shall give all reasonable assistance required in connection with the inspection and testing of the work.

No part of the work shall be treated as approved unless so informed by the Engineer-In-Charge in writing. However, approval of any material fabricated at shop / field shall not invalidate final rejection at site by the Engineer-In-Charge if it fails to be in

proper condition or has fabrication inaccuracies, which prevents proper assembly. Similarly any approval of the fabrication and / or erection by the Engineer-In-Charge shall not relieve the Contractor of his responsibility for furnishing material and / or workmanship conforming to the requirements of the specifications.

All sections shall be free from surface defects such as pitting, cracks, laminations, twists, bends etc. The use of defective sections shall not be permitted and all such rejected material shall be immediately removed away from the store / site at contractor's cost.

All sections shall be marked for identifications and each lot shall be accompanied by manufacturers quality certificate, chemical analysis and mechanical characteristics as specified in relevant IS Codes.

Each lot of electrodes, bolts, nuts etc. shall be accompanied by manufacturer's quality test certificate conforming to relevant IS codes.

Materials at the shops shall be kept clean and protected from weather.

All members likely to collect rain water shall have drain holes.

Not more than one shop shall be provided to make the full length of a member.

All bolts, nuts, washers, rivets, electrodes, screws, etc. shall be supplied 10% in excess of the requirement in each category and size.

Materials -

Unless specified otherwise various materials shall conform to the following IS Codes and Standards -

Structural steel (Standard quality): IS:226

Rolled steel section : IS: 808

Steel tubes for structural purpose: IS: 1161

Structural steel (for walkways, ladder, hand rails): IS: 1977

Welded Electrodes: IS: 811

Threaded fasteners: IS 1367

Supply

Supply of structural steel and all required material for the works shall be arranged by the Contractor.

Receipts and storing of materials

All steel shall be carefully off-loaded and stacked on timber or concrete supports suitably spaced on a firm level surface, and of sufficient height to keep steel clear of the ground and water. The steel shall be stored separately, by section size or thickness.

All sections shall be checked, sorted out and arranged by grade and quality in the store as per instructions of the Engineer-In-Charge.

All bolts including nuts and washers shall be thoroughly checked, sorted out and arranged diameter wise by grade and quality in the store.

All materials shall be kept protected from corrosion. Storing shall be generally in accordance with IS: 4082.

Welding electrodes and welding wires if used shall be stored separately in their original bundles or cartons, in a dry place adequately protected from weather and other effects as per IS :9595 and as per instructions given by Engineer-In-Charge. Electrodes shall be kept dry.

Welding

Welding shall generally be done by electric arc process and shall conform to the respective IS Codes and Standards as listed above.

Sequencing of welding

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- a) The contractor shall choose the welding sequence after carefully studying each case such as to minimize distortion and shrinkage and submit the same to the Engineer-In-Charge for comments and approval.
- b) As far as practicable, all welds shall be made in sequence that will balance the applied heat of welding while the welding progresses.
- c) The direction of the general progression in welding on a member shall be from points where the parts relatively fixed in position with respect to each other towards points where they have a greater relative freedom of movement.
- d) All splices in each component part of a cover-plated beam or built up member shall be made before the component part is welded to other component parts of the member.
- e) Joints expected to have significant shrinkage shall be welded before joints expected to have lesser shrinkage.
- f) Welding shall be carried continuously to completion with correct number of runs.

Quality of Weld

The weld metal as deposited shall be free from blow holes, cracks, slag inclusions, excessive porosity, cavities and other faults. It shall be properly fused with the parent material without overlapping or serious under-cutting at the toes of the weld. The weld surfaces shall be cleaned of slag or flux and show a uniform and consistent contour and regular appearance.

Faulty Works

In the event of excessive convexity, weld size is to be reduced by removing the excess weld metal. In the event of faulty work, the defective portions shall be cut out and re-welded. Where serious under-cutting occurs, additional weld metal shall be deposited to make good the reduction. In case of members getting distorted due to heat of welding, the members are to be straightened out by mechanical means or by careful applications of limited amount of heat when temperature of the areas affected more than 650 C.

Protection

Immediately after dislodging, inspection and approval, all site welds and the surrounding surfaces shall be painted to protect the metal.

Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance with IS: 1852 and/or ASTM A6.

No rolled or fabricated member shall deviate from straightness by more than 1/1000 of the axial length or 100 mm whichever is smaller.

The length of members with both ends finished for contact shall have a tolerance of ± 1 mm.

Members without ends finished for contact bearing shall have a tolerance of ± 1.5 mm for members up to 10 meters long and a tolerance of ± 3 mm for members over 10 meters in length.

Lateral deviation between centre line of web plate and centre line of flange plate at contact surface in the case of built up sections shall not exceed 3mm.

The combined warp age and tilt of flanges in welded built up sections shall not exceed 1/200th of the flange width or 3 mm whichever is smaller.

The deviation from flatness of welded plate girder web in the length between stiffeners for a length equal to the depth of the girder shall not exceed 1/150th of such length.

Deviations from the specified depth of welded girders measured at the centre line of the web shall not exceed ± 3 mm up to a depth of 1000 mm, ± 5 mm for depths above 1000mm, up to 2000mm and + 8mm and - 5mm for depths over 2000mm.

Painting

The whole of the steel work shall be thoroughly cleaned and all dirt, marks, grease overspills of primer paint and other foreign matter shall be removed by hand, cleaning tool (power tool cleaning) using compressed water jet etc. After this preliminary work of making good has been approved by the Engineer-In-Charge, all surfaces shall be thoroughly cleaned and when dry two finishing coats of approved paint shall be applied. Each coat shall be allowed to dry and harden thoroughly before the next coat is applied. The paint manufacturer's instructions shall be followed strictly. Also proper attention shall be paid to the following:

- i) Proper storage to avoid exposure and extremes of temperature
- ii) Surface preparation prior to painting.
- iii) Mixing and thinning.
- iv) Application of paint and the recommended limit on time intervals between consecutive coats.
- v) Primers and finish coat paints shall be from the same manufacture in order to ensure compatibility. Unless specified and approved, painting colour code shall be as directed by Engineer-In-Charge.

Painting work shall be carried out in accordance with IS: 8629 (Parts I to III)

All preparation, priming and painting, in colours selected by the Employer, shall be deemed to be included in the Contract price.

Painting shall generally be in accordance with IS : 1477

All items of equipment shall be suitably protected and packed to resist corrosion and impact damage. Machined surfaces are to be treated with a proprietary sealing agent for transportation and storage.

Paint materials shall be in accordance with the appropriate Indian Standard and shall be obtained from approved manufacturers and applied in accordance with the manufacturers' instructions or as ordered by the Engineer-In-Charge. All materials shall be delivered to the Site in sealed and labelled containers.

The paint for each coat shall be from the same manufacturer, compatible with the underlying coat and shall be a different colour for ease of identification.

Particular regard shall be paid to the maintenance of the recommended temperature and humidity during application and curing. Painted steelwork shall not be over coated or handled until the recommended curing period has elapsed. No finished paint coating will be accepted until the specified dry film thickness has been achieved to the entire surface including edges.

All steel surfaces shall be completely dry and free from oil and grease and all welds ground smooth and weld spatter removed. All fins at saw cuts, burrs and sharp edges shall be removed, and the edges shall be rounded off.

The surface shall be prepared by shot/grit/slag as per manufacturer's /contractor's own standard. The surface quality shall confirm to grade SA2 as per ISO Standard 8501-1/manufacturer's specifications.

For all painted items, the Contractor shall submit for approval a 'Paint System Sheet' stating full details of each paint system proposed indicating the following information, with reference to IS:1477. Surface preparation system reference together with manufacturer's brand name and product reference dry film thickness colour time to repaint

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Items to be painted:

All existing & new structural steel member including columns, trusses, purlins, floor plates, floor gratings, stair treads, hand rails, brackets, steel inserts etc. but not limited to it shall be painted except if otherwise specified.

No black bolts, nuts, washers and welds shall be painted before assembly or erection and approved by Engineer-In-Charge. They shall be thoroughly cleaned and dipped into boiling linseed oil and after erection, painted as specified herein.

Standard

The operations, workmanship, schedules and equipment for painting shall be generally comply with the requirement to IS: 1477 (Parts I & II) "Code of Practice for Finishing of Iron and Steel in Building – Painting and Allied Finishes".

All painting shall be carried out by brushing, spraying and roller application of paint shall not be allowed without the written permission of the Engineer-In-Charge.

No painting shall commence until the cleaned surfaces are approved by the Engineer-In-Charge.

No exterior or exposed painting shall be carried out under adverse weather conditions such as rain, extreme humidity, dust storms etc.

Rub down and primer application

The existing steel surfaces shall be rubbed down thoroughly with emery/abrasive paper to remove dust, rust, other foreign matters and degreased, if required, in accordance with IS: 1477, cleaned with warm fresh water and air dried. The portions, from where the shop coat has peeled off, shall be touched up and allowed to dry. Primer coat of **zinc chromate primer** (conforming to IS: 2074) shall be applied by brushing/spraying in a manner so as to ensure a continuous and uniform film throughout. Special care shall be taken to cover all the crevices, corners, edges etc.

Unless otherwise specified, paints shall confirm to the relevant IS specifications. The paints which have been tested for the following qualities as per specifications given in the relevant IS codes only shall be used:

- Weight test (weight for 10 litre of paint, thoroughly mixed)
- Drying time
- Consistency
- Dry thickness and rate of consumption.

Final paint application

After the primer is dry, the surfaces shall be dusted off and one coat of **Epoxy paint** shall be applied by brushing/spraying so that a film free from "holidaying" is obtained. The thickness applied for each coat to be measured by DFT meter.

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5. STRUCTURAL STEEL FABRICATION AND ERECTION WORK

The structural steel for Construction of blasting and Painting Sheds at MDSL area have to be designed by RCC structural consultant or Chartered Engineer prior to execution of work at site to take the permanent loads of all Dead loads, handrails, lighting fixtures, wind load, earthquake load, seismic load etc. and moving loads to be considered at the time of design. The fabricated/epoxy painted structural steel will be retained as it is permanently. The cost of structural designer to be considered at the time of quoting the rate by the bidder. No additional cost will be paid by Client MDSL. For Fabrication work at site, skilled personnel will be required to carry out the work at constrained space and having the experience of work done around marine conditions. **Methodology for fabrication and execution of work will have to be submitted by the contractor.**

The fabrication and erection of structural steel work shall be in compliance with:

5.1.1 General specifications for structural steel work as per IS: 800.

5.1.2 Necessary drawings to be prepared by the contractor to be got approved through MDL before execution of work.

5.2 The fabrication and erection of steel work shall consist of accomplishing of all jobs including providing all labour, tools and plant, all materials and consumables such as welding electrodes, bolts and nuts (GKW Quality) Oxygen and Acetylene gases, oils for cleaning, etc., all of approved quality as per the relevant IS Specifications. The work shall be executed according to the drawings, specifications and relevant IS codes in an expeditious and workmanlike manner and of best standard to the complete satisfaction of the Engineer of MDL.

5.3 All materials shall be new and shall conform to the respective specifications as specified. The use of equivalent or higher grade or alternative materials will be considered only in very special cases subject to the approval of the Engineer of MDL.

5.4 Structural steel shall conform to IS: 226 or IS: 2062. Steel plates for crane girders shall conform strictly to IS: 2062. Bolts and nuts shall be of GKW Quality and in accordance with IS: 1363.

5.5 The fabrication work shall be done in accordance with IS: 800, in addition to the following:

The fabrication work shall be done as per the approved fabrication drawings or as directed. The connections shall be welded or bolted as per the approved drawings or as directed. The work shall include also fabrication of built up section, if required. Any fault fabrication pointed out at any stage of the work by MDL shall be made good by the contractor at his own cost.

The structural steel member shall be cut mechanically or by oxy-acetylene flame. All edges cut by oxy-acetylene process shall be cleaned of all slag materials prior to assembly. Edge preparation for welding of members more than 10mm thick shall be done by edge cleaning machine only.

5.5.1 All bolt holes shall be drilled. The drilling shall be made to the diameter specified in the drawings. No enlarging of holes by filling, by man drilling or oxy-acetylene flame shall be allowed.

5.5.2 The assembly of structural members shall be done with proper jigs and fixtures to ensure the correct positioning of the members. The first component / assembly fabrication in such jigs and fixtures shall be inspected thoroughly by the contractor and then offered to the Engineer of MDL for approval before proceeding with the fabrication.

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- 5.5.3 All welding shall be done either manually by the shielded metallic arc process. Welding shall be carried out only by fully trained and experience approved welders. All welds shall be usually made continuous and watertight. The welding electrodes shall conform to IS:816, low hydrogen type covering or equivalent.
- 5.5.4 The erection work in general shall be carried out as required only after approval by the Engineer of MDL.
- 5.5.5 All scaffolding work required for the erection work will have to be made by the contractor and included in the structural steel rate.
- 5.5.6 Positioning, levelling of the structural members and their alignment shall be done in accordance with the relevant drawing and to the complete satisfaction of the Engineer of MDL.
- 5.5.7 The various parts of the steel structure shall be done so erected so as to ensure stability against inherent weight, wind and erection trusses.
- 5.5.8 All field assembly and welding shall be executed in accordance with the requirement of the relevant fabrication drawings. The bolted joints shall be tightened so that the entire surface of the bolt heads and nuts shall rest on the members. For parts with sloping surfaces tapered washers shall be used.
- 5.5.9 Any faulty erection done by the contractor shall be made good at his own cost. The contractor shall satisfy himself about the levels, alignment, etc., before starting the erection work.

5.6 CONSTRUCTION SAFETY

5.6.3 IS: 3696(Parts I & II) - Safety code for scaffolds and ladders.

5.6.4 IS: 7969 - Safety code for handling and storage of building materials.

5.6.5 IS: 8989 - Safety code for erection of concrete framed structures.

5.6.6 MEASUREMENTS

IS:1200 (Part 1 to 23) - Method of measurement of building and engineering works

5.7 M.S. Tubular Hand Railing

Material

M.S. tubes for hand railing shall be 50mm outer diameter, unless specified of mild steel medium grade conforming to IS: 1239, vertical rolled steel angles etc. confirming to IS-808.

Toe/Base plates shall be of mild steel conforming to IS: 226

Fabrication

Hand railing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents / deformations. Tubes shall be cut and ends shall be prepared to a neat and workman like finish. All elements shall be directly welded. Tubes shall be cold bent to shape and curvature in case of discontinuous ends of handrails. Lower ends of vertical posts shall be cut and splayed (for grouting in pockets provided in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower end of vertical posts.

Erection / Fixing

Hand railing shall be fixed to the bearing members by welding / bolting / grouting as indicated in the drawings or as directed by the Engineer-In-Charge.

Painting

MS tubes shall be cleaned (both the surfaces) with wire brush and given two coats of yellow zinc chromate primer on the plain surface after fabrication conforming to

IS:2074 and 2 coats of approved Epoxy paint over one coat of primer of zinc chromate to be applied per specifications described under-Steel work specifications.

6.1. Details of Scope of work : -

Section 1: Design, Manufacturing, Supply & Execution of Structural Steel Shed Material by the Contractor.

Sr. No.	Nomenclature	Structural Steel Shed at Anik Chembur Yard
1	Type of Frame	As per Structural Engineer with respect to Defined scope
2	End Frames	Non-Expandable Light End frame
3	Width (m)	18.00 MTR Out to Out
4	Length(m)	20.00 MTR Out to Out
5	Intermediate Columns	AS PER DRAWING
6	Height (m)	10.00M at Ridge Level
7	Roof Slope	1:10
8	Bay Spacing along Building length	AS PER DRAWING
9	Bay Spacing along Building width	AS PER DRAWING
10	Type of Bracing in Sidewalls	Structural Steel
11	Framed openings	GI Rolling Shutter Size 4m x 6m
12	CANOPY	NA
13	Special Condition	• All Columns are fixed base and starting from FFL. • All secondary members are Built up and cold rolled and cold formed and spacing is as per our standard design. • The Structure is to be designed for normal working condition and under no circumstances the offered building should be subjected to high temperature (>55deg C) or toxic fumes or acid vapours failing which we shall not be liable for any inconsistent performance.
14	EAVE GUTTER	0.5 MM THICK GI GUTTER
15	Downspouts	0.5MM THICK PPGL 150AZ 550MPA WITH COVERING
16	Trims Flashings	0.5MM THICK PPGL 150AZ 550MP
17	Self-drilling screws	Xylon coated with EPDM washer

Roof Panel –JSW

Single Skin	Profile Sheet	0.50MM PROFILED THICK Color Coated
	Material	AZ150 GALVALUME 550MPA
	Finish	PPGL COLOR COATED
	Colour	AS per client approval
Trims +Flashings		0.5mM thick bare AZ150 GALVALUME 550MPA

Wall panel (Cladding) - JSW

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	Material	AZ150 GALVALUME 550MPA
	Finish	PPGL COLOR COATED

Trims +Flashings		0.50MM THICK COLOR COATED AZ150 GALVALUME 550MPA
Eave Gutter + Downspouts		0.50MM THICK COLOR COATED AZ150 GALVALUME 550MPA with 100mm /Hr rain intensity

Applicable Codes: - All the sheds are to be designed in accordance with the following codes -

- Design as per AISC 2010 and MBMA 1996
- Minimum Thickness for primary-4.0mm
- Minimum Thickness for Secondary -1.60mm
- Welding as per international welding AWS Code---

1	Design Live Load on Frames KN/SQ M.	057
2	Dead load KN/SQM	0.10
3	Wind Speed MBMA-96	39
4	Seismic Zone as per IS:1893 Part 1-2002	III
5	Solar Panel load above roof KG/SQM	NA

MAIN Frame	RAFTER	PURLINS	Girts	Crane Beam	Mezz Beam/Joist
Vertical Deflection	L/180	L/150	L/120	L/600	L/240

MAIN Frame	With Crane	Without Crane
Lateral Deflection	H/100	H/100

Standard Material Specifications-

Structural Components			Specifications
1	BUILT UP SECTIONS		345MPA, MAKE:TATA/JSW/ESSAR
2	Hot Rolled Sections	Beams & Channels	As per IS 2062-E250A,250MPA
		Angles	As per IS 2062-E250A,250MPA
3	Secondary Material	Pre-Galvanized	MAKE:TATA/JSW/ESSAR
4	DECK SHEETING	Pre-Galvanized	MAKE:JSW/ESSAR
5	Bracing Material	ROD	Grade Fe-250
6	Anchor Bolts	ROD	Grade Fe-250
7	Primary Connection Bolts		High strength Bolts, ASTM A325/8.8Grade
8	Secondary Connection Bolts		MS Bolt 4.6Grade

Trims & Flashings will be made of the same material sheeting material unless otherwise specified.	
Paint Scheme Primary & Secondary Structural Members	
Primer and paint	
For Primary Members only	Epoxy Paint
Secondary Members	PRE-Galvanized

7. ROOFING:

Corrugated Colour coated steel sheet single skin for Roofing/ Cladding:

7.1 Material

• Manufacturer –Product reference here below given are of M/s. Interarch Building Products Private Limited. However, other similar approved manufacturer's product reference can be used subject to prior approval of Engineer-In-Charge. • Product Reference - TRACDEK, HI-RIB AZ 150 GSM SMP Galvalume • 0.50 mm (including metallic coating) cold rolled galvalume steel, 550 MPa yield stress (ASTM A 446 Grade-E) with hot dip metallic coating of AZ 150 (150 gm / Sq.m, zinc / aluminium alloy coating of 55% and 45% respectively conforming to ASTM 792/AS 1397).

7.2 Storage on Site

Storage /stacking of the material shall generally in confirmation with IS 4082 unless otherwise specified by the manufacturer. Material shall be protected from damage while stored on site. When they are stacked for any length of time, it is recommended that cover be provided. Packs of sheets shall be kept dry in transit and on site to prevent water and / or condensation being trapped between adjacent surfaces. Packs of sheets standing on site shall be stored clear off the ground. Sheets shall be handled using clean dry gloves.

7.3 Paint

20 microns' exterior coat of silicon modified polyester (SMP) paint system over 5-micron polyester back coat over 5 micron approved primer. Colour of the roofing and cladding sheet shall be as approved by the Employer

7.4 Laying and fixing

Roofing sheets shall be factory cut and supplied in required lengths (upto 12m) to suit shop drawings. Sheets shall be crest fixed to purlins with 12 x 14 x 55 mm mechanically galvanized self-drilling fasteners with EPDM seals (one fastener on each crest, unless specified). Colour caps same as that of roofing to be supplied along with fasteners. End laps of roofing to be minimum 200 mm. Cladding sheets shall be supplied in required lengths (upto 12 m) to suit shop drawings. Sheets shall be valley fixed with 12 x 14 x 20 mm mechanically of 273 galvanized Self drilling fasteners with EPDM seals (one fasteners in each valley, unless specified). Colour caps same as that of cladding to be supplied along with fasteners. End laps of cladding to be minimum 100 mm.

Roofing and cladding shall generally comply with the following: • Slope of roofing shall be as shown on approved fabrication drawing. • Cut panels, sheets and flashings shall give clean true lines with no burrs. • Cut openings to minimum size necessary. • Lay panels and sheets with exposed joints of side laps away from prevailing wind unless shown otherwise on drawings. • Panel and sheet ends, laps and raking cut edges fully supported and with fixings at top of lap unless otherwise specified. • Drill holes, position at regular intervals in straight lines, centred on support bearings or as shown on the drawing. • Remove dust and other foreign matter before finally fixing panels and sheets. • After completion check fixings to ensure water tightness. • Cut edges paint to match face finish.

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7.5 Foam fillers

For roofing Self-adhesive PU form (polyurethane) fillers shall be supplied as per manufacturer's instructions matching to the shape of roof profile and to be fixed along the ridge and eaves end of roofing.

7.6 Finish

The roof when completed shall be true to lines and slopes and shall be leak proof. The ridge should be notched at the crest & turned down, at the ridge the valley of the roof to be turned up to prevent entry of water & dust.

7.7 Safety Precautions

No person other than workmen employed by the roofing contractor shall be permitted access to any area over which the sheeting is being laid. Cat ladders or roof boards should in variably be used by men working on the roofs. The observations of this rule which is advocated primarily on the grounds of safety, will also avoid damage to the roofing materials. All personnel on roof top shall have safety belts tied to life-line attached from the ridge to the eaves and also any other safety as per requirement of the manufacturer's instructions.

7.8 Scaffolding for cladding

Only steel 'H' frames shall be used for scaffolding. The scaffolding shall be design to execute the work at 30 meters' height and same shall be checked from the Engineer-In-Charge.

7.9 Material warranty

At least minimum 10 years' warranty against corrosion of material shall be given.

7.10 Leakages

Leakages if any, observed during contract period, including 2 years after expiry of defects liability period rectification and maintenance shall be the responsibility of the contractor at his own cost.

7.11 Measurements

The length and breadth shall be measured correct to a cm. Area shall be worked in Sq.m. correct to two places of decimal. The superficial area of roof / cladding shall be measured net 'as laid' and paid for accordingly. Laps shall not be paid for separately. Measurement shall be taken on the flat and not girthed. Roof with curved sheets shall be measured and paid for separately. No deduction in measurement shall be made for opening up to 0.4 sq.m and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.4 Sq.m in area, deduction in measurements for the full opening shall be made. Cutting across corrugation shall be measured on the flat and not girthed. No additions shall be made for laps cut through.

7.12 Colour coated sheet for flashing, capping & trims, etc.:

7.12.1 Material

These shall be formed out of same substrates and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5 m, unless specified in the required shapes and girths.

7.12.2 Fixing

These shall be supplied in required lengths (upto 2.5 m) to suit shop drawings and shall laid / fixed as per approved fabrication drawing. These shall be stitched to the roofing / cladding with 10x12x20 mm hex-head mechanically galvanised self-drilling fasteners with EPDM seals at every 500 mm c/c, unless specified. The end laps shall

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be stitched at minimum every 50 mm c/c unless otherwise specifically instructed by the manufacturer.

7.12.3 Finish

The edges of the flashing / capping and Trims shall be straight from end to end and their surfaces should be plane and parallel to the general plane of the roof. The ridges and hips shall fit in squarely on the sheets. Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

7.12.4 Measurement

The measurements shall be taken for net 'as laid' length along the centre line of flashing capping or Trims, correct to a cm. Laps provided in between shall not be measured.

7.13 2mm thick Fiber Reinforced Plastic corrugated transparent sheet Materials

Manufacturer – Product reference here below given are of M/s. Interarch Building Products Private Limited. However, other similar approved manufacturer's product reference can be used subject to prior approval of Engineer-In-Charge.

7.13.1 Product Reference

FRP sheets shall be supplied in 2mm thick matching to the roof profile in required length to suit approved fabrication drawing. Storage of materials, safety precautions, warrantee, leakages etc. shall be as described under roofing/ cladding specifications.

7.13.2 Fixing

FRP sheets shall be fixed to purlins with 12 x 14 x 55 mm fasteners with EPDM seal and having cyclonic washers. Butyl tape shall be applied on the side/ end lap of FRP sheets and near about roofing sheets. Fix in profile, in accordance with manufacturer's day light system recommendations, technical manual. Fixing should not be over tightened. Overlap (side and end) as per approved drawing.

Measurement

The length & breadth shall be measured correct to a cm up to two places of decimal. The superficial area of roofing shall be measured net 'as laid'. Laps shall not be measured separately. Measurement shall be taken on the flat and not girthed.

7.13.3 Rates

The rate shall include the cost of all the materials and labour involved in all the operations described above including necessary fittings and accessories scaffolding for cladding, laps as per drawing, safety precautions, overlaps etc.,

7.14 Colour coated steel sheet for gutters:

7.14.1 Material

These shall be formed out of same substrates and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5 m. in the required shapes and girths.

7.14.2 Profile

The depth, width and height should be as per the rainfall catchments area and as approved.

7.14.3 Fixing

Gutters shall be fixed as per profile and drawings approved for construction. The gutter shall be fixed on MS brackets of size and location as shown on the drawings. The end laps of gutter shall be bolted with galvanized (175 gauge minimum) nuts and bolts with metallic washers to suit design

7.14.4 Finish

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MAHARASHTRA GOVT

The edges of the gutters shall be straight from end to end and their surface should be plain of the roof. Storage, paint, safety precautions, warrantee etc. shall be as described under roofing and cladding specifications.

8. DISMANTLING & DEMOLISHING:

8.1 GENERAL:

The item wise detailed specifications are intended for the general description of quality, workmanship, etc. desired for the items covered in the Schedule of Items. The Specifications are not, however, intended to cover the minute details and the work shall be executed according to the relevant latest Indian Standard Codes. In absence of the later, the work shall be executed according to the prevailing local Public Works Department Practice or to the recommendations of American and British Standard Institution at the discretion of the Engineer-In-Charge.

8.2 Scaffolding

MS double scaffolding of self-supported steel H frame shall be provided by the Contractor as and when required to carry out the work for Shed work for centering and shuttering, structural repairs, casting of all types of works at **all heights (above and below)** etc. Cost of scaffolding to be considered while bidding the tender. No additional cost shall be paid for the scaffolding.

8.3 Objective:

The desired technique to be adopted in carrying out the demolition and dismantling work of existing structure shall be such that the fragments falling out of such operation can be contained within the work area or taking suitable protection so as to prevent materials from going out. This would relieve the surrounding area from any uncertain or uncontrolled behaviour of dismantled materials.

The rubbish / materials after dismantling shall also be stored systematically and disposed off immediately outside the plant boundary in order to ensure no major formation of heaps inside / adjacent to the work site and not hamper in any way the normal business operation of the Employer.

The term demolition implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

The term 'Dismantling' implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the structures / facilities as specified or shown on the drawings.

Precautions

All materials obtained from dismantling or demolition shall be the property of the Contractor once the materials are taken out of the boundary of MDL after completion of the necessary gate pass and other formalities. But till such time the materials shall be kept in safe custody as per the directives of the Engineer-In-Charge.

The demolition shall always be planned beforehand and shall be done in reverse order of the one in which the structure was constructed. The scheme shall be got approved from the Engineer-In-Charge before starting the work.

Necessary propping, shoring and / or underpinning shall be provided for the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever required, as per the opinion of the Engineer-In-Charge, temporary enclosures or partitions shall be provided at the Contractor's cost.

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Necessary precautions shall be taken to keep down the dust nuisance.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roofs, masonry, etc. shall be carefully removed first. The dismantled articles shall be passed by hand, where necessary, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-In-Charge.

Where fixing is done by nails, screws, bolts, rivets, etc. dismantling shall be done by taking out the fixed items with proper tools and not by tearing or ripping off.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-In-Charge within work site for verification required for gate pass and other formalities for taking outside the boundary. All unserviceable materials, rubbish, etc. shall be disposed off immediately outside the Owner's premises as directed by the Engineer-In-Charge.

8.3.1 General

Necessary data such as building size, wall thickness, construction materials, etc. that may be required shall have to be collected by the Tenderer from MDL site at his own expenses.

Information to be supplied by the Tenderer along with Tender

The information to be provided for by the Tenderer, unless otherwise specified, shall include the following:

To submit his method of erection of she at site duly supported by specifications and drawings and sequence of operation along with a list of equipment, plants and machineries to be employed during such operation, to meet the above mentioned objective.

8.3.2. Work to be provided by the Contractor

The works to be carried out with due safety precautions using all the PPE like safety shoes, helmet, safety belts etc. to workers, Engineers at site. MS Double scaffolding (H frame) as per specification to be erected prior to commencement of erection work.

Site Engineers has to obtain permission from appropriate authority of MDL Safety department prior to commencement of work on day to day basis.

To notify, the Employer for arranging to shut off all gas, water, electricity, steam and other service lines running over ground or underground. Any temporary service connections required for the dismantling work shall be separately taken and arranged by the Contractor.

Any preliminary work, necessary for Contractor's method of demolition.

To furnish all materials, labour, tools and plant and all consumables required for this work and its related temporary work such as cordoning the area, staging etc.

8.4 Work by Others

No work under this specification will be provided for by any agency other than the Contractor, unless specifically mentioned otherwise elsewhere in the Contract or approved by the Engineer-In-Charge / Employer.

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Codes & Standards

The demolition work shall be carried out as per Indian Standard Code of Practice No. IS 4130 - 1970 (Safety Code for demolition of buildings) or any other relevant Indian Standard Specifications and Codes of Practice. If demolition by blasting is adopted IS 4081 (Safety Code for blasting and related drilling operations) shall be followed. However, if any, particular aspect of the work is not specifically covered by any Indian Standard Specifications or any other standard practices, Engineer-In-Charge's instruction shall be followed.

8.4.1 Execution

The materials available after dismantling and demolition will be deemed to be the property of the Contractor once the material are disposed off from the plant boundary and the amount offered by the Contractor against each of the facilities / buildings / structures are received by the Employer.

It is presumed that the Contractor will adopt the most suitable method of demolition and dismantling to protect the materials and its surroundings. While doing so the Contractor shall ensure the following, which should be considered as binding towards the method and specification adopted by the Contractor:

Total safety of the people working in the area of the Employer, other agencies employed by the Employer as well as those employed by the Contractor.

Safety and no damage to the adjoining properties, facilities or services.

Disposal immediately after dismantling to keep the area clean after the days work and not more than one truckload being accumulated.

No noise or dust nuisance around the area of working.

No obstruction to vehicular / pedestrian traffic during dismantling and disposal inside the plant boundary as well as outside municipal areas.

No hindrance in the Employer's day to day production work or other operation.

No accidents or other hazards.

For all the Civil works, specifications to be followed as per CPWD guidelines, specifications and relevant IS Codes.

8.4.2. Appointment of Licensed Structural Engineer: -

- a. Bidder shall submit details of 'Structural Engineer' to be appointed by them on award of work such as their license no., work experience, details of similar work designed & supervised by them.
- b. On award of work, Contractor shall appoint 'Structural Engineer' for this Contract as approved by MDL.
- c. All the Field investigation works shall be witnessed by the Approved Structural Engineer. Based on the interpretation & reports of field investigation on boreholes to be taken at site, trial pits etc., Structural Engineer shall submit detailed project report to MDL including all the test reports, detailed design calculations, approved drawings & method statement for execution duly proof checked & approved by third party IIT / VJTI / NIT/ IRS.
- d. Structural Engineer shall be responsible for technical matters, issue of GFC drawings for the construction works, supervision of work, execution at site with quality control, tests carried out, inspection & clearance of works as per drawings for joint measurement, As-built drawings and Stability Certificate for the structure.
- e. No additional cost towards any type of foundation methodology shall be paid by MDL. **Bidder should quote the rate considering all the parameters.**

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9. LIST OF PREFERRED MAKE- CIVIL WORK

Sr. No.	DESCRIPTION	APPROVED MAKES
1	Cement	ULTRATECH/ AMBUJA/ BIRLA/ACC
2	Reinforcement Steel - Thermo Mechanically treated steel (Fe 550D grade)	Tata-TISCON/SAIL/ RINL VIZAG/JSW/ISPAT
3	Structural Steel	TATA / SAIL / JINDAL/ VIZAG/JSW
4	Galvalume Roofing & Cladding Sheets	TATA/JSW/ESSAR
5	Ready Mix Concrete Suppliers	Ultratech, ACC, Godrej, Lafarge, RMC India, Hella Infra Market, RDC, Ecomix, Dev RMC LLP, Manoj Infra Market RMC plant or other any plant as approved by MDL Engineer in Charge.
6	Epoxy Paint	Asian/ Shalimar/ Berger/Bombay
7	Polymers Modified mortar	Sunanda/ BASF/ Chemistic/ Krishna Conchem/ MC Bauchemie
8	Grouting Material, epoxy putty	Sunanda / BASF/Dr. Fixit / Fosrok
9	Micro concrete	Sunanda/ BASF/Krishna Conchem/ Dr. Fixit
10	Rust remover, passivator	Sunanda/ BASF/Krishna Conchem/ Dr. Fixit
11	Corrosion inhibitor	Sunanda/ BASF/Krishna Conchem/ Dr. Fixit
12	Carbon laminate	BASF/ Dr. Fixit / MC Bauchemie
13	Anti-Corrosive Coating	Sunanda/ BASF/ Chemistic/Krishna Conchem/ Dr. fixit
Note :	i)Brand deviation if any, needs to be tested for cement, reinforcement steel and structural steel prior to using it for construction only if above app makes are not available and after Prior confirmation/approval from Engineer in charge. ii)Brand deviation if any, for other finishing items can be changed only if above approved makes are not available and after Prior confirmation/approval from Engineer In-charge. iii)Whenever specification of BOQ item is not mentioned; then CPWD specification shall be applicable. (iv)Wherever make is specified in BOQ then manufacture's specifications & procedure shall be applicable. (v)Wherever no specifications or make is specified than work is to be carried out as per the written direction of Engineer-In-Charge.	



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10. Chipping & Removal of Dilapidated concrete

- a) **Scope:** To remove weak / loose / dilapidated concrete from RCC structural members by chiseling, chipping etc.
- b) **Tools:** Electrically operated low impact chipper tools, complete with accessories, hand- tools like chisels, hammer, etc.
- c) **Procedure:**
- Provide props & other suitable arrangements to relieve the structural member of stress and strains wherever feasible.
 - Suspended or suitable type of scaffolding to be provided. The same should be safe and adequate for executing all repair operations.
 - Working Platforms shall be erected suitably, if necessary.
 - Provide Protective Screen or suitable arrangements to minimise falling of debris in sea.
 - Mark off the area to be repaired.
 - Chipping to remove all the weak / loose / dilapidated concrete from RCC structural members shall be done carefully from the damaged portions by adopting electrically operated low impact chipper tools or manual means up to the required depth till sound concrete substrate, without causing excessive vibrations or damaging the structure. All the edges and cavities shall be square shouldered. Care must be taken to avoid contact with therein forcing steel, as both the reinforcement and the cutter could be damaged.
 - Removing the excessively corroded reinforcement wherever directed by the Engineer's Representative. The reinforcement steel shall be cut /shear manually or by electrically operated cutter or any other method as approved by the Engineer's Representative. The operation shall be without causing excessive vibrations or damage to the structure.
 - Cleaning the chipped surface with wire brush or buffing machine.
 - Inspection, after concrete chipping & cleaning, for weaknesses and delamination of exposed surfaces shall be visually carried out. If required.



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MAZAGON DOCK SHIPBUILDERS LIMITED

c) Materials: Rust Remover

d) Procedure:

- Remove the rust manually/ mechanically from all round the surface along the length of reinforcement, using hand tools like chisels, hammers, wire brushes, Rotary wire brush machine, abrasion cloth/paper, etc. till such time that the steel surface is cleared of all rust that could be removed.
- Chemical rust passivator shall be brush applied over the reinforcement surface thoroughly all around the circumference and along the full length of rusted reinforcement. After the coating has cured, the surface shall be cleaned with wire brush and all loose particles removed. The second coat, if required, the same shall be applied as per manufacturer's recommendation after the first coat is touch dry.

10.2 Rebar protective coating with zinc rich epoxy primer

a) Scope: To protect new & exposed rebars from corrosion with an Anti-Corrosive Coating.

b) Tools: Rotary wire brush machine, wire brushes, paint brush, abrasion cloth / paper, mechanical mixer, mechanical stirrer, etc.

c) Materials: Rebar protective coating with zinc rich epoxy primer approved make or equivalent

d) Key performance properties: As per approved manufacturers technical data sheet/ specifications.

e) Procedure:

- Remove the rust manually/ mechanically from all around the surface of new / exposed reinforcement bars along the length of reinforcement, using tools like wire brushes, Rotary wire brush machine, abrasion cloth/paper, etc. till such time that the steel surface is cleared of all rust.
- The components of the anticorrosion coating epoxy based zinc rich primer shall be thoroughly blended with a mechanical mixer to a uniform and homogeneous mixture. Small batches (upto 1 litre) may however be allowed by manual mixing using spatulas, palette, knives etc.
- Anticorrosive Coating shall be applied to cleaned new reinforcement before placing it in the structure. The Anti Corrosive Coating shall be brush applied or spray applied to the existing reinforcement wherever feasible, over the reinforcement surface thoroughly all around the circumference and along the full length of reinforcement and at the cut ends, ensuring that no pinholes are remaining.

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- After the coating has cured, the surface shall be cleaned with soft wire brush and all loose particles removed. Apply anti corrosion coating with zinc rich epoxy primer or equivalent for active corrosion control to both the new as well old steel reinforcement, ensuring that the reinforcing steel is completely coated with the product from all around.

10.3 Providing and fixing shear connectors

- Scope:** Shear Connectors & Rebar connectors are used for providing a structural connection of the applied repair materials with the substrate/parent surface for transfer of forces occurring at the interface.
- Tools:** Caulking gun, standard power driven drilling equipment, hand operated blow out pump, brushes, epoxy dispenser and any other incidental accessories and T&P items.
- Materials:** shear connectors approved make or equivalent
- Key performance properties:** As per approved manufacturers technical data sheet/ specifications.
- Procedure:**
 - Mark the locations of Shear / Rebar connectors as directed.
 - Drill holes to specified depth and diameter in concrete at marked locations for the specified dia of shear / rebar Connectors.
 - The drilled hole in dry state shall be cleaned with round brushes and by blowing air through a tube inserted in the hole and connected to hand operated blow out pump or by compressed air.
 - Inject epoxy Epoxy grout, via chaulking gun inside the drilled hole to fill it from bottom of the hole and upwards.
 - Placing the shear / rebar connectors in position and allowing it to remain undisturbed till epoxy is set.

10.4 Providing and fixing new rebars

- Scope:** Providing additional reinforcement to the existing RCC Structure for the reinforcement lost due to corrosion of rebar above 25% of its original size or providing reinforcement in new RCC members.
- Tools:** welding machine, generator and other incidental tools etc.
- Material:** HYSD reinforcement of minimum 500 grades, conforming to IS 1786 and already coated at site with Epoxy Zinc Rich Primer, Galvanised / PVC coated binding wire.

d) Procedure:

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- The additional reinforcement shall be provided as directed by the Engineer's Representative.
- While carrying out the repairs to the existing RCC members, new rebars shall be fixed to the shear / rebar connectors (already driven into the concrete) by welding. The new rebars shall also be welded with the old rebars. In case, welding is not feasible, binding wire will be permitted, at the discretion of the Engineer's Representative.
- The new rebars shall be secured rigidly so that the vibration resulting from the deposition of repair material shall not impair or displace them. Minimum requirement of lap length of bars and Minimum cover to the reinforcement shall be as specified in I.S. 456.
- The rebars shall be provided for new RCC members as per the direction of the Engineer's representative.

10.5 Providing and applying bond coat

- Scope:** To provide adequately strong adhesion of parent concrete with applied repair micro concrete / polymer mortar.
- Tools:** Electronic Weigh Machine (for accurately weighing different components of materials in required proportions), slow speed stirrer with 300 to 400 rpm speed, Spray equipment / brush / roller for application of polymer modified bonding cement slurry.
- Material:** Bond coat approved make or equivalent
- Key performance properties:** As per approved manufacturers technical data sheet/ specifications.
- Procedure:**
 - Wash the Concrete surface with water jet and saturate the surface with water but shall be free of excess surface water.
 - Bond Coat Mixing: Components of the bonding coat mix shall be weigh batched and mixed in proportions as specified by the manufacturer, in a clear container free from harmful residue or foreign particles. The components shall be thoroughly blended with a mechanical stirrer to a uniform and homogeneous mixture.
 - Bond coat application: Bonding coat shall be applied by spray equipment or stiff nylon bristle brush as approved by Engineer's Representative. The bonding material shall be worked well into the surface of the parent body ensuring that no pinholes are visible.

10.6 Jacketing work with micro- concrete

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- a) Scope:** This specification covers the refurbishment of damaged concrete and sectional enlargement using single component, free flow microconcrete
- b) Tools:** High pressure (min 150bars) water jetting machine, Sand blasting, Thermometer, Wooden/Steel Trowel, Surface Spatula, Mixing Paddle, Chipping Machine, Hand Held Mixing Machine/Pan Mixer, Roller/Brush, Hammer & Chisel
- c) Materials:** Sectional enlargement/refurbishment of damaged concrete in old and new concrete structures should be carried out with micro concrete of approved make or equivalent
- d) Key Performance properties:** As per approved manufacturers technical data sheet/ specifications.
- e) Procedure:**
- To enhance bonding, the substrate shall be primed with a cementitious slurry based bond coat.
 - Shuttering moulds of plywood or steel formwork shall be used to pour microconcrete.
 - In case of plywood, reuse of plywood more than 3 times shall be avoided.
 - Alternatively, mould release agent shall be applied to prevent formwork loss and achieve good finish.
 - The Required formwork shall be properly measured, fabricated and kept ready for installation before the application of bond coat.
 - Formwork should be sturdy, leak proof and should be strong enough to take the pressure of concrete and the weight and force of the vibration equipment till the concrete solidifies.
 - Proper supports to the formwork shall be provided to avoid displacement during the placement of the concrete and to avoid unwanted bulging using good quality props.
 - After the concrete sets, formwork shall be removed carefully without damaging the concrete.
 - To facilitate easy removal of the formwork, it should be coated with a mould release agent of any make (chemical) before the concrete is placed in the mould.
 - To prevent sagging/cracking of the bulk green concrete, remove the formwork minimum after 24 hours of placement.
 - It is strongly recommended that only full bags are mixed. Damaged or opened bags should not be used.
 - Only use clean potable water for mixing.
 - Water Powder Ratio needed: The repair mortar is designed for water powder ratio of 0.16 or flowable or pourable consistency.

- Use slow speed electric drill fitted with a spiral paddle for 1-2 bags mixing. For larger batch size use a pan type mixer or tilting drum type mixer.
- Place approximately 80% of the water in the mixer. Keeping the mixer running add microconcrete slowly. Add remaining water while continuing to mix. Mix for 3 – 4 minutes or until a lump free homogeneous consistency is achieved.
- Allow the mortar to rest for 2 - 3 minutes and then remix briefly, adjusting the consistency when required, without exceeding the maximum water demand.
- The minimum temperatures must be maintained during application and for at least 24 hours thereafter for optimum curing of the product.
- The prepared substrate should be pre-soaked, preferably at least 2 hours before applying microconcrete. The surface must be saturated dry, but without standing water.
- Place microconcrete into the formwork within 20min. after mixing by pouring or pumping.
- The mortar should continue to be placed into the pouring hopper of the formwork until completion while gently tapping with a light hammer along the sides of the formwork.
- Microconcrete can be placed in thickness ranging from 25mm to 100mm without the need of adding aggregates.
- To prevent sagging/cracking of the bulk green concrete, remove the formwork minimum after 24 hours of placement.

10.7 External wall protection with anti-carbonation coatings

- Scope:** This specification covers external protection Dolphine walkway area, Staircase at RDD structures in the exposed areas above water and ground level that are exposed to the risk of deterioration from rebar corrosion caused by carbonation, chloride ion ingress, other atmospheric corrosive agents and water permeability.
- Tools:** Sand blasting, Surface Spatula, Drilling Machine, Angle Grinder, Mixing Paddle, Mechanical cutter, Utility Knife, Grooved Pressure Rollers, Roller/Brush
- Material:** Anti-carbonation coatings of approved make
- Key performance properties:** As per approved manufacturers technical data sheet/ specifications.
- Procedure:**
 - Concrete must be cured and minimum 14 days old.
 - Substrate shall not have a moisture level $>4\%$.

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- **For exposed Concrete without existing coating:** All loose traces of dust, dust, grease oil, form release agent etc. must be thoroughly removed mechanically by scrapping, brushing, high pressure water jetting.
- Blow holes, rough or irregular/rough substrate shall be made even by the equivalent dual shrinkage compensated repair mortar.
- The weak cementitious slurry powder/ laitance on top of the concrete shall be suitably abraded & cleaned.
- Damaged or contaminated concrete shall be removed to obtain a keyed surface.
- **For exposed Concrete with existing coating:** Existing coating /its traces must be completely removed by suitable mechanical method to obtain a substrate suitable for coating application as above.
- Anti-carbonation coatings material is homogenized first by stirring with a clean stick before application.
- Application can be either by Hand (by roller or brush)- small quantities shall be transferred to container for use, while keeping the lid of the supplied container closed. Or by low pressure sprayer – can be directly sprayed from the supplied container or transferred to the sprayer container.
- Ideally do not apply the material when either the temperature $>40^{\circ}\text{C}$ or humidity is $>75\%$.
- Allow anti-carbonation coatings material to dry for 2-3 hrs. before the application of shrinkage compensated mortar
- Stir shrinkage compensated mortar thoroughly before application till homogeneous mixture is achieved.
- Do not dilute the material.
- The prepared surface should be air dry before the application starts.
- After the anti-carbonation coatings material is touch dry, shrinkage compensated mortar shall be applied @ 0.5Kg in two coats, to obtain a dry film thickness of 150μ .
- Apply the material either by Hand (by roller or brush) - small quantities shall be transferred to a wider container for use, while keeping the lid of the supplied container closed.
- Application shall be in two coats, the second coat only after the first coat is dry to touch and at right angles to the first. Or by airless spray equipment – can be directly sprayed from the supplied container or transferred to the sprayer container.

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- The Specified WFT of 375µ shall be applied in a two coat of 185µ each after ascertaining through a trail patch it can be achieved.
- Do not apply the material when either the temperature >40°C/<5°C or humidity is >75% or both.
- Shrinkage Compensated mortar is self-curing. Full cure requires minimum of 7 days.

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