

PART B:
MAJOR COMPONENTS (CIVIL & STRUCTURAL WORKS)
ATTACHMENT TO PART B-3- ADDITIONAL / PARTICULAR
SPECIFICATIONS – CIVIL WORKS

1. SPECIFICATIONS

The following CPWD Specifications for Civil, Structural, Landscaping and Plumbing Works are uploaded as part of this Tender with reference to Schedule F and Cluses of the Contract under General Terms and Conditions, Part A of the Tender.

- A. CPWD Specifications- 2019_VOL 01 (July 2019) and updates if any till submission of the Bid.
- B. CPWD Specifications- 2019_VOL 02 (July 2019) and updates if any till submission of the Bid.
- C. Delhi Schedule of Rates, Analysis of Rates and Specifications (Horticulture & Landscaping) 2020

ADDITIONAL PARTICULAR SPECIFICATIONS FOR CIVIL WORKS

1 Particular specifications for woodwork, factory made doors and wooden fire-resistant doors (FRD) frames and shutters, Hollow metal doors (FRD & NFRD) frames and shutters.

A. General

- a. The work in general shall be carried out as per the CPWD specifications.
- b. The glue / wooden adhesive to be used for this sub-head shall be PVAc based adhesive, of approved make (Fevicol of Pidilite Industries Ltd. or Korlok of National).
- c. Architectural hollow metal doors and glazed doors both fires rated, and non-fire rated including frames as shown in the Drawings and as specified herein, excluding hardware.
 1. Pressed Steel frames
 2. Flush Steel Doors
 3. Steel fire doors with insulation
 4. Steel fire doors un-insulated
 5. Glazed fire doors, partitions & fixed windows, un-insulated
 6. Glazed fire doors, partitions & fixed windows with insulation

d. References

Indian Standard for product & testing

IS 277 - Standard specification for steel sheet, Zinc Coated (Galvanized)

IS 4351 - Standard specifications for steel frame.

IS 16074 - Standard specification for Steel flush doors.

IS 3614: 2021 - Fire doors and doors set specification.

IS / ISO 834-1 - Fire Resistance test elements of building construction (General Requirement)

IS 17518(Part1): 2022 - Fire Resistance test - Door and shutter assemblies, Part-1 (General Requirement)

IS / ISO 3009-1 - Fire resistance test - Elements of Building construction- Glazed elements.

IS 16947: 2019 - Fire resistance test for doors with glass panes, openable glass windows and sliding glass doors.

e. Submittals

Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiation that products comply with requirement.

A. Certificates:

1. Manufacturers Certification that products comply with referenced standards.
2. Evidence of certificates as listed.

B. Shop Drawings:

Submit for fabrication and installation of metal doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and details of joints and connections. Indicate door elevation, internal reinforcement, closure method, and cutouts for glass lights and louvers. Show anchorage and accessory items. Provide schedule of doors and frames using same reference numbers for details and openings as shown on Drawings.

C. Samples:

Submit 300 mm x 300 mm cut away sample door with provisions for lockset, hinge and corner section of the frame.

f. Transportation, Handling & Storage

A. Deliver, store and handle hollow metal work in a manner to prevent damage and deterioration.

A. Provide packaging such as cardboard or other containers, separators, banding, spreaders, and paper wrappings to protect hollow metal items.

C. Store doors and frames upright, in a protected dry covered area, at least 100 mm or more above ground or floor and at least 6 mm between individual pieces.

D. Doors and frames are to have a metal tag with the door number thereon.

E. Should door wrapper become wet, remove immediately.

g. Quality Assurance

B. General: Unless otherwise specified, provide doors and frames complying with the Indian standard and the British standard for stability, integrity, and insulation

C. Fire-Rated Door Assemblies: Provide Fire Doors and Frames CBRI or any international Lab confirming to the Indian standard.

1. Labelled Fire doors and frames in accordance with IS 3614: 2021 for stability, and integrity Fire tests of Door Assemblies. (Un-insulated door)

2. Where insulation is the criteria supply labelled Fire doors and frames in accordance with IS 3614: 2021 for stability, integrity, and Insulation Fire tests of Door Assemblies. (Insulated door)
3. Complying with BS476 part 22: 1987 and which are labelled and listed by Certifier or internationally accredited laboratory.
4. Manufacture doors and frames under the third-party inspection program and in strict compliance to standards and provide the degree of fire protection, heat transmission.
5. Affix a physical label or approved marking to each fire door or fire door frames at any authorized facility as evidence of compliance and test conducted by approved agency.
6. Conform to applicable codes for fire ratings. It is the intent of the specification that hardware and its application comply or far exceeds the standard for fire doors.
7. Manufacturer: Provide doors, frames, and hardware as a complete door set from a single manufacturer approved by the Engineer.
8. Installers: Minimum three years documented experience installing products of similar nature.

h. Testing

Fire door certificates shall be compliant to the latest product test Indian standards. The test certificates shall be from national / international reputed test laboratory and NABL accredited (whose scope of testing includes fire doors as per there accreditation) for acceptance of reports. Submitted test reports or certificate shall be within the validity period of five years from the date of test. Fire door with BIS label and marking and labelling like ISI is preferable.

i. Materials

- A. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with IS 277 zinc-coating, mill phosphatized. Minimum sheet thickness 1.2mm for the frame and 1.2mm for the shutter.
- B. Supports and Anchors: Fabricated of 1.20 mm thick, galvanized sheet steel.
- C. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls.
- D. Shop Applied Paint: Rust-inhibitive self-etching primer or pure polyester powder coated as per manufacturer specification and minimum dry film thickness of 40microns.
- E. Material sheet thickness shall be as per the door selection criteria as mentioned below –

Level 1 – Standard Duty

Used for low frequency openings such as apartments, dormitory, hotel and motel units, Care is taken by the user and mostly it is not subject to any kind of abuse. (Not recommended as per BIS for fire doors)

Level 2 – Medium Duty

Used for medium frequency opening such as main Entrance to apartment, dormitory buildings Stairwells, storage, and mechanical rooms. Some care is taken in the maintenance of such doors.

Level 3 – Heavy Duty

Used for high frequency openings such as the main entrances to schools, offices, industrial buildings, stairwells, public restrooms, and manufacturing areas. Little care or no care is taken in the functioning of doors.

Level 4 – Extra Heavy Duty

Extra Heavy Duty – Used for very high frequency openings and are subject to abuse. It also includes areas like main entrance to schools, offices, industrial building, public buildings, metros, and locker rooms.

Table 1 – Minimum Sheet thickness as per classification

Sr. No.	Duty	Frame		Shutter	
		(mm)	(gauge)	(mm)	(gauge)
1	Standard Duty	1.2	18	0.8	22
2	Medium Duty	1.2	18	1.2	18
3	Heavy Duty	1.6	16	1.2	18
4	Extra Heavy Duty	2.0	14	1.6	16

Note - For further details on the product, we recommend you refer to the relevant standard.

j. Fabrication Materials

D. Fabricate metal door and frame units to be rigid, neat in appearance and free from defects (warp or buckle). Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site.

E. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only Galvanized steel.

F. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers, and mouldings from Galvanized steel.

G. Fabricate exterior doors, panels, and frames from galvanized sheet steel. Close top edges of all doors as an integral part of the door construction or by addition of inverted steel channel.

H. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat heads for exposed screws and bolts.

F. Shop Painting – Primer

1. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

3. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint or the mono coat powder coat.

k. Door leaf

I. General:

Provide door leaf with double skin sand witted panel construction with various infill materials. Pressed manufactured shutter shall meet the conditions detailed on the drawings and be constructed of galvanized steel sheet. All shutters shall be fabricated from zinc-coated sheet chemically treated after fabrication for optimum paint adhesion.

II. Materials: Provide pressed metal frame shall be based on the door selection criteria as mentioned above and as per following minimum thickness:

1. Fire rated door shall be minimum 1.2mm thick galvanized steel sheet

2. Stile channels, stiffener channels and other construction members shall be of sizes as recommended by the manufacturer.

3. Glass Lite doors: Fabricate glass lite of approved sizes and rating based on the door schedule. The material shall be 1.2mm galvanized steel with face fixing countersunk screws or with clip on arrangement as per manufacturer design.

4. Metal Louvered Doors: Shall be manufacture's standard product fabricated of 20-gauge GI sheet metal, free from rust, scale, pits, and surface defects. For fire doors the louvers are not applicable.

5. Astragals: Shall be integrated with the construction of the door leaf without any visible joints on the surface of the exposed skin. No welding joints are acceptable on the surface of the door. Surface mounted astragals are not recommended for performance criteria.

A. Wood Work

- a. The work in general shall be carried out as per the CPWD specifications.
- b. The wood shall be selected best quality second-class teak wood.
- c. The work shall be carried out in accordance with the architectural drawings issued by the IITB. The architectural drawings shall at all times be properly correlated and architectural requirements have to be fully satisfied.
- d. All the wood used for the manufacturing of the door shutters including the door frames, internal & external lipping, beading for fixing glazing etc. shall be seasoned as per the requirements of the CPWD Specifications.
- e. All the screws used for woodwork shall be fully threaded, counter sunk stainless steel screws, grade 304 and they shall be suitably concealed or plugged.

B. Factory made doors

The work shall be carried out as per the CPWD specifications.

- a. Decorative high-pressure laminate
- b. The work in general shall be carried out as per CPWD specifications.
- c. The contractor shall procure and submit to the Dean (IPS), samples of laminate for approval. After approval of the samples, the contractor shall prepare a mock up for approval. The material shall be procured, and the mass work taken up only after the approval of the mock up by the Dean (IPS).
- d. Each type of laminate shall be obtained from only one of the approved manufacturers as specified and in one lot. Adequate spare quantity shall be ordered to cover for any damaged sheet and for replacement by the Contractor till the completion of the work.
- e. The Contractor shall ensure that the edges of the laminates do not come out or chip / peel off during cutting and fixing of the laminates. Defective work on this account shall not be accepted and shall be redone by the contractor at his own cost.

C. Door Construction

1. Full Flush Doors (Non-fire rated)

- 1.1 All steel doors shall be manufactured as per the original product specification IS 16074 in terms of material and thickness.
- 1.2 Door leaf to have internal reinforcing channels or z-shaped members of 1.6 mm thick steel, on top and bottom. Door stiles to be interlocked on both sides with a bending radius of 1.4mm.
- 1.3 Hollow portions of doors shall be filled completely with expanded honeycomb core glued on either inside surface for stability and integrity. If it is mineral wool minimum 96kg density per sq.mt, shall be the infill material.
- 1.4 Door thickness should be minimum 46mm, minimum sheet thickness shall be 0.8mm.
- 1.5 Vertical edge seams: Provide doors with continuous vertical edges and mechanical interlocking joints at lock and hinge edges. No side welding allowed.
- 1.6 Provide single swing doors with not more than 3 mm clearance at jambs and heads and not more than 6 mm clearance at meeting edges of pair of doors (3 mm on fire rated doors).
- 1.7 Where required as indicated on door type schedule drawing, provide doors with grills and vision glass panels of thickness indicated on drawings. Manufacturer's standard steel assembly, one side integral with door and the other side equipped with applied steel stops of minimum 20 gage steel, 1-piece lengths, secured within 76 mm of ends and maximum 306 mm centres between with cross-slotted flat-head countersunk screws.
- 1.8 For vision panel the thickness of the glass shall be minimum 5mm non fire rated clear view glass.

2. Fire rated Doors: Insulated

- 2.1 All insulated fire doors shall be manufactured as per the test certificate and the original product specimen for maximum of 120minutes and 30minutes insulation and relevant Indian Standard of IS 3614: 2021.
- 2.2 It should comply with the specification in terms of sheet thickness and frame design. Door frame and leaf sheet thickness can be on the higher side of the specification but not otherwise and shall be fully compliant in terms of construction design and finish. Minimum recommended sheet thickness shutter shall be 1.2mm (18guage).
- 2.3 All fire doors should be tested for stability, integrity, and insulation. Doors shall be tested for 120minutes integrity and 30minutes insulation.
- 2.4 The infill material shall be high density mineral wool of minimum 120kg density/m³ tested for minimum 30minutes insulation. The internal construction of the door shall be rigid reinforcement for stability and integrity. Or any proprietary material for better insulation.

- 2.5 Minimum door thickness shall be 60mm.
 - 2.6 Fire doors shall be tested as a complete assembly including Frame, door leaf, vision lite and hardware. Glass shall be minimum 6mm, clear fire rated glass for the entire duration of time, not exceeding overall dimension of 0.06sqmt.
 - 2.7 Intumescent seal is mandatory for all insulated doors. This is independent of the addition smoke seal if required. Smoke seal cannot be used as an alternative for the intumescent seals.
 - 2.8 Products tested and certified shall be from CBRI/ NABL approved labs (whose scope of accreditation includes fire door testing) or any international lab of repute. Third party certified products under a labelling program shall be acceptable provided the test certificates are valid and in line with the door and hardware. Doors with ISI marking and labelling shall be preferred.
 - 2.9 All fire doors supplied by the manufacturer shall also be acceptable to the Local authority or AHJ (Authority Having Jurisdiction).
 - 2.9 Doors tested without vision panel shall not be used if it is not covered as an assembly in the related test certificate.
 - 2.10 The Maximum size of the glazing shall not exceed the overall glass sq.mt tested.
 - 2.11 All hardware used shall be in line with minimum and maximum fire rating for which it is tested and approved. The hardware supplier shall provide relevant certificates to the door manufacturer and agree in writing if the material is not tested along with the door.
 - 2.12 Door manufacturer shall be fully responsible for manufacturing, supplying of material in compliance with the standard and certification. Any deviation there off shall be documented and approved by competent authority before the supplies are affected.
 - 2.13 Fire Rating: Supply door units bearing Labels for fire ratings indicated in Door Schedule for the locations indicated. Validity of the test certificate shall be within the five-year period term as specified in IS 3614: 2021.
- 3. Fire rated Doors: Un-Insulated**
- 3.1 All fire doors shall be manufactured as per the test certificate and the original product specimen for maximum of 120minutes and shall satisfy the requirement of NBC and the relevant Indian standard IS 3614: 2021.
 - 3.2 It should comply with the specification in terms of sheet thickness and frame design. Door frame and leaf sheet thickness can be on the higher side of the specification but not otherwise and shall be fully compliant in terms of construction design and finish. Minimum recommended sheet thickness for shutter shall be 1.2mm (18guage).
 - 3.3 All fire doors should be tested for 120minutes of stability, and integrity.

- 3.4 The infill material shall be resin bonded honeycomb craft paper of higher density. The internal construction of the door shall be rigid reinforcement for stability and integrity.
- 3.5 Minimum door thickness shall be 46mm.
- 3.6 Fire doors shall be tested as a complete assembly including Frame, door leaf, vision lite and hardware. Glass shall be minimum 6mm, clear fire rated glass for the entire duration of time, not exceeding overall dimension of 0.12sqmt.
- 3.7 Products tested and certified shall be from CBRI/ NABL approved labs (whose scope of accreditation includes fire door testing) or any international lab of repute. Third party certified products under a labelling program shall be acceptable provided the test certificates are valid and in line with the door and hardware.
- 3.8 All fire doors supplied by the manufacturer shall also be acceptable to the Local authority or AHJ (Authority Having Jurisdiction).
- 3.9 Doors tested without vision panel shall not be used if it is not covered as an assembly in the related test certificate.
- 3.10 The Maximum size of the glazing shall not exceed the overall glass sq.mt tested.
- 3.11 All hardware used shall be in line with minimum and maximum fire rating for which it is tested and approved. The hardware supplier shall provide relevant certificates to the door manufacturer and agree in writing if the material is not tested along with the door.
- 3.12 Door manufacturer shall be fully responsible for manufacturing, supplying of material in compliance with the standard and certification. Any deviation there off shall be documented and approved by competent authority before the supplies are affected.

Measurement - For the purpose of payment, the area shall be measured from outer frame to outer frame above the finished floor level excluding the portion embedded inside floors, wall cladding. The door frame shall not be measured separately for payment. No deduction shall be made for making vision panel, if any.

D. Execution

1.1 Inspection

- a. Examine the substrates and the conditions under which hollow metal doors and frames shall be installed and correct any unsatisfactory conditions.

- b. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

1.2 Installation

- a. General: Install metal doors, frames, and accessories in accordance with final shop drawings and manufacturer's data, and as specified in this section.
- b. Placing Frames: Shall comply with provisions Recommended Erection Instructions for Steel Frames, unless otherwise indicated.
- c. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified.
- d. Finish Hardware: Conform to recommended hardware installation manual.
- e. Anchors for installation shall be recommended by manufacturer based on kind of construction and fire rating
- f. Grouting of frames shall be done once the doors are fully aligned.

1.3 Adjust and clean

- a. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- b. Protection Removal: Immediately prior to final inspection, remove protective plastic wrappings from prefinished doors.
- c. Final Adjustments: Check and readjust operating finish hardware items leaving steel doors and frames undamaged and in complete and proper operating condition.

2 Particular specifications for door hardware and fittings

A. General

- a. The work in general shall be carried out as per CPWD specifications.
- b. The contractor shall procure and submit samples of various hardware's and fittings for approval, of the Dean (IPS). The material shall be procured, and the mass work shall be taken up only after the approval of the samples by the Dean (IPS).
- c. All the hardware and fittings shall be supplied with the required spindles, pivots, stud, connecting bolts, screws, grub screws, nuts, bolts, connecting pin / bolt (including stainless steel washers / shims, PVC washers, PVC buffers etc.) and of the material as per the manufacturer's specifications. Their cost is deemed to be included in the cost of the hardware and fittings to be supplied and these accessories shall not be measured separately for payment. If any of the

accessories get damaged during fixing of the hardware and fittings, additional numbers as required shall be supplied by the Contractor at his own cost.

- d. The size for the hardware and fittings shall be as specified in the item description in the schedule of quantities and the particular specifications. Wherever the size is not mentioned in the item nomenclature and particular specifications, it shall be as per the manufacturer's specifications or as directed by the Dean (IPS). The shape has been specified as per the model number mentioned in the manufacturer's product catalogue / information.
- e. If the model number for an item is changed or modified or the item itself is changed /modified, during execution and / or during the defect liability period / guarantee period, the decision of the Dean (IPS) as to the equivalence of the item provided in the schedule of quantities shall be final and binding on the Contractor and no claim of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account.
- f. The Contractor shall be permitted to supply items superior than the item in the schedule of quantities, but only with specific written approval of the Dean (IPS) , provided they are aesthetically similar and nothing extra shall be payable on this account. That the product proposed to be supplied by the Contractor is superior to that provided in the schedule of quantities / product supplied, shall be the sole discretion of the Dean (IPS) and his decision shall be final and binding on the Contractor and no claim of any kind shall be entertained from the Contractor on this account.
- g. The entire supply for each type of hardware and fittings shall be made, preferably, in one lot to keep variations in finishes to the minimum.
- h. Three samples from each lot of each hardware shall be tested for conformity to the required grade. Samples shall be supplied by the agency free of cost. Testing charges shall be borne by the IITB provided that the hardware fulfils the requirements of its grade. If the hardware fails to fulfil the requirements, testing charges shall be borne by the Contractor.

B. Handles

- a. All the Door handles shall be of the same type (model and finish) and make unless specifically permitted in writing by the Dean (IPS).
- b. The handles shall be of stainless-steel grade as specified under item description.
- c. The handles shall be supplied in required finish as directed by Dean (IPS) for which nothing extra shall be paid.

C. Mortise latch, mortise dead bolt, mortise latch cum lock, lock with keys, escutcheon.

- a. The mortise latch, mortise dead bolt, mortise latch cum lock, lock with keys and escutcheon shall be of approved same make.
- b. The locks and accessories shall be supplied as per item description.

- c. The strike plate and for end plate shall be brush finish stainless steel of grade SS 304. Nothing extra shall be payable for supplying stainless steel grade SS 316 instead of SS 304 specified.
- d. The cylinder escutcheons (key hole covers) shall be of stainless steel grade SS
- e. These shall be supplied along with the key cylinder lock and shall not be measured separately for payment. Nothing extra shall be payable for supplying stainless steel grade SS 316 instead of SS 304 specified.
- f. The lock shall be supplied with a set of three keys.

D. Concealed / flush tower bolts

The concealed / flush tower bolts shall be made out of SS grade, size and shape as specified, as per the item description and as per the approved samples.

E. Door stopper

- a. The fittings shall be made out of stainless steel of Grade as specified.
- b. The required screws, bolts, spindles etc. of stainless-steel grade SS 304 as per the manufacturer’s specifications, shall be supplied along with the fittings and their cost is deemed to be included in the cost of the fitting itself.
- c. The fittings shall be of size, shape and finish as specified in the item description in the schedule of quantities and as per the approved samples.

F. Floor spring: The floor spring of approved make shall conform to the following parameters:

Sr. No.	Attributes	Range
6.1	Mechanism	As per manufacturer’s specifications
6.2	Maximum door width	≤1100 mm
6.3	Maximum door weight	Minimum 120 kg
6.4	Spring strength (EN)	1-4
6.5	back check	Mechanical
6.6	Closing speed	Two Independent Speed Adjustment Valves - (175□ – 15□) and (15□- 0□)
6.7	Hold open Function feature	At 90□
6.8	Internal components of floor Spring	Stainless steel precision manufactured

6.9	Cover plate	Stainless steel SS grade 304, secured to the floor spring body using stainless steel screws of SS 304 grade.
6.10	Non handed	Should be suitable for single and double action doors

G. Surface door closer: The surface door closer of approved make shall conform to the following parameters:

(i) Surface door closer –

Sr. No.	Attributes	Range
7.1.1	Mechanism	As per manufacturer's specifications
7.1.2	Maximum door width	1100 mm
7.1.3	Closing force as per EN	2 – 4
7.1.4	Non-handed	Feature needed
7.1.5	Two Independent Speed Adjustment for variable closing and latching speed	Two Independent Speed Adjustments, (180□ – 15□) and speed (15□- 0□).

(ii) Surface door closer -

Sr. No.	Attributes	Range
7.2.1	Mechanism	As per manufacturer's specifications
7.2.2	Maximum door width	1100 mm
7.2.3	Closing force as per EN	3 – 4
7.2.4	Non-handed	Feature needed
7.2.5	Two Independent Speed Adjustment for variable closing and latching speed	Two Independent Speed Adjustments, (180□ – 15□) and speed (15□- 0□).
7.2.6	Suitability for fire door	Feature needed

3 Particular Specifications for pressed galvanized steel door frame

- a. The work in general shall be carried out as per the Specifications (as per Schedule F) for pressed steel door frame and relevant IS code.

4 Particular Specifications for hot dipping galvanizing work

- a. Work shall be carried out as per item nomenclature and relevant IS code.

- b. Rates quoted by the bidder also includes cutting of required sections, transporting to factory, complete procedure for galvanization, transporting to site and installation.
- c. Three random sample of each section shall be tested for required coating and samples shall be supplied free of cost by the agency. Testing shall be done as per relevant IS code in the lab approved by Dean (IPS).

5 Epoxy flooring

1.1 Moisture tolerant epoxy primer

a. Description – Epoxy primer is a solvent-free, two-component moisture tolerant epoxy primer for use on concrete and cementitious surfaces that have damp surfaces (e.g., from water spillages or rain) prior to installing polyurethane and epoxy floor systems. It can also be used as a primer for cementitious floor systems by blinding with fine aggregates.

b. Features –

- a. Multipurpose: can be used with cement, epoxy, and polyurethane based flooring systems.
 - i. Seals the substrate porosity.
 - ii. Solvent free
 - iii. Low viscosity: penetrates into the concrete substrate for a better bond.
 - iv. Supplied in pre-measured packs for ease of mixing and consistency at site.

c. Physical Properties –

Epoxy Primer	@ 27± 1°C
Mixed Density	Approx. 1.07 g/cc
Working time	20 mins.
Drying Times - Initial Cure	24 Hours
Recoat time	Over night
Full Cure	07 Days
Bond Strength	> 1.5 N/mm ²
VOC Content	7 g/l

d. Coverage Estimate –

Pack size - 5 Kg.

Coverage - Approx. 20 - 24 m²/coat

Part A - 3.125 kg

Part B - 1.875 kg

e. Application Instructions –

Substrate Preparation

The concrete or screed substrate must be hard, sound, and free of dust and other barrier materials such as paint, lime coatings, plaster, curing agents, laitance, adhesive residues etc., that will inhibit adhesion to the substrate. Use a suitable degreaser to remove polish, wax, grease, oil, and similar contaminating substances prior to mechanical preparation.

Contaminated concrete surfaces should be mechanically prepared, either by scabbling, grinding or contained shot blasting equipment or similar, and be vacuumed clean prior to applying epoxy primer. Overwatered or otherwise weak concrete surfaces must also be suitably prepared down to sound, solid concrete by mechanical methods. Dust and other debris should be removed using vacuum equipment.

Note: Any joints or cracks in the concrete base where differential movement is anticipated e.g., movement joints, should be brought through to the finished surface and suitably sealed. New concrete slabs must be allowed to cure for at least 14 days.

Mixing –

The individual contents of the epoxy primer should be thoroughly stirred before being mixed together. The entire contents Part B should be poured into Part A and the two materials mixed thoroughly for at least 3 minutes using a heavy-duty slow speed drill and spiral paddle. Some of the mixed components should be reintroduced back into the hardener container in order to activate any residue and then poured back into the larger mixing vessel and re-mixed for 30 seconds. Mixing in this way will ensure product consistency and that any resin that remains in the containers after application will cure to provide for easier waste disposal.

Application –

Once mixed, the material should be spread over the floor as self-heating in the container will reduce working time. Apply using a brush or short/medium pile roller. One or more coats may be needed to ensure that a uniform coating is achieved and to compensate for differences in surface porosity.

Limitations –

The product should not be applied in temperatures less than 10°C or where the ambient relative humidity is greater than 85%.

Cleaning –

Epoxy primer can be removed from tools and equipment by using RTC 100 immediately after use. Any hardened material will need to be removed mechanically.

Storage & Shelf life –

Epoxy primer has a shelf life of 12 months if kept in a dry, clean store between 5°C and 30°C in the original unopened containers. The product should be protected from frost, away from direct sunlight and sources of heat.

Precautions –

During mixing and application, the following precautions should be observed: Ensure adequate ventilation and avoid contact of the material with the eyes, nasal passages, mouth, and unprotected skin. Avoid contact with the hands by wearing protective gloves and by using, if necessary, a suitable barrier cream. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice and after contact with the skin wash immediately with plenty of soap and water. Prolonged contact with the skin should be avoided, especially where the user has an allergic reaction to resin-based materials. Always wear gloves and eye/face protection as necessary. Observe personal hygiene, particularly washing the hands after work has been completed or at any interruption whilst work is in progress. Care should be taken when removing gloves to avoid contaminating the insides. In case of accidents seek medical advice.

Disposal / Spillage –

Spillage of any of the product components should be absorbed onto sand or other inert materials and transferred to a suitable disposable vessel. Disposal of such spillage or empty packaging should be in accordance with local waste disposal authority regulations.

1.2 Epoxy Floor Finish –

Description –

The material is a high gloss, self-smoothing, epoxy resin floor finish applied between 1 - 4 mm thickness. It combines outstanding wearing properties with chemical resistance and decorative finish. Ideally suited in situations where a seamless, joint free finish is required, and maximum cleanliness is essential.

Features –

- Seamless: easily cleanable to maintain high standards of hygiene.
- Does not support growth of bacteria and fungus.
- Self-smoothing: provides a flat high gloss finish.
- Tough & Hard wearing: durable with low maintenance cost.

- Resistant to a wide range of chemicals and liquids.
- Food grade: CFTRI approved; confirms the specifications as per U.S FDA 175.30.
- Supplied in pre-measured packs for ease of mixing and consistency at site.
- Available in any standard RAL colors.

Physical Properties –

Epoxy Floor Finish	@ 27± 1°C
Mixed Density	Approx. 1.64 g/cc
Pot life	30 mins.
Initial Hardness	24 Hours
Full Cure	07 Days
Bond Strength	> 1.5 N/mm ²
Compressive strength	70 N/mm ²
Flexural strength	> 30 N/mm ²
Tensile strength	20 N/mm ²
Shore D hardness	> 70

Chemical Resistance Chart –

Chemical	Concentration in %	Result
Acetic acid	10	R
Acetic acid	50	N

Part E: Other Documents

Acetone	100	N
Ammonia	30	R
Beer	100	R
Citric acid	50	R
Coffee	100	R
Diesel	100	R
Formic Acid	50	N
Guava Juice	100	R
Hydrochloric acid	35	L
Hydrochloric acid	25	R
Hydrogen peroxide	20	R
Kerosene	100	R
Lactic Acid	25	R
Lemon solution	100	R
Mango Juice	100	R
Methanol	100	N
Milk	100	R
Nitric acid	30	R
Nitric acid	50	N

Oleic Acid	100	R
Orange juice	100	R
Papaya Juice	100	R
Petrol	100	R
Promogranate Juice	100	R
Red wine	100	R
Sabeena solution	100	R
Sambar	100	R
Saturated salt solution	100	R
Saturated sugar solution	100	L
Sodium Hydroxide	50	R
Sodium Hypo chlorite	15	R
Sulphuric acid	25	R
Tea	100	R
Tomato Juice	100	R
Vegetable oil	100	R
waste oil	100	R
Xylene	100	L

Note –

Resistant – R (Subject to reasonable standards of housekeeping).

Limited Resistance – L (Occasional spillage tolerated If the floor is washed down Immediately).

Not Resistant – N (Rapid & severe attack even by small spillages).

Discoloration is not classified as chemical attack / Resistance if hardness is unchanged.

Coverage Estimate –

Pack size 16 Kg. - Approximately 4.9 m² @ 2 mm thick

Part A 3.80 kg.

Part B 1.70 kg.

Part C 10 kg.

Part D 500 g

Application Instructions –

Installation of epoxy floor finish should be carried out only by an approved applicator of ARDEX ENDURA.

Surface Preparation –

Note: The substrate should have a surface tensile strength of at least 1.5 N/mm².

The concrete substrate must be hard, sound, free of dust and other barrier materials such as paint, lime coatings, plaster, curing agents, laitance, oil, grease, wax, polish etc., that will inhibit adhesion to the substrate.

New concrete floors must be allowed to cure for at least 28 days and shall have an effective damp-proof membrane below to prevent rising dampness. Contaminated concrete surfaces should be mechanically prepared, by grinding, scarification, shot blasting or similar methods and be vacuum cleaned prior to installing R 25 CE. Overwatered or otherwise weak concrete surfaces must be suitably prepared down to sound, solid concrete by mechanical methods. Dust and other debris should be removed using vacuum equipment.

Note: Any joints in the base e.g., movement joints, should be brought through to the finished surface and suitably sealed.

Priming –

All areas to be treated with epoxy floor finish must be first primed with a suitable epoxy primer from the ARDEX ENDURA range. Selection of the primer must be made depending on the substrate condition & porosity.

One or more coats of the primer may be required depending upon the condition and porosity of the concrete substrate. High porosity substrates may be revealed after

preparation and will be evident by their rapid suction and absorption. Poorly primed surfaces may lead to blistering or pin holing in the cured resin.

Mixing –

The individual contents of R 25 CE should be thoroughly stirred before being mixed together. Mix Part D with Part A and ensure smooth mixing. The entire contents should be poured into a larger mixing vessel to incorporate Part B and Part C. The materials are mixed thoroughly with a spiral mixing paddle in a slow speed drill for 3 minutes until a consistent homogenous mix is achieved. One or more packs may be mixed simultaneously to ensure a quick rate of installation.

Note: Once mixed, the material will generate heat and lose working time if it is left in the mixing container or otherwise kept in bulk.

Applications –

The mixed material should be applied to the prepared and primed surface without delay using a trowel or depth set rake to achieve the desired thickness. As soon as the material has been laid and as work progresses, the surface should be gently rolled with a spiked roller in order to release any entrapped air from the mix and also to blend out any trowel marks. The work area should be protected during the installation process and during the initial curing time to ensure that no debris can contaminate the surface, as this will lead to unwanted blemishes in the hardened, cured surface.

Limitations –

The product should not be applied in temperatures less than 10°C or where the ambient relative humidity is greater than 85%.

Cleaning –

It can be removed from tools and equipment by using RTC 100 immediately after use. Any hardened material will need to be removed mechanically.

Maintenance –

Good housekeeping and regular cleaning are essential in order to maintain the performance of material. It is particularly important in areas that are subject to regular spillage of chemicals. Spillages should not be allowed to dry, which results in higher concentrations of the chemicals, which may lead to early failure. Regular cleaning of the surface with a rotary scrubbing machine in conjunction with a water miscible cleaning agent or hot water washing at temperatures up to 50°C is recommended.

Storage and shelf life –

It has a shelf life of 12 months if kept in a dry, clean store between 5°C and 30°C in the original unopened containers. The product should be protected from frost, away from direct sunlight and sources of heat.

Precautions –

During mixing and application, the following precautions should be observed: Ensure adequate ventilation and avoid contact of the material with the eyes, nasal passages,

mouth, and unprotected skin. Avoid contact with the hands by wearing protective gloves and by using, if necessary, a suitable barrier cream. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice and after contact with the skin wash immediately with plenty of soap and water. Prolonged contact with the skin should be avoided, especially where the user has an allergic reaction to resin-based materials. Always wear gloves and eye/face protection as necessary. Observe personal hygiene, particularly washing the hands after work has been completed or at any interruption whilst work is in progress. Care should be taken when removing gloves to avoid contaminating the insides. In case of accidents seek medical advice.

Disposal / Spillage –

Spillage of any of the product components should be absorbed onto sand or other inert materials and transferred to a suitable disposable vessel. Disposal of such spillage or empty packaging should be in accordance with local waste disposal authority regulations.

6 Epoxy Coving –

Description –

The material consists of a three component, high performance, trowel applied epoxy mortar designed for use as coving in areas where cleanliness and hygiene are of prime importance. It has outstanding wearing properties with high chemical resistance. Ideally suited for aggressive areas where a seamless, joint free finish is required.

Features –

- Tough & hard wearing: durable with low maintenance cost.
- Good abrasion resistance.
- Resistant to a wide range of chemicals and liquids.
- Seamless: easily cleanable to maintain high standards of hygiene.
- Hygienic and non-tainting.
- Supplied in pre-measured packs for ease of mixing and consistency at site.

Physical Properties –

Epoxy Floor Finish	@ 27± 1°C
Mixed Density	Approx. 1.60 g/cc
Pot life	45 mins.

Setting time	48 Hours
Full Cure	07 Days
Bond Strength	> 1.5 N/mm ²
Compressive strength	70 N/mm ²
Flexural strength	23 N/mm ²
Tensile strength	11 N/mm ²

Coverage Estimate –

Pack size 16.50 Kg. – Approx. 9.0 Rmt. @ 2” x 2” thick

Part A 1 Kg. – Approx. 6.5 Rmt. @ 3” x 3” thick

Application Instructions –

Surface Preparation –

Note: The substrate should have a surface tensile strength of at least 1.5 N/mm².

The substrate must be hard, sound, and free of dust and other barrier materials such as paint, lime coatings, plaster, curing agents, laitance, adhesive residues etc., which will inhibit adhesion to the substrate. All vertical surfaces must be of a rigid construction to resist deflection during the application process. Use a suitable degreaser to remove polish, wax, grease, oil, and similar contaminating substances prior to mechanical preparation.

Contaminated substrates should be mechanically prepared, either by grinding or contained shot blasting equipment or similar and be vacuumed clean. Overwatered or otherwise weak concrete surfaces must also be suitably prepared down to sound, solid concrete by mechanical methods. Dust and other debris should be removed using vacuum equipment.

Priming –

All areas to be treated with primer must be first primed with a suitable epoxy primer from the ARDEX ENDURA range. Selection of the primer must be made depending on the substrate condition & porosity.

One or more coats of the primer may be required depending upon the condition and porosity of the concrete substrate. High porosity substrates may be revealed after preparation and will be evident by their rapid suction and absorption. Poorly primed surfaces may lead to blistering or pin holing in the cured resin.

Mixing –

The individual contents Part A & Part B should be thoroughly stirred before being mixed together. The entire contents of Part A and Part B should be poured into a larger mixing vessel to incorporate the Part C. Mix thoroughly with a spiral mixing paddle in a slow speed drill. Finally, the Part C is added to the same container and continue mixing for two minutes to obtain a consistent homogenous mix. One or more packs may be mixed at the same time in order to maintain a quick rate of installation.

Application –

The mixed material should be applied onto the prepared and primed tacky surface without delay using a trowel to achieve the desired thickness and coving profile.

Note –

- Do not overwork the surface and do not mix more than can be used within the working time. The work area should be protected during the installation process and during the initial curing time to ensure that no airborne debris can contaminate the surface of the wet resin as this will lead to unwanted blemishes in the hardened and cured surface.
- All movement joints in the substrate must be carried through the coving and properly sealed. Construction joints and cracks not subject to movement may be overlaid but should the substrate move in anyway, these defects will reflect through the coving.

Limitations –

The product should not be applied in temperatures less than 10 C or where the ambient relative humidity (RH) is greater than 85%.

Cleaning –

It can be removed from tools and equipment by using RTC 100 immediately after use. Any hardened material will need to be removed mechanically.

Storage and shelf life –

It has a shelf life of 12 months if kept in a dry, clean store between 5oC and 30oC in the original unopened containers. The product should be protected from frost, away from direct sunlight and sources of heat.

Precautions –

During mixing and application, the following precautions should be observed: Ensure adequate ventilation and avoid contact of the material with the eyes, nasal passages, mouth, and unprotected skin. Avoid contact with the hands by wearing

protective gloves and by using, if necessary, a suitable barrier cream. In case of contact with the eyes, rinse immediately with plenty of water and seek medical advice and after contact with the skin wash immediately with plenty of soap and water. Prolonged contact with the skin should be avoided, especially where the user has an allergic reaction to resin-based materials. Always wear gloves and eye/face protection as necessary. Observe personal hygiene, particularly washing the hands after work has been completed or at any interruption whilst work is in progress. Care should be taken when removing gloves to avoid contaminating the insides. In case of accidents seek medical advice.

Disposal / Spillage –

Spillage of any of the product components should be absorbed onto sand or other inert materials and transferred to a suitable disposable vessel. Disposal of such spillage or empty packaging should be in accordance with local waste disposal authority regulations.

7 Crazy ceramic (China Mosaic) tile flooring

- a. The materials to be used shall be broken glazed ceramic tile pieces. These shall be obtained from broken glazed tiles of uniform thickness and of approved shade and manufacture and conforming to I.S. 13753. The tile pieces shall be hard, sound, dense and glossy in texture. These shall be of required colour and shade and free from stains, cracks, decay and weathering.
- b. The work shall be carried out as per the architectural drawings in design (geometric, abstract etc.) and in linear and / or curvilinear pattern and in combination with tile pieces of different colour and shade.
- c. Before laying tile flooring on RCC slabs / PCC base, the laitance shall be removed, and the surface shall be roughened. A coat of cement slurry @ 2.2 kg of cement per sqm shall be applied over the base surface for bonding between RCC slab / PCC and mortar bedding of tile flooring. Nothing extra shall be payable on this account.
- d. Pieces of ceramic glazed shall be brought to required size & shape to achieve the required design/ pattern. The shade of the tiles shall also be selected depending upon the pattern/ design. Tiles shall be thoroughly cleaned and soaked in water before fixing. Cement grout of desired consistency admixed with approved water-proofing compound and synthetic polyester fibre shall be spread over the mortar bedding when the mortar is still plastic. Pieces of glazed tile shall be pressed piece by piece in the required pattern in the cement float. The fixing shall be done by keeping the joints between the pieces as thin as possible but not exceeding 5mm. The work shall be carried out to correct level and slopes and compacted by striking the surface with hand thappies and straight screed tamper. The grout shall cream up to the surface. The junctions of the flooring and the parapet wall shall be rounded, and the flooring shall be extended up to the wall for 15cm or as specified. After the flooring has been laid or the day's fixing work is completed, surplus cement grout that may have come out of the joints on compacting shall be cleaned off. The flooring laid shall

be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

- e. Once the floor has set, it shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after the construction work is completed.
- f. The Contractor shall ensure that the China Mosaic work provides waterproofing treatment and shall not allow penetration of water. The guarantee for the water proofing work at the terrace shall also include restoration of the China Mosaic work after rectification, if any to the integral cement based waterproofing treatment to the terrace. Nothing extra shall be payable on this account.
- g. For the purpose of payment, actual area of the China Mosaic tile work shall be measured in sqm correct to two decimal places. No deduction shall be made for joint width between the adjacent tile pieces.

8 Vinyl Flooring

1.1 Summary

Section Includes: Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

Related Documents: Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

1.2 System Description

A. Performance Requirements: Provide flooring which has been manufactured, fabricated, and installed to performance criteria certified by manufacturer without defects, damage, or failure.

B. Administrative Requirements

- i. **Pre-installation Meeting:** Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
- ii. **Pre-installation Testing:** Conduct pre-installation testing as follows: [Specify testing (i.e., moisture tests, bond test, pH test, etc)].
- iii. **Test Installations/ Mock-ups:** Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish colour, texture and pattern, and workmanship standards.
- iv. Mock-up size: 4' x 4'.

- C. Maintenance:** Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
- D. Incorporation:** Mock-up may be incorporated into the final construction with Owner's approval.

E. Sequencing and Scheduling

- i. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
- ii. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.3 Submittals

- a. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation, and maintenance instructions (latest edition of Armstrong Flooring Guaranteed Installation Systems manual, F-5061.) for flooring and accessories.
- b. Submit the manufacturer's standard samples showing the required colours for flooring, welding rods, and applicable accessories.
- c. Submit Safety Data Sheets (SDS) available for flooring products, adhesives, weld rod, patching / levelling compounds, floor finishes (polishes) and cleaning agents.
- d. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.
- e. Closeout Submittals: Submit the following:

Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.

- f. Warranty: Warranty documents specified herein.

1.4 Quality Assurance

- g. **Single-Source Responsibility:** Provide types of flooring and accessories supplied by one manufacturer, including levelling and patching compounds, and adhesives.
- h. Select an installer who is competent in the installation of Armstrong resilient sheet flooring using Armstrong Flooring S-761 Seam Adhesive method.

1. Engage installers certified as Armstrong Commercial Flooring Certified Installers.
 2. Confirm installer's certification by requesting their credentials.
- i. **Fire Performance Characteristics:** Provide resilient vinyl sheet flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:
1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
 2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.
 3. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested.

1.5 Delivery, Storage and Handling

- a. Comply with Division 1 Product Requirements Sections.
- b. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- c. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- d. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.

1.6 Project Conditions

Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of [100°F (38°C)] [85°F (29°C)] for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.

1.7 Limited Warranty

- A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- B. Limited Warranty Period: 10 years.

C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Armstrong Flooring Guaranteed Installation System. Product installed not using the specific instructions from the Guaranteed Installation System will void the warranty.

1.8 Maintenance

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.

B. Quantity: Furnish quantity of flooring units equal to 10% of amount installed.

C. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

1.9 Vinyl Sheet flooring materials

A. Provide Homogeneous Sheet Vinyl Flooring: ColorArt™ Medintech® with Diamond 10™ Coating manufactured.

- Description: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a diamond-infused UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.

- Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing.

- Pattern and Color: color selected from the range currently available from Armstrong Flooring Inc.

- Thickness: 4 to 5mm.

B. Vinyl Weld Rod:

- Provide solid color vinyl weld rod as by manufacture and intended for heat welding of seams. Color shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring.

C. Seam Adhesive:

- Provide Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

1.10 Adhesives

A. Provide Vinyl Sheet Flooring Adhesive Premium Commercial for field areas Flash Cove Adhesive at flash coving as recommended by the flooring manufacturer.

B. For High-Moisture Installation Warranty, Full Spread: Provide Commercial Sheet Flooring and LVT Adhesive for field areas Flash Cove Adhesive at flash coving as recommended by the flooring manufacturer.

C. For non-heat welded seams: Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

1.11 Installation of flooring

A. Install flooring in strict accordance with the latest edition of manufacturer Flooring Guaranteed Installation Systems manual, F-5061. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.

B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the sub floor around covers and to covers.

D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

E. Adhere flooring to the sub floor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.

F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.

G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

H. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.

I. Provide integral flash cove wall base were shown on the drawings, including cove fillet support strip and top edge cap trim. Construct flash cove base in accordance with the flooring manufacturer's instructions. Heat-weld seams as specified for those on the floor.

8 Vacuum Dewatering Flooring

Usually, the deficiencies like drying shrinkage, excess water in mix, improper grade/thickness control, poor finishing and curing techniques, and excessive load on the concrete are noticed in conventional flooring during its service period. To overcome the deficiencies of conventional concrete flooring, a system is devised to improve the properties of such concrete floors. The system by virtue of its uniqueness is known as vacuum dewatering concrete in which surplus water (or excess water) from fresh concrete is removed to improve strength, durability, and other properties of concrete by reducing the water-cement ratio (to the optimum level) immediately after the mix is placed, usually in floors and other flooring purposes.

The VDF system is an effective technique used to overcome this contradiction of opposite requirements of workability and high strength. With this technique, both these workability and high strength are possible at the same time. The system is workable for laying high quality concrete floors with superior cost effectiveness to achieve High strength, Durability, Longer Life, Better Finish and Faster Work.

Material Requirements

The following considerations in material requirement are necessary prior to start of vacuum dewatering concrete flooring –

8.1 Concrete Grade

In vacuum dewatered flooring, the grade of concrete used shall be as –

- a) M20-25 where Industrial Floors, Car Parking, Railway Platform, Workshop floors are planned to be laid.
- b) M30-60 where Highways, Airport, RCC Roads are planned to be laid.

8.1.2 Cement – The cement selected should be appropriate for the intended use as provided for in the specifications.

Vacuum treatment of concrete gives better results with Portland cement to increase the compressive strength of concrete.

8.1.3 Fine Aggregate – Locally available sand is used as fine aggregate in the concrete mix.

The test procedures as mentioned in IS-383 shall be followed to determine the physical properties of fine aggregate.

8.1.4 Coarse Aggregate – Crushed stone aggregates ranging from 10mm to 20mm sizes shall be used in respective proportions in concrete mixes. The aggregates shall be tested in accordance to IS-383.

8.1.5 Water – As per recommendation of IS: 456, the water to be used for mixing and curing of concrete should be free from deleterious materials.

Therefore, potable water shall be used in all operations demanding control over water quality.

8.2 Workability Requirement

Workability requirement depends up on two factors i.e., Water-Cement Ratio & Slump of Concrete.

Workability tests shall be performed using Slump moulds as it is the quick measure of workability of concrete mixes.

8.3 Water Cement Ratio

It is proven fact that the water-cement ratio is detrimental for concrete to achieve higher strength. Provided the flooring is fully compacted, the lower the water-cement ratio the greater the durability and wear resistance. A lower water cement ratio compatible with workability is, therefore, essential.

8.4 Slump

Since the water-cement ratio is lowered through vacuum dewatering, concrete of high initial slump can be used while pouring. Slump range of 25-40 mm or as per site requirement is provided. As according to IS 1199, the slump range for mass concrete, lightly reinforced sections in slab, beams, walls, columns, floors, hand placed pavements, canal lining, strip footing is recommended as 25-75 mm with degree of workability as low.

The slump test shall be done in accordance with the IS 1199.

8.5 Equipment's used in VDF System

a. MS – C Channel: The MS C Channel of desired thickness is heavy, and durable used as shuttering having holes in each interval max. 400 mm for dowel bars. The dowel bars are used for proper gripping of two adjoining panels of floor. The channels are placed and checked for zero levels.

b. Auto Level Machine: This is required to check the zero levels of MS C Channel placed as side supports.

c. Poker Vibrator: Used for vibrating the concrete especially to the sides of the panels.

d. Surface Vibrator: Termed as Double Beam Screed Vibrator which is used for levelling as well as compaction of concrete. Two passes are required to achieve maximum compaction. Self-contained water protective vibrator motor is mounted on the centre of the beam.

e. Vacuum Dewatering Pump with Mat: A system consisting of Vacuum Pump, Lower Mat (Nylon cloth to act as very fine filter) and Top Mat (large single PVC Sheet) is used to draw out surplus water from the green concrete. The magnitude of the applied vacuum pump is usually about 0.08MPa, which reduces water content about 15-20%.

Vacuum Pump is mounted on transportation trolley and powered by Electric Motor of 5 to 10 HP. The vacuum pump is connected through a Hose (pipe) with the mat to remove the surplus water from fresh concrete. The mat consists of two layers, one is in direct contact with green concrete to prevent removal of cement with water and other used for extraction of water through pipe.

Top Mat of standard size normally 5 M x 7 M or as of panel size is provided with junction box and short hose. Filter Mat is placed directly on the green concrete which acts like a filter made of backing sheet, expanded metal, wire gauze or muslin cloth sheet.

Water separator functions as to provide proper control on the magnitude of water removed is equal to the contraction in total volume of concrete. About 3% reduction in concrete layer depth takes place.

f. Trowel Floater Machine: The machine is used for grinding to make surface even and remove any of the undulations in floor.

g. Power Floater Machine: The machine is used to provide Mirror/Final finish of surface and usually deployed when hardener is used to make surface wear resistance.

h. Wire Brush: Wire brush is used when broom finish is required as in case of parking, road surface, etc.

i. Groove Cutting Machine: Used to create grooves of size usually 5 mm wide or as specified by Engineer In-charge.

j. Backer Rod and Masking Tap: Backer rods are usually round, flexible lengths of foam that are used as a “backing” in joints or cracks to help control the amount of sealant / caulking used and create a back stop. Many sizes/ diameters are available for optimal fitting to the size of the joint being sealed.

8.6 Construction Process:

It has been universally recognized that concrete is the best suitable material for long strip casting of floors. The method is a system for having high quality long strip casting of floors at an affordable cost.

A high-quality long strip casting should have the following properties –

- maximum wear-resistance
- high compressive strength and
- minimum water-permeability

8.7 Preparation of Sub-base

The ground or earth filling should be thoroughly compacted so that there are no loose pockets left anywhere in the whole area. This should then be covered with clean sand well consolidated to a thickness of not less than 100 mm. Great care is necessary in the preparation of the sub-base, as a settlement in the sub-base may cause the failure of the whole floor.

It is to be noted that if the sub-base is made of compacted soil or WBM, a separation layer of plastic sheet (125 micron expanded polythene foam sheet), if specified, is placed over for protection against humidity and water which also act as a sliding layer to prevent floor concrete from sticking to sub-base in order to avoid cracking.

If the sub-base is PCC, then there is no need to provide polythene sheet. The primary purpose of the sub-base is to provide a level base for the floor slab.

Note: The position of trenches and pipes for services such as water and drainage, heating, electric supply and telephones etc. must be fixed before floor concreting starts.

8.8 Laying the Reinforcement

Reinforcement shall be provided as per drawing. Reinforcement at the interface of expansion joint shall also be provided as per drawing.

8.9 Concreting

The area to be paved should be divided into suitable panels to reduce the risk of cracking. This should be done by fixing screed strips, the depth of which should be equal to the combined thickness of the base concrete and the topping.

- Generally, no dimension of a panel shall exceed 4 m in case of floor finish laid monolithically with the base concrete and 2 m in case of floor finish laid separately on a hardened base. Length of a panel shall not exceed 1.5 times its breadth.

Before being laid in position the screed strip should preferably be coated with a thick coat of lime wash to prevent them from sticking to the concrete deposited in the panels.

Before placing the base concrete, the sub-base should be properly wetted. The concrete should then be deposited between the screed strips, thoroughly tamped and the surface screeded uniformly below the desired finished grade of flooring to accommodate the required thickness of topping.

Any slope desired in the floor finish should be given in the base concrete. The surface should not be finished smooth but kept rough to provide adequate-bond for the topping.

Concrete of specified strength (generally grade M 25) and workability is spread in specified thickness along the stretch of two parallel slotted M.S. channels acting as formwork placed approx. 3.0 to 4.0 m apart and well compacted using Trimix surface vibrator of suitable length. The pouring sequence should be from the grid and towards construction joint. The instructions of Engineer In-charge should be followed in vacuum dewatered concrete flooring.

8.10 Dewatering of Concrete

After compaction surplus excess water is sucked out placing filler pad consisting of two layers on wet concrete. The bottom layer of filler pad in contact with concrete is fine nylon cloth to act as filter whereas the upper layer consists of a special type of plastic net which acts as a water duct. The suction mat (filler pad) is attached to suction pump through suction hose (vacuum dewatering system). Vacuuming time is approx. 1 to 2 minutes per centimetre thickness of concrete.

The aim of this system is to reduce initial w/c ratio by 10 to 15% and this also makes concrete denser through static compaction. Care should be taken to ensure that optimum water required for hydration reaction must be there in concrete during vacuum treatment of concrete.

8.11 Surface Finish

The surface should be towelled with the help of power trowelling floater to get neat finish. If specified, chemical hardener @ specified quantity per unit area is spread while power trowelling in progress, to get hard top wearing surface. The same process is repeated in alternate stretches of concrete bay of specified size.

8.12 Curing

Immediately after the flooring surface is finished it should be protected from rapid drying by erecting barriers against wind or draught and strong sunlight. As soon as the surface has hardened sufficiently to prevent damage to it, it should be kept continuously moist for at least fifteen days by means of wet gunny bags, 50 mm thick layers of damp sand spread over the surface or pooling water on the surface. During this period the flooring shall not be exposed to any traffic. Regular traffic on the floor should be allowed only after 28 days. (IS 2571).

9.0 Specification for Geofoam

9.1 General Description

This work shall consist of furnishing and placing expanded polystyrene, referred to in this specification as EPS Geofoam fill, in accordance with the details shown in the plans, these specifications, Division 31 Earthworks Sections, or as directed by the engineer.

Reference Publications - Some or all the publications referred to in this specification, form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of the referenced American Society of Testing Materials (ASTM) publication shall govern.

ASTM Designation

C 165 Test Method for Measuring Compressive Properties of Thermal Insulation.

C 203 Breaking Load and Flexural Properties of Block-Type Thermal Insulation.

C 303 Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation.

C 390 Practice for Sampling and Acceptance of Thermal Insulation lots.

D 1621 Compressive Properties of Rigid Cellular Plastics.

D 1622 Apparent Density of Rigid Cellular Plastics.

D 1623 Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.

C 2863 Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index).

D 6817 Specification for Rigid Cellular Polystyrene Geofoam.

D 7557 - Standard Practice for Sampling of Expanded Polystyrene Geofoam.

9.2 Material

Manufacturer with a minimum of 10 years documented experience in the manufacture of lightweight, geo-synthetic fill. Manufacturer must also have a UL classification in category BRYX. Manufacturer must also maintain a UL classification in category QORW that ensures physical properties in accordance with ASTM D 6817. Third-party certifications that only include ASTM C 578 physical properties will not be considered as an alternative equal and will be rejected.

Geofoam may be fabricated using material with recycled content provided the physical properties of Table 1 are met. Unless the project dictates otherwise, the blocks shall have a height of at least .91 m (36 inches), a width of at least 1.22 m (48 inches), and length of at least 2.44 m (96 inches). All blocks shall be within tolerances of 0.5% of respective height, width, and length dimensions. Additional field and/or shop trimming and cutting will be required as necessitated by the geometry of the fill being constructed.

Geofoam blocks shall have the following physical properties:

TYP - ASTM D6817	EPS 12	EPS 15	EPS 19	EPS 22	EPS 29	EPS 39	EPS 46
Density, min., kg/m ³ , (lb/ft ³)	11.2 (0.70)	14.4 (0.90)	18.4 (1.15)	21.6 (1.35)	28.8 (1.80)	38.4 (2.40)	45.7 (2.85)

Compressive Resistance @ 1% deformation, min., kPa (psi)	15 (2.2)	25 (3.6)	40 (5.8)	50 (7.3)	75 (10.9)	103 (15.0)	128 (18.6)
Flexural Strength min., kPa (psi)	69 (10.0)	172 (25.0)	207 (30.0)	276 (40.0)	345 (50.0)	414 (60.0)	517 (75.0)
Elastic Modulus, min., kPa (psi)	1500 (220)	2500 (360)	4000 (580)	5000 (730)	7500 (1090)	10300 (1500)	12800 (1860)
Oxygen Index, min., volume %	24.0	24.0	24.0	24.0	24.0	24.0	24.0

Geofoam should be considered combustible and should not be exposed to open flame or any source of ignition. The Geofoam shall be manufactured using modified expanded polystyrene. Manufacturer must have a UL classification in category BRYX.

Each Geofoam block shall be marked with the manufacturer's identification, and type.

Approved Material:

Insulfoam Manufacturing Facility, Headquarters, 19727 57th Avenue. E., Puyallup, WA 98375, Phone: 253-248-5995 Fax: 253 383-7100.

Insulfoam Manufacturing Facility, 5635 Schaefer Avenue, Chino, CA 91710, Phone: 909-591-7425, Fax: 909-591-8083.

Insulfoam Manufacturing Facility, 3401 W. Cocopah Street, Phoenix, AZ 85009, Phone: 602-269-2272, Fax: 602-269-8402

Insulfoam Manufacturing Facility, 1155 Business Park Drive, Building A, Dixon, CA 95620, Phone: 707-678-6900, Fax: 707-678-2962

Insulfoam Manufacturing Facility, 4500 South Frontage Road, Lakeland, FL 33815, Phone: 863-688-8879, Fax: 863-682-1702

Insulfoam Manufacturing Facility, 501 S. Emerald Road, Tooele, UT 84074, Phone: 800-735-4621, Fax 800-769-6065

Insulfoam Manufacturing Facility, 12601 East 33rd Ave, Unit 110, Aurora, CO 80011, Phone: 303-366-7730, Fax: 303-366-7742

Insulfoam Manufacturing Facility, 628 Western Drive, Anchorage, AK 99501, Phone: 907-279-9407, Fax: 907-279-9011

Insulfoam Manufacturing Facility, 2000 Summit View Drive, Smithfield, PA 15478, Phone: 855-207-0087, Fax: 855-246-9936

Insulfoam Manufacturing Facility, 1057 Sunburst Lane, Mead, NE 68041, Phone: 402-624-6611, Fax: 402-624-2325

No product substitutions permitted.

9.3 Sampling & Testing

Quality assurance testing and sampling, to monitor the conformance of the Geof foam fill with the specification requirements, will be completed as directed by the engineer. Density, compression, and geometry (dimensional tolerances) testing shall be conducted using 50.8 mm (2") cubes cut from representative blocks. Blocks in conformance with contract requirements can be used to make required fills.

Testing shall be conducted on samples taken from the first 76 m³ (100 yd³) of each Geof foam type manufactured for project delivery and at a rate of one test per 1147 m³ (1500 yd³) thereafter. No more than 76 m³ (100 yd³) of Geof foam shall be manufactured until the Engineer has approved the material.

The Engineer has the right to randomly sample the manufacturing plant. If any block does not conform to the physical requirements, it may be rejected by the Engineer.

9.4 Submittals

1. Prior to the start of work the Contractor shall submit for approval the following:

a. A plan sheet showing a profile and section view of the proposed embankment. The drawing shall clearly indicate the size, type, location, and orientation of all Geof foam blocks.

b. The location and type of connectors.

c. Proposed ballasting or guying techniques.

d. Proposed placement methods.

2. Prior to the delivery of the EPS Geof foam blocks, the Contractor shall furnish the Engineer with a copy of manufacturer's test reports or a third party's certified test report showing that the Geof foam blocks meet the physical properties and standards listed above in Table 1

3. The Contractor shall submit to the Engineer a Manufacturer's Certificate of Compliance for the first 76 m³ (100 yd³) and for every 1147 m³ (1500 yd³) thereafter before the Geofoam is delivered to the site.

4. The Certificate of Compliance shall include current inspection reports showing that the Geofoam manufacturer is in compliance with a UL follow-up service program for both flame and physical properties. In addition, computer generated stress-strain data and the accompanying curves shall be produced from compressive testing and supplied to the Engineer. The curves and/or data shall clearly indicate the stress at 1% strain and the modulus of elasticity.

9.5 Protection

1. The Contractor shall prevent damage to the Geofoam blocks during delivery, storage, and construction. Prior to delivery of Geofoam block fill to the project site, the Contractor shall review and be thoroughly knowledgeable with the manufacturer's care and handling recommendations. Any Geofoam block that is exposed to sun light for more than six months shall be covered with an opaque material to prevent ultraviolet light degradation.

2. The Contractor shall protect the Geofoam blocks from: (1) Organic solvents such as acetone, benzene, and paint thinner; (2) Petroleum based solvents such as gasoline and diesel fuel; (3) Open flames.

3. Placement of embankment soil cover material will require special procedures and careful selection of appropriate construction equipment to prevent damage to the Geofoam fill. No heavy construction equipment or vehicles shall be allowed directly on the Geofoam.

4. Any damage to the Geofoam blocks resulting from the Contractor's vehicles, equipment or operations, shall be replaced by the Contractor.

5. Damage to Geofoam shall be corrected as follows:

a. Slight damage less than .0283 m³ (1 ft³) may be left in place as is.

b. Moderate damage between .0283 m³ (1 ft³) and 1 m³ (35.3 ft³) shall be filled with sand.

c. Geofoam blocks with excessive damage (i.e., exceeding the "moderate" category) shall be replaced with Geofoam blocks which meet the damage material design properties. Geofoam blocks not meeting the damage criteria may be cut to eliminate the excessive damage and the remaining, undamaged, portion of the block may be used within the fill, provided the undamaged portion of the block meets all other design requirements.

9.6 Subgrade Preparation

3.6.1 Clear and grub site.

3.6.2 Dewater site as required.

3.6.3 The grade on which the Geofoam fill will be placed shall be graded to the elevations shown in the plans. The finish-grade shall be smooth and free from

holes and protruding objects. A 200 mm (8 in) levelling pad shall be constructed over the prepared grade. The levelling pad material shall be sand, pea gravel or any locally available permeable material approved by the Engineer of record.

9.7 Placement

3.7.1 EPS Geofoam fill shall be placed to the lines and grades shown in the plans and as directed by the Engineer. The surface of a layer of Geofoam blocks to receive additional Geofoam blocks shall be constructed with a variation in surface tolerance of no more than 15 mm (0.05 feet) in any 3 m (10 ft) interval. All blocks shall accurately fit relative to adjacent blocks. No gaps greater than 20 mm (0.07ft) will be allowed on vertical joints.

3.7.2 The finished surface of the Geofoam immediately beneath pavement sections shall be constructed to within the tolerance of zero to minus 60 mm (0.20 ft) of the indicated grade.

3.7.3 The finished surface of the Geofoam on side slopes that receive soil cover shall be constructed to within a tolerance of plus 90 mm (0.30 ft) to minus 90 mm (0.30 ft) of the indicated grade.

3.7.4 Blocks placed in a row in a particular layer shall be offset .6 m (2.0 ft) relative to blocks placed in adjacent rows of the same layer as shown on the plans. To avoid continuous joints, each subsequent layer of blocks shall be rotated on the horizontal plane 90 degrees from the direction of placement of the previous layer placed.

3.7.5 When needed to prevent blocks sliding during embankment construction, Insulgrip plates or a urethane adhesive such as Flexible Fast™ should be placed between horizontal layers of blocks. For the number required, refer to Section 8 of this specification.

3.7.6 Blocks shall be cut using a hot wire.

3.7.7 Because of the light unit-weight of the geofoam fill, it is the Contractor's responsibility to provide temporary weighting and/or guying as necessary until all the blocks are built into a homogeneous mass, and the pavement section as well as any soil cover are in place.

3.7.8 Embankment over the side slopes of the Geofoam fills shall be placed starting at the bottom of the slope in such a manner to prevent damage to the Geofoam. Finished Geofoam on side slopes shall have a minimum of 0.61 m (2 ft) embankment cover.

3.7.9 The embankment material, in areas beyond the lateral distances necessary to protect Geofoam from damage, shall be compacted according to *[Editorial Note: Insert the Applicable specification section for soil compaction]*. The intent of this requirement is to minimize the encompassed zone around the Geofoam fill.

3.7.10 During placement of the load distribution slab over the top surface of the Geofoam fill it is permissible to use rebar supports to support the reinforcing steel during concrete placement.

9.8 Connectors

3.8.1 Connectors shall be galvanized steel multi-barbed connectors or a urethane adhesive. Each connector shall have a lateral holding strength of at least 27.22 kg (60 lbs.) when tested with an EPS15 Geofoam.

3.8.2 Install a minimum of 2 connectors for each 1.22 m (4 ft) x 2.44 m (8 ft) section of Geofoam material or as shown on plans or directed by the Engineer. Press firmly into the rigid foam until the connector is flush with the surface. Position the next foam block as specified and seat firmly before placing subsequent blocks.

9.9 Measurements

3.9.1 The completed EPS Geofoam fill-work will be measured by the in-place volume in cubic meters (yard). No credit will be given for wasted material.

10 Particular specifications – Aluminium work

- a. The material for the work shall be procured from the approved manufacturer as per the list attached with the tender documents. The Contractor shall procure and submit samples of various materials to be used in the work for the approval of Dean (IPS) and no work shall commence before such samples are approved. Samples of un-anodized as well as anodized aluminium sections, neoprene gaskets, glass, stainless steel screws, anchor fasteners, hardware and any other material or components requiring approval of samples, in opinion of Dean (IPS), shall be submitted for the approval as mentioned above. The above samples shall be retained as standards of materials and workmanship.
- b. The Contractor shall prepare the shop drawings for the aluminium windows giving details of the various aluminium sections, neoprene gaskets, cleats, anchor fasteners, hardware, sealants, glass etc. and submit the same for the approval of Dean (IPS).
- c. Only after the approval of the samples and the shop drawings by the Dean (IPS), the Contractor shall procure the material for the work. All materials brought to the site by the Contractor, for use in the work, as well as fabricated components shall be subject to inspection and approval by Dean (IPS). The

Contractor shall produce manufacturer's test certificates for any material or batch of materials supplied by him.

- d. The Contractor shall prepare a finished sample of the aluminium window along with glazing panel and fittings etc. for approval of workmanship and material. Nothing extra shall be payable on this account.
- e. Aluminium sections to be used for various works shall be appropriate to meet technical, structural, functional, and aesthetic considerations. The anodizing shall be carried out in an approved factory / workshop as specified in the tender documents.

A. Fabrication

- a. All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects.
- b. All hardware used shall conform to the relevant specifications and as per samples approved by the Dean (IPS) . Design, quality, type, number and fixing of hardware shall be generally in accordance with architectural drawings and as approved by the Engineer-in- Charge before use.
- c. All doors, windows, ventilators and glazing etc. shall be made water tight with neoprene gaskets and weather silicone sealants to the satisfaction of the Dean (IPS) , for which nothing extra shall be payable.
- d. The frames shall be strictly as per Architectural drawings, the corners of the frame being fabricated to the true right angles. Both the fixed frames and openable shutter frames shall be fabricated out of sections cut to required length, metered and mechanically jointed for satisfactory performance. All members shall be accurately machine milled and fitted to form hairline joints. The jointing accessories such as aluminium cleats, stainless steel screws etc. shall not to cause any bi-metallic reaction by providing separators, wherever required.
- e. Vertical members of the aluminium framework shall be embedded in the floors, wherever required, by cutting and making good of the floor.

B. Fixing of Aluminium Framework

- a. The screws used for fixing fixed aluminium frames of the aluminium windows to masonry walls/ RCC members and aluminium members to other aluminium members shall be of stainless steel of approved make and quality and of stainless-steel grade 304. Threads of machine screws used shall conform to requirement of I.S. 4218.
- b. For the aluminium windows, the gap between the aluminium frames and the R.C.C / Masonry and also any gaps in the various sections shall be filled with weather silicone sealant DC 795 of Dow Corning or equivalent in the required bite size, to ensure water tightness including providing and fixing backer rod, wherever required. The weather silicone sealant shall be of such approved colour and composition that it would not stain or streak the masonry / R.C.C. work. It should not sag or flow and shall not set hard or dry out under any

conditions of weather and shall be tooled properly. The weather silicone sealant shall be used as per the manufacturer's specifications and shall be of approved colour and shade. Any excess sealant shall be removed / cleared. Nothing extra shall be payable for the above.

- c. Fixing of glass panes shall be designed in such a way that replacing damaged / broken glass panes is easily possible without having to remove or damage any members or interior finishing materials.

C. Anodizing

- a. Aluminium sections shall be anodized as per I.S. 7088 – 1973. Anodizing to be as per grade AC 20 and not less than 20 microns thick when measured as per I.S. 6012, in colour and shade as approved by the Dean (IPS) The anodic coating shall be properly sealed by steam or dipping in de-ionized water as per I.S. 1868-1982 and / or I.S. 6057. Sealing quality shall be tested in accordance with the relevant standards. Nothing extra shall be payable on this account.
- b. The Contractor shall satisfy himself by checking in the factory that the thickness of the anodic coating is found to be minimum 20 microns and sealing quality is appropriate everywhere. The testing shall be done in an approved laboratory by EDDY CURRENT METHOD as per I.S. 6012 for thickness. For testing the thickness of anodic coating of the anodized aluminium sections, the calibration shall be done on bare (un-anodized) aluminium sections of same type. If any material is found sub-standard, it shall be rejected.
- c. All anodized aluminium works shall conform to relevant I.S. Codes relating to materials, workmanship, fabrications, finishing, erection, installations etc. In this connection I.S. Codes including I.S. 1868 – 1982, I.S. 733 – 1983, I.S. 1948-1961, I.S. 7088-1973, I.S. 6012-1970, I.S. 1285 – 1975, I.S. 740-1975 are considered relevant and applicable.
- d. The exposed surface of the aluminium sections shall be protected against surface damage, dents, scratches etc. It shall, therefore, be provided with protective tape. After fixing and assuring of proper functioning of doors, windows, framework for partitions / false ceiling etc. such protective tape shall be cleaned out / removed as per the directions of Engineer-in-Charge. Nothing extra shall be payable for above.

D. Glazing

- a. All glass panes shall be retained within aluminium framing by use of exterior grade neoprene gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:
- b. All glazing rebates shall be square to plumb, true to plane, dry and free from dust.
- c. Glass edge shall be clean and cut to exact size and grounded.

- d. Annealed float glass in doors, windows, ventilators, and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications.
- e. 4 mm thick glass panes shall be provided for openings not exceeding 0.5 sqm. For openings exceeding 0.5 sqm in area, 5.0 mm thick glass panes shall be provided unless specified otherwise.

E. Protections and Cleaning:

- f. All glass panes shall be retained within aluminium framing by use of exterior grade neoprene gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:
- g. All glazing rebates shall be square to plumb, true to plane, dry and free from dust.
- h. Glass edge shall be clean and cut to exact size and grounded.
- i. Annealed float glass in doors, windows, ventilators, and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications.
- j. 4 mm thick glass panes shall be provided for openings not exceeding 0.5 sqm. For openings exceeding 0.5 sqm in area, 5.0 mm thick glass panes shall be provided unless specified otherwise.

F. Aluminium Cladding

a. Part 1 – General -

1.1 Related Sections

Section 05 40 00 – Cold-Formed Metal framing: Metal framing for support of aluminum cladding.

Section 01 74 21 – Construction/Demolition Waste Management and Disposal.

Section 06 10 00 - Rough Carpentry.

Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 References

American Society for Testing and Materials (ASTM)

A. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

B. ASTM E2768-11 – Standard Test Method for Extended Duration Surface Burning Characteristics for Building Materials (30 min Tunnel Test). Results: Zero Flame Spread, Smoke Developed Index of 5. Meets criteria for Class A fire rating.

C. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

D. ASTM E1477 - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers (LRV).

American Architectural Manufacturers Association (AAMA)

A. AAMA 2605 Voluntary Specification, Performance requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. AAMA 2604 - Voluntary Specification, Performance requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels.

C. AAMA 2603 - Voluntary Specification, Performance requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

International Code Council Evaluation Service (ICC-ES)

ICC-ES Evaluation Report

1.3 Submittals

A. Product data: submit manufacturer's printed product literature, specifications, and data sheet.

B. Submit duplicate 4mm 0.5mm Alum sheet 3000/5000 Grade alloy with PVDF coating 30-40 Microns +3mm FR Core (90% Mineral Core) + 0.5mm Alum Sheet 3000 / 5000 samples of cladding material, of color and profile specified.

C. Shop drawings to indicate dimensions, profiles, attachment methods, schedule of wall elevations, trim and closure pieces, soffits, fascia, metal furring, and related work.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

E. LEED Submittal Data: Manufacturer's product data for each product specified in this section per ecoscorecard.com.

F. Submit manufacturer's installation instructions.

1.4 Warranty:

A. Provide a written guarantee, signed, and issued in the name of the owner, covering the metal cladding/cladding material for 15 (fifteen) years from the date of Substantial Completion.

B. The manufacturer's warranty is limited to replacement of defective material only, rather than installation of the same. Faulty installation shall be corrected by the installing contractor. The warranty required herein is the sole remedy against the manufacturer and there are no other implied warranties. In any event, the manufacturer shall not be liable for incidental or consequential damages.

Part 2 – Products

2.1 Aluminum Cladding and Components

25.4mm X 127mm) extruded aluminum 6063-T5 or as per calculation

A. Finish coating: powder coated finish.

B. Color: color selected by Owner's Representative.

C. Gloss: 30 ± 5 .

D. Thickness: 4mm.

E. Profile: As per calculation

Part 3 – Execution

3.1 Installation

A. Install battens in accordance with CGSB 93.5, and manufacturer's written instructions.

B. Install cladding as indicated.

C. Maintain joints in exterior cladding, true to line, tight fitting, hairline joints.

D. Attach battens in a manner that does not restrict thermal movement.

3.2 Cleaning

Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

F. Measurement and rates:

- a. Aluminium framework shall be measured as per CPWD specifications.
- b. For glazing, the actual area of the glass panels excluding the portion in the beading shall be measured in sqm up to two decimal places, for payment.

- c. Stainless steel adjustable friction hinges and the aluminium handles for the openable side- hung windows shall be of "Earl Bihari", make or equivalent as approved by the Engineer-in- Charge. 2 nos. friction hinges shall be provided per shutter.
- d. The cost of designing and preparation of shop drawings, all the samples, mock- up of window etc. is deemed to be included in the cost of the relevant items. Nothing extra shall be payable on this account.
- e. The item for aluminium for fixed portions for aluminium windows and framework for partitions shall include cost of all inputs of labour, material (anodized aluminium sections, including cleats, other fixtures, weather silicone sealants, stainless steel screws, nuts, bolts, rawl plugs, backer rods, polyethylene tapes etc. which shall be required for fabrication and erection of aluminium work) T & P, all incidental charges, wastages etc. involved in the work. However, for the purpose of payment, the weight of aluminium sections for the fixed window frame and framework for partitions, shall be measured in Kg. The aluminium cleats, stainless steel screws, nuts, bolts, separators etc. shall not be measured separately for payment and their cost is deemed to be included in the cost of this item. The item for aluminium for framework for fixed partitions shall also include cost of providing and fixing stainless steel anchor fasteners as required.
- f. The item of aluminium for the openable aluminium shutters for windows and doors etc., shall include cost of all inputs of labour, material (anodized aluminium sections, including such as cleats / angles, other fixtures, stainless steel screws nuts, bolts, stainless steel hinges, weather silicone sealant etc. which shall be required for fabrication of aluminium work) T & P, all incidental charges, wastages etc. involved in the work. However, for the purpose of payment, the weight of aluminium sections for the window shutter (sash frame) shall be measured in Kg. The aluminium cleats, stainless steel anchor fasteners, screws, nuts, bolts, separators, stainless steel hinges, etc. shall not be measured separately for payment and their cost is deemed to be included in the cost of this item. The anodized aluminium snap beading for fixing glass panels in the openable shutters of the windows shall be measured separately (on weight basis) and paid under this item of aluminium framework for window shutters.
- g. The glass shall be paid for separately under relevant item. The cost providing and fixing neoprene gasket, felt etc. is included in the cost of this item and shall not be measured separately for payment.
- h. The item for the aluminium framework includes cost of making provision for fixing fittings, wherever required, as per the item description (The cost for providing fitting (handle, lock, and buffer) shall be paid for separately).

11.0 Acoustic Wall & Ceiling Panels

11.1 General

These special requirements are intended to amplify the general conditions and special conditions of the contract and shall be read in conjunction with the same. For

any discrepancies between the General Conditions and these Special Requirements, the more stringent shall apply.

These points shall act only as a guide to the type of Acoustic, Interior, Civil, Electrical, Air - Conditioning desired for the project. The special conditions described in this tender are based on the "Background Data of the Project" and are the minimum required from the tenderer. Any and all features offered over and above those mentioned in the tender shall be given due credit. In the event of discrepancies between the tender specifications and the drawings, the tender specification shall have precedence over the drawings. The basic scheme shall be as described herein the tender and the engineering based on this shall be carried out after the award of work by the Contractor.

11.2 Scope of work

The general character and the scope of work to be carried out under this contract are illustrated in schematic design, Specifications and Bill of Quantities. The contractor shall execute the said work as per the terms and conditions set out in the specifications laid down. The Contractor shall furnish all labour, materials and equipment, transportation, and incidentals necessary for execution of work on site. All items as specified in BOQ/ Technical Specifications shall be finished/ assembled/ installed at site without any damage to the surrounding works and the finished items. This also includes any material, equipment, appliance, and incidental work not specifically mentioned herein or noted on the Drawings/ Documents as being furnished (or installed), but which are necessary and customary to complete the installation for better functionality.

In general, the work to be performed under the contract shall include the following,

- a. The contractor shall provide the mockup/ sample also for all kind of mass production items in civil, electrical, carpentry, etc.
- b. The contractor shall provide all interface components for furniture or fixed items including door hardware connectors, transducer, etc. to interface with other related items unless otherwise specified in this contract.
- c. It shall be the responsibility of the contractor to perform all checks on the quality of hardware used in the furniture items and get prior approval on the samples for handle, floor spring, door handles, and all kinds of accessories.
- d. The contractor shall provide specimens for all kinds of ceramic, items for approval prior to installation/ execution.
- e. Proper operation and maintenance of the loose furniture shall be the responsibility of the contractor.
- f. No claim for extra items shall be entertained for supply/ installation of Acoustic, Interior, Civil, Electrical and Air - conditioning.

11.3 Quality Assurance

- a. All layouts should be marked on the floor and should be approved by the Architect in the common meeting held on site. The execution should be as per working layout submitted by the Architect.
- b. The materials arriving at site should be strictly as per material specification stipulated by the Architect.

11.4 Project Execution and Management

- a. The contractor shall appoint one Manager holding a senior management position in the organization. He shall have a minimum of 7 years' experience in this type of execution and shall be required to be present on site as and when desired by the Employer/ Architect Consultant during the initial stage of the project and full time during the final stage. The Architect Consultant Employer shall identify the final stage of the project.
- b. The project manager shall be assisted on a full-time basis by a minimum of one Erection Manager and one senior supervisor. The entire staff shall be posted at site on full time basis.
- c. The project management shall be through modern equipment.

11.5 Bye laws and regulations

- a. The said works shall be in conformity with the Byelaws rules, regulations, and standards for the local authorities concerned as far as these become applicable to the installation. The complete civil, electrical, and interior works shall be in accordance with the national and local Acoustical, Interior, Civil, Electrical and Air - conditioning works codes.
- b. The said works shall be in conformity with the Byelaws, Rules and Regulations of the electric supply authority and Indian electric rules and regulations, latest Indian Standard and as per the requirement of Chief Fire Officer and the local authorities concerned as far as these become applicable to installation.

11.6 Approvals and clearance

Associated activities required for obtaining necessary clearance/ permission/ approvals/ licenses front concerned authorities are in the scope of contractor without any additional cost to the Employers. Actual statutory fees for approval/ licenses payable if any shall however be borne by the Employers on production of documentary evidence of payments made.

11.7 Drawings

- a. The Acoustical, Interior, Civil, Electrical and Air- conditioning works drawing, which are being issued with this tender, are indicative only and the arrangement of various civil and interior works and the extent of covered in the contract. The drawings indicate the arrangement of civil and interior works, highlight various materials/ hardware required and broadly suggest the color scheme/codes to be followed. The contractors estimate the quantity of materials, hardware, accessories, etc. required based on these drawings.

- b. The contractor shall follow the tender drawing in preparation of his shop drawings, and for subsequent installation work after the approval of the Architect/ Employer. The contractor shall check the drawings of others to verify spaces in which his work shall be installed.
- c. Maximum headroom and space condition shall be at all points. Where headroom appears inadequate, the contractor shall notify the Architect / Employer and get approval before proceeding with installation.
- d. The contractor shall make and furnish Shop Drawings for all conduit layout, lighting layout, Distribution Panel, Switch Board/ Cabinets, Cable trays or for any other requirements to be fabricated or purchased through contractor.

11.8 Material and Equipment

All materials and equipment's shall conform to the appropriate standards, relevant IS codes and shall be of the approved make and design listed in the specifications and list of approved makes/brands.

11.9 Manufacturers Equipment

Specific instruction, from manufactures of the materials and equipment used in this project and not specifically mentioned in these documents shall be followed in all cases.

11.10 Civil works associated with electrical installation

All minor civil works like providing/ making of chases/ opening/ hole in the wall/ floor for conduits etc. shall be carried out and finished at no extra cost.

11.11 Testing

- a. All works/ materials wherever required shall be tested, as per relevant codes as applicable. The result for these submitted duplicate for scrutiny.
- b. The contractor shall pay for and arrange, without any extra cost to the owners, all necessary testing equipment, instruments, materials accessories and the require labor. Any defects in material and/ or in workmanship detected in the course of testing shall be rectified by the contractor, entirely at his own cost and risk to the satisfaction of the engineer.
- c. The Acoustical, Interior, Civil, Electrical and Air- conditioning works shall be commissioned only after the contractor has certificate in writing from Architect Consultant regarding full conformity with the approved shop drawings, specification, and manufacturer's instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy, and conformity to the contract requirement, of the civil and interior works relating with the Acoustic and interior

works rest with the contractor in so far as the functioning of the Acoustic and interior work is concerned.

11.12 Maintenance during defect liability period

- a. It shall be the responsibility of the contractor to attend the complaints on the completed civil and interior works during the Defect Liability Period at no extra cost. The contractor shall receive calls for any and all problems experienced in the operation of the Acoustical, Interior, Civil, Electrical and Air- conditioning work under this contract attend these within 8 hours of receiving the complaints and shall take step to immediately correct any deficiency that may exist.
- b. All works executed by the contractor/ subcontractor shall be guaranteed against defects in the materials and workmanship for one year from the date of Taking over by Employer.
- c. All equipment/ installations that require repairing shall be immediately serviced and repaired. Replacement of any spare parts for any gadgets/ equipment's supplied under this contract shall be the responsibility of the contractor at no extra cost to the owner.
- d. The Contractor shall submit their bill, along with measurement in hard as well as soft copies for expeditious processing of the bill.
- e. The contractor has to furnish the Name & address of its sub – contractors for special type of work say Stage Craft, Stage Light, Auditorium Chairs, Electrical Panel, Air condition agencies for approval to Architect (in separate sheet).

Ceramic Tiles Dado.

- a. Tiles.

Ceramic tiles shall be same as described under Ceramic tiles flooring.

- b. Mortar Backing.

All joints in the facework shall be racked out to a depth equal to not less than the width of the joints or as directed by the SITE Engineer concrete surfaces shall be properly backed. All dirt, soot oil, or any other material that might interfere with satisfactory bond shall be removed. The surface shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to applying backing mortar. The dado work shall not be commenced unless the preparatory work is passed by the Site Engineer. The proportion of mortar for backing shall be 1: 3 cement mortar sand in mortar budding shall be from approved source and shall confirm to IS 1542 – 1960 as applicable to internal wall and ceiling plastering and external wall plastering. The thickness of mortar backing shall not be less than 12mm and not more than 20mm (mortar with water proofing compound).

- c. Fixing Dado Tiles.

Dado work shall be done only after fixing tiles on the floor. The ceramic tiles shall be soaked in water for at least 2 hours before being used for dado work. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff. The back of tiles shall be covered with a thin layer of neat cement plaster and the tile shall then be pressed in the mortar and gently tap against the wall with a wooden mallet. The fixing shall be done from bottom of wall upwards without any hollows in the bed or joints. Each tile shall be fixed as close as possible to the one adjoining. The tiles shall be joined with white cement slurry. Any difference in the thickness of tiles shall be evened out in cushioning mortar so that all tiles' faces are in one vertical plane. The joints between the tiles shall not exceed 1.5mm in width and they shall be uniform. While fixing tiles in dado work, care shall be taken to break joints vertically after fixing the dado they shall be kept continuously wet for 14 days. If doors, windows, or other openings are located within dado area the sills, jambs, angles etc. shall be provided with white glazed tiles and appropriate specials according to the foregoing specification and such tiled area shall be measured net along with the dado.

d. Cleaning.

After the tiles have been fixed the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing the dado of skirting work shall be washed thoroughly cleaned.

Rates to Include.

Apart from other factors mentioned elsewhere in this contract, the rates for the item of dado or skirting shall include the following.

1. Backing mortar with water proofing powder.
2. Providing and fixing tiles including all specials like round edges, angles capping etc. in neat cement floating over backing mortar.
3. Joining the tiles with white cement slurry.
4. Curing.
5. Cleaning.

All labor, material, use of the tools and equipment for carrying out the items as specified above.

SECTION – C: TECHNICAL SPECIFICATION

1. Joinery in Woodwork

- 1.1 Joinery is to be prepared immediately after the placing of the contact framed up, bonded, and wedged up. Any portions that are wrapped or found with other defects are to be replaced before wedging up. The whole of the work is to be framed and finished in a proper workman like manner in accordance with the detailed drawings, wrought and whenever required fitted with all necessary metal ties, straps, belts, screws, glue etc. running beaded joints are to be cross – tongued. Jointers work generally to be finished with fine sand/ glass paper.

- 1.2 All joints will be standard mortise and tenon, dowel, dovetail, and cross – halved. Nailed or glued butt joints will not be permitted. Screws, nail etc. will be stated, from wire of oxidized ‘Nettle Fold’ make unless specified where mortise and tenon joints are used, tenons should fit the mortises exactly.
- 1.3 Nailed or glued butt joints will not be permitted, except in exceptional cases with approval of Architect / Employer.
- 1.4 Where screws are shown on a finished surface, these will be sunk, and the hole plugged with wood plug of the same wood and grains of the finished surfaces unless detail otherwise. Nail on finished surface will be neatly punched and the hole filled with wood filler to match the colour.
- 1.5 Should joints in joiner’s work open, or other defects arise within the period stated for defect liability in the contract and cause thereof be deemed by the Employer/ Architect to be due to such defective joinery shall be taken down, and refilled, redecorated and/ or replaced if necessary and any work distributed shall be made good at the Contractor’s expense.
- 1.6 The Employer/ Architect shall approve the lengths and weights nails, spikes and bolts. Nails shall comply with IS 1959 – 1960 or approved equivalent quality sample. Brass headed nails are to comply with B.S. 1210. Wire staples shall comply with B.S. 1994 or equivalent.
- 1.7 The contact surface of dowel, tenons, wedges etc shall be glued with an approved adhesive.
- 1.8 Where glued joinery and carpentry work is likely to come into contact with moisture, the glue shall be waterproof.
- 1.9 All dovetail joints shall be further strengthened with M.S. cleats for Cabin ate furniture like tables, storage units etc.

2 Hardware and Metals

- 2.1 The hardware throughout shall be of an approved manufacturer or supplier well-made and equal in every respect to the samples deposited with the Architect. The contractor may be required to produce and provide samples from many different sources before the Employer/ Architect Consultant takes the decision and nothing extra shall be paid for this.
- 2.2 Fitting generally shall be brass oxidized, unless otherwise specified and shall be suitable for their intended purpose. In any case, it will have to be approved by the Employer/ Architect Consultant before the contractor procures it at the site of work.
- 2.3 Screws are to match the finish of the article to be fixed, and to be round or flat headed or counter sunk as required.
- 2.4 The contractor should cover up and protect the metal surface such as brass, bronze SS etc. with thick grease or other suitable protective material, renew as necessary and subsequently clean off and clear away on completion.
- 2.5 Aluminum and stainless steel shall be of approved manufacture and suitable for its particular application. Generally, the surface of aluminum shall have an anodized finish, and both shall comply with the samples approved by the Employer/Architect Consultant.

All stainless-steel sheets shall be 304 S. S Japan or equivalent with gauge as specified but not thinner than 16 G.

- 2.6 All steel, brass, bronze, aluminum and stainless-steel articles shall be subjected to a reasonable test for strength, if so, required by the Employer/ Architect Consultant at the contractor's expense.
- 2.7 All brazing and welds are to be executed in a clean and smooth manner rubbed down and left in the flattest and tidiest way, particularly where exposed.
- 2.8 Chromium plating shall be in accordance with I.S. standard or as per approved specifications for normal outdoor conditions and shall be on a base material of copper or brass.

3 Glazier

- 3.1 All glass to be of approved manufacturer complying with IS 1548 – 1966 as per approved quality and sample to be of the selective qualities specified and free from cracks, bubbles, smoke, wanes, waviness, air holes and any other defects.
- 3.2 Polished plate glass shall be 'glazing glass' (G.G) quality and that for mirrors shall be "silvering quality" (S.Q.) confirming to I.S 3438-1965 or as per approved sample and quality.
- 3.3 The compound for glazing to metal is to be a special non-hardening compound manufactured for the purpose and of a brand and quality approved by the Employer/Architect.
- 3.4 While cutting glass, proper allowance is made for expansion. Each square of glazing to be on a whole sheet. On completion of work clean all glass inside and outside, replace all cracked scratched and broken panes and leave in good condition.

4. Paint and Polishes

- 4.1 All material required for the works shall be of specified and approved manufacturer, delivered to the site in the manufacture's containers with the seals, etc., unbroken, and clearly marked with the manufacture's name or trademark with a description of the contents and colour. All materials are to be stored on the site of work.
- 4.2 Spray painting with approved machines will be permitted only if written approval has been obtained from the Employer/ Architect prior to painting. No spraying will be permitted in the case of priming coats where the soiling of adjacent surfaces is likely to occur. The nozzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the employer/ Architect. The paint used for sprayings is to comply generally with the specifications concerned and is to be specially prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.
- 4.3 Wood preservative shall be so lignum or other equal approved impregnating wood preservative and all concealed woodwork shall be treated with wood preservative.
- 4.4 All brushes, pots, tools, kettles, etc. used in carrying out the work shall be clean and free from foreign matter and are to thoroughly clean out before being used with a different type of class.

- 4.5 All iron and steel surface shall be thoroughly scraped and rubbed with wire brushes and shall be entirely free from rust, mill scale, etc. before applying the priming coat.
- 4.6 Surface of new woodwork, which are to be painted, are to be rubbed down, clean down to the approval of the Architect.
- 4.7 Surface are previously painted wood work which are to be painted are to be cleaned down with soap and water detergent solution or approved solvent to remove dirt, grease, etc. Whilst wet the surface shall be flattened down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed completely by chipping, scrapping back to a firm edge and the exposed surface touched in with the primer as described and stopped with putty. Where woodwork has been previously painted or polished and is to be newly polished, scrapping, burning off or rubbing down, should be carried out properly.
- 4.8 Surfaces of previously painted metal which shall be painted are to be clean down and flattened down as described in surfaces of any rust and loose scale shall be removed completely by chipping, scrapping and wire brushing back to the bare metal touched in with 2 coats of primer as described/ specified/ directed by the Architect Consultant.

5 Upholsteries

- 5.1 This will be of first-class standard workmanship with webbing, no sag springs, coiled springs, padding and filling as specified on drawing. Covering fabrics will be soon tufted and corded as shown on drawing and as approved by the Employer/ Architect.
- 5.2 Cushion Vents: Brass "Cushion Vents" should be installed at the back or under side of seat cushions (especially those covered in leather, vinyl plastic or very tightly woven fabric) to allow air to escape easily and to prevent torn steel.
- 5.3 Materials: Finished timber shall be of the type specified, furnishing fabrics, colour, pattern, substance to be as specified, and manufactured or supplied by the company specified, no variations of this will be permitted unless with prior approval of the Architects.

6 Polish

- 6.1 French Polish: The basic material shall be shellac dissolved in methylated spirit.
Preparation: the timber must be well sanded and cleaned, and the grain filled with grain filler. Any staining must be done before applying the polish.

Equipment: The polishing rubber, the most important implement in French polish shall consist of a pad of cotton wool, which acts as a reservoir for the polish, and a cover of a soft white linen or cotton fabric like a well-worn handkerchief, which acts as a filler. The rubber must never be dipped into the polish on to the pad with the cover removed.

Application: work evenly over the surface with a slow figure-of-eight motion until the timber is coated with a thin layer of polish. The object is to apply a series of thin coats, allowing only a few minutes for drying between the coats. When a level and even body surface is obtained the work is ready for the second stage i.e., spiriting off.

Allowing the work to stand for at least eight hours, then take a fresh rubber with double thickness of cover materials and charge it with methylated spirit. The object of spiriting off is to remove the rubber marked and to give the brilliance of finish.

Finally, work in the direction of the grain and continue until the surface is free from smears and rubber marks then leave to harden off.

- 6.2 Wax polish: Wax polish shall contain silicon and driers. A good silicon wax is to be used, not creamy or spray. The timber shall be sealed first with another finish such as Ronseal, before applying the wax.

Application: Apply a light coat of the sealer by brush or cloth direct to the unfilled timber, working it well in and finishing evenly with the grain. Allow drying thoroughly then sanding lightly with fine abrasive paper. Apply a heavy coat of wax by cloth or on flat surfaces, with a stiff brush. Work well into the timber and finish off by stroking with the grain before leaving to harden. Leave for several hours before rubbing up with a soft brush. Finally, buff the grain with a soft cloth.

- 6.3 Transparent Colored Polyurethane (Melamine): This shall be applied where natural grain of the wood is required to be shown. Polyurethane gives a tough surface, which resists chipping, scratching and boiling water.

Application: Clean off all the grease and wax with an abrasive and white spirit, this should be applied in humid conditions.

Apply the same coat, preferably with clear hard glaze with a cloth pad. Leave this to dry for at least six hours, then apply the coat with paint brush –off you wait for longer than 24 hours between coats, rubbed down the previous coats with fine glass paper or medium grade of steel wool. Obtain a matt finish, if required, by giving a final coat of clear Ronseal Matt Coat.

7 Timber

- 7.1 All internal frame works shall be of Central Province Teak Wood (C.P.T.W.) unless otherwise specified.
- 7.2 All exposed woodwork shall be of first quality B.T.C. grade teak only or as specified.
- 7.3 All the wood shall be properly seasoned, natural growth and shall be free from worm holes, lose or dead knots or other defects, saw die square and shall not suffer warping, splitting or other defects.
- 7.4 The moisture content shall not exceed 12%.
- 7.5 All B.T.C, C.P teak wood and must be approved by the Architect before using.
- 7.6 All internal frameworks shall be treated with approved wood preservatives.
- 7.7 All wood brought to site shall be clean, should not have any preservative or other coating/covering.
- 7.8 All rejected, decayed bad quality wood shall be immediately removed from site.
- 7.9 All wood brought to site must be stacked and stored properly as per instruction.

8 Plywood

- 8.1 Plywood/ block board/ teak particleboard/ veneered board, etc. as specified in the approved list of manufacturers shall only be used.
- 8.2 Only B.W.R grade phenol formaldehyde bonded hot pressed plywood generally confirming to I.S.I 303 of approved make shall only to be used.
- 8.3 Marine plywood shall generally confirm to I.S. 710-1980 and also to Defense/Navy specification, bonded with phenol formaldehyde treated with wood preservative.
- 8.4 Only teak wood particleboard shall be used, particleboard shall be phenol formaldehyde and generally confirm to I.S. 3087-1965.
- 8.5 Only 3mm to 4mm thick straight-grained group matching approved veneers shall be used. Only veneers laminated from species like Teak, Maple White cedar, Rosewood, White cedar, Walnut, Mahogany shall be considered for approval and use.
- 8.6 Block board shall be equal or superior quality to that laid down in B.S. 3444 with one of the following I.S. Specifications or such approved adhesives:
I.S.I 851-1957: Synthetic resin adhesive for construction works in wood.
I.S.I 849-1957: cold setting case in glue for wood.
Block board shall be generally confirming to I.S.I. 1959-1960 or as per approved sample.

9 Laminates

Laminates where specified shall be of approved brand, type, texture and thickness and manufactured as per IS: 2046-1969. Fixing of laminates shall be done as per best trade practices and strictly as per printed instructions of the manufacturers using Phenol Formaldehyde Synthetic Resin Adhesive of approved make. Unless otherwise indicated laminates shall be 1.5 mm thick for horizontal surfaces and 1.0 mm thick for vertical surfaces.

10 Iron Mongery

All finish hardware shall be well made, reasonably smooth and free from sharp edges and corners flaws and other defects and shall be as per relevant Indian Standard Code. Unless otherwise required, all finished hardware shall be polished brass.

All hardware shall be of approved make and shall be specifically approved by the Architect before ordering. No fittings and fixtures shall be fixed before all major work is over. While fixing correct handling of fixtures shall be ensured.

All finished hardware shall be fixed by skilled carpenters experienced in this work. Work shall be done as per the manufacturer's printed instructions and to the satisfaction of the Auditorium Consultant.

All hardware fixed to the respective location shall be adequately protected from damage and splashes of mortars and paints by covering it suitably with Jute Cloths/ Black PVC sheets till handing over of the work to the Employer to his satisfaction. The finished hardware shall be clean without any foreign materials and fully showing the original finish in its best condition.

11 Gypsum Board

Gypsum Board to be as manufactured by Messrs. India Gypsum Ltd.

1. Density – Nominal in dry state – 807.10 Kg/m³.
2. Standard – Confirming to IS 2542 – 1981 & IS 2095 – 1982.
3. Non-combustible as per BS 476: Part 4: 1970.
4. Non ignitable class 'P' as per BS 476: Part 5: 1968.
5. Fire propagation index 1 = 4.06 as per BS 476: Part 7: 1971.
6. Surface spread of flame class – 1 as per BS 476: Part 7: 1971.
7. Fire resistant evaluation as per BS 476: Part 87 ISO: 834 and IS3 3809.
8. Resistance to knocking and scuffing – greater than that of cement plaster work.

12 Acoustic Polymer Wool / Mikron

- Thermal insulation and sound insulation
- Fire Retardant – non-combustible and in accordance with IS 3144 and BS 476 (part 4)
- Light weight, roll form, easy and safe for installation,
- Eco-friendly - Manufactured from recycled plastic and can be reused and recycled.
- Do not disintegrate or emit any dust particles, no form or irritation or itching sensation is witnessed.
- Waterproof, shape, and sound insulation is stable even gets wet.
- Melting point: 250°C
- Sound Absorption Properties for 1000 GSM, ranging from 0.75 to 0.90.

13 Wooden Flooring

Wood for wooden flooring with Tongue & Groove joints shall be kiln seasoned 1st class CP teakwood. It shall be free from large loose dead cracks, warps, twists, bends, sapwood, or defects of any kind.

Teakwood skirting etc. shall be out of kiln seasoned 1st class CP teakwood. It shall have uniform colour, reasonably straight matching grains and shall be free from large, loose dead knots, cracks, shakes, warp, bends, sapwood, or defects of any kinds.

14. Wood wool Board

Wood wool cement slab or approved equivalent.

1. Wood wool fiber board
2. Density – 400Kg/ m³ (+- 10%).
3. Sound Absorption – as per ISO 354 equivalent to ASTM C423.
4. Sound Insulation – as per ISO a 40 – III 1995 and rating as per ISO 717 – 1.
5. Non – Combustibility as per ISO 1182 – AT 750, C.
6. Ignitable classification as per BS 476 Part 5 – 'P' not easily ignitable.
7. Fire propagation index as per BS 476 Part 6 – 5.17.
8. Moisture – 15%.
9. Straight lines of edges - + - 1mm < 1250 + - 2mm > 1250.
10. Straightness of edges - +- 1mm.
11. Weathering - < 1mm change in dimension < 5% changes in density.

15 Microfiber Acoustic Tiles

Microfiber Acoustic tiles

- Humidity Resistant (RH 95)
- Fire Resistance: BS-476-4:1970 (Certified)

- Excellent Sound Absorbing (Noise Reduction) Properties (NRC +0.55)
- Light Reflectance (0.80-0.85).
- Thermal Conductivity – 0.50 – 0.58
- Density -260 – 300 kg/m³
- Recycled material – 50 to 60%

16 Fabrics

All fabric to be used shall be fire rated for at least half an hour fabric. The contractor has to give the fire-retardant certificate.

17 Wood Wool Board

Anutone is manufactured by M/S. Anutone Acoustic Ltd – Bangalore as per IS: 8225 – 1987 Equivalent to ISO: 354 – and ASTM: C 423 – 99. Board is made wood fire bound by cemented adhesive having enhanced sound absorption / insulation / diffusion / reflectance density: 400 kg. / m³, Fire Resistance: CLASS I BS 476 – Part 6/7 Fire propagation: 5.17

18 Viscoelastic Synthetic Soundproofing Membrane

It is a polymer-based asphalt Free, high density (1.99 / cm³) systematic sound proofing membrane, that offers good acoustic insulation in different building elements. It is available in Tecsound 5kg / M² & 10 kg /M² Membrane sheet. It has very good sound insulation property.

19 Jolly Board Perforated Hard Board or Avil Hard Board

It is made of wood fiber reduced to fibers which are thus felted on hole pressed to form sheet, with the primary bond derived from the felting and inherent adhesive properties of fibers

Thickness : 4.5 , 6 and 8 and 9mm

Density : 800 to 120 kg / M².

K Value : 0.14 W / M* 6

Fire Resistance: IS 1734 (part – III)

Spread flame : CLASS – 3 . IS 1734 AND BS 476, PART – 7.

Oil Tempered hard board is hard dark brown, blackish sheet material (4.5 mm thick)

Perforation about 4% to 12%.

20 Acoustical Treatment or AMF Ceiling Board

AMF Thermatex finestratos micro perforated, sandpaper finish surface colour RAL 9010, pure white. A grid concealed panels non removable system S30 UNO. Sound absorption as per BS EN 20 354: 1993. DIN EN 4109 and DIN EN 52210. NRC – 0.65. Sound Attenuation as per BS EN 20140 – 9. DIN EN 4109 and DIN EN 5221.2 D n, c, w = 38 dB. Fire resistance in accordance with DIN 4102, Part 2. The thermal conductivity is 0.052 – 0.057 W/mk. Light resistance is up to 90%. Humidity resistance is up to 95 5RH. Complete as per design, drawings, and Architect.

21 Kraft Ceiling

Knauf Danoline KRAFT -: Tectopanel Size 1200*600*12.5mm

Micro perforation 3.5X3.5mm with 7.1 - 9.8% perforation and 0.85NRC.

The acoustic properties of the ceiling system are due to the perforation of the Knauf Danoline Tectopanel U Panel.

Isolation grey primer to be applied on Tectopanel by spray. Drying time - min 4 hours.

Special Adhesive is applied on the Tectopanel using a special spray gun.

The acoustic fleece is fixed on the Tectopanel aft ensures the absence of cracks and serves as a smooth plaster support surface. 4 The look of the KNAUF DANOLINE KRAFT acoustic ceiling is characterized by the especially fine structure of the acoustic plaster Picco S.

The acoustic plaster is applied on the fleece in two layers. Choice of colours is required.

Antistatic, renewable surface – Possibility of incorporating installations – High sound absorption surfaces.

Cleaneo Technology - Air purification & Air quality. Active reduction of air pollutants thanks to Cleaneo Technology effectively reduces concentrations of VOC's like alcohol, aldehydes, ketons and esters as well as unpleasant odours from e.g. food or cigarette smoke

Air purification properties tested according to CEN standards and VDI guidelines by Fraunhofer Insistute for Building Physics

The false ceiling surfaces shall be prepared to the satisfaction of the Architect and shall be applied with two coats of primer and Paint to the satisfaction of Architects.

22 Signage

Auto glow Signage Board for exit, toilet on 1/2" thk glass with its bracket for suspension. Imported chemical compounds are used in manufacture it will work without electrical energy complete with suspension bracket and scaffolding etc.

23 Marine Ply

Termite, borer and boiling water-resistant marine ply shall be plywood bonded with phenolic resin, Kitply, Anchor, Green or equivalent approved make in thickness as required.

Neoprene Gasket / Pads / Isolation Hangers / Spring Mounts Neoprene pads would be manufactured by Messrs Resistoflex Vibrasorb Private Ltd. Noida, U.P. or approved equivalent.

24 Wood Adhesive

Wood adhesive would be Fevicol, Vemicol or approved brand.

25 Polyester Fiber Board

Thickness: 9mm, 12mm and 25mm

Maximum dimensions : L-2.44m W-1.22m

Density Kg/m³ (+/- 10%): 9mm: 200 Kg, 12mm: 190 Kg, 25mm: 120 Kg

Composition: 100% Polyester Core

Edges : Square / Bevelled/ Mitre

Warranty: Warranted against workmanship and manufacturing defects for 2 years from date of purchase

3 Green & recycle Products:

Recyclable and eco-friendly, Lead certification

4 NRC: Enhanced sound insulation. NRC up to 0.7:

Higher NRC may be obtained with a decreased airgap thickness of the material.

5 Fire rated: Formaldehyde Free

26 Wood Preservative

All concealed teakwood framing for the flooring etc. shall be painted with one coat of fire-resistant wood preservative like wood – retar as manufactured by Messrs Navair Private Ltd. New Delhi, APCO Paints Ltd. or approved equivalent make.

Paint and Polish

All paints and polishes shall be of reputed makes such as Shalimar, Berger, Jenson and Nicholson, Asain Paints etc.

Installation

The installation shall be carried out by skilled workmen thoroughly experienced in this type of work.

Approval before commencement

The contractor shall not proceed with installation of the acoustical treatment until the condition of the work site is satisfactory for starting the installation work. No acoustical work shall be commenced without obtaining approval of the Engineer.

Work to be done as per Drawing and Design

Work shall be done strictly in accordance with the drawing and with the modifications as specifically approved by the Engineer after taking special care to see that the acoustical requirements of the design are not adversely affected.

Surface to be true

All finished surfaces shall be true in level. Line and plumb. Uneven surfaces shall be rejected and redone.

Proper Alignment of Framework

The framework shall be plumb and level and various individual panels shall be flat both horizontally and vertically except for the framework, which is profiled as shown in the drawing.

Dimensions

The detailed dimensions for the various acoustical treatments shown in the drawings shall be generally adhered to. Both horizontal and vertical members, on all walls shall be marked after a physical check of the actual dimensions has been made.

Types of Treatments shown in the Drawings.

The various types of acoustical treatments for walls and false ceiling and ceiling treatments have been indicated and detailed in the drawings. The following general specifications shall be followed.

Ceilings

All specifications for false ceiling work shall be followed in so far as these are applicable and not contradictory to these specifications.

After the ceiling is cleaned the framing shall be done as specified always, that the joints are located as shown in the drawing. In case no details are given for joints, joints should be symmetrically located in the room.

Wall Treatments

After the wall surface is thoroughly cleaned, framing shall be done as shown and specified.

The surface material shall then be screwed over the framing according to drawings and details.

Painting / Polishing

All exposed woodwork shall be finished in natural and matt finish. All painting and polishing work shall be done as per relevant specifications.

TECHNICAL SPECIFICATION**MODE OF MEASUREMENT**

1	Walls	Elevation
2	Flooring	Plan Area between skirting
3	Skirting	Running length
4	Window	Elevation Area
5	False Ceiling	Actual Area between partitions (Rate shall be inclusive of making holes/ cutouts/ openings for light fittings, AC grill, Smoke Detectors, Sprinklers, provision of perimeter channel for support/ fixing of grills/ light fittings and suitable boards of 300 x 300 x 10 mm for spotlights. No deductions shall be made for any such cutouts/ opening. However, column areas shall be deductible. Cut-out area more than 0.245 Sq.mt will be deducted from ceiling area.
6	Partition	Elevation Area (from finished floor/ false floor level to finished false ceiling level).
7	Wall Paneling	Elevation Area
8	Pest Control/ Anti- termite treatment	Carpet area
9	Tables	Nos.

10	Rear/ Side Credenza	Elevation Area
11	Utility/ Staff counters	Running length
12	High/ Low Storage	Elevation Area
13	Storage above counter	Elevation Area
14	Door/ Frames	Cu. Mt
15	Air condition Grills	Actual Surface area
16	Shutters for ducts and below window sill	Elevation Area
17	Blinds	Elevation Area

Note: Measurement shall be recorded up to three digits after decimal point.

3.3 Vermiculite Concrete

Material: Vermiculite concrete is a mixture of cement and other fire-retardant chemicals capable of controlled swelling. It is a light weight, low density product which expands, ensuring a tight seal against the passage of fire, toxic gases and smoke. This type of fire stop can be adopted for opening in walls as well as cut-outs in floors, shafts, providing a fire rating of up to 4 Hour. Material Features:

It shall have fire rating of up to 4 Hours.

It expands while it sets, ensuring a tight crack-free seal.

Can be easily retrofit cables through the penetration.

It is easy to mix and apply.

Is splash and ageing resistance.

Stick well on steel and concrete.

Material Specifications:

Bulk density – Approx 700 gm/litre (+/-50)

Storage temperature – 5 to 50 degrees Celsius in dry conditions

Ph value – Approx. 9 to 12.5

Packaging – 20 kg & 30 kg

Toxicity – Nontoxic

Mix ratio – 1:0.64 (Mortar: Water)

Application temperature Room temperature

Colour – Grey

Shelf life – 18 months, in original packed conditions

Testing – Material shall be tested in accordance with ASTM-E-814, UL-1479 up to 4 hours rating.

3.4 Particular Specifications of Rock Anchoring

Passive Rock Anchors - Using Adhesive Grout

Execution - Providing & installing 32mm dia. 1 no Fe 500 rebar Adhesive Anchors - 23 Tons Capacity, hole dia. 34mm to 40mm, located below Raft / Foundation having 0.6 M fixed length with HILTI RE 500 V3/ RE 500 V4 in HARD BASALT ROCK (Product Tested in HARD ROCK).

Identifying and marking all locations for passive rock anchors with any suitable paint for easy demarcation. Drilling holes at all the locations using Drilling Machines and drill bits for the designed depth in rock measured from the top of the excavated & exposed rock face at or below raft / footing bottom level. Cleaning all holes prior to grouting by Air at a pressure of 6 Bar/90 PSI blown 4 times inside the hole starting from the bottom of the hole.

Inserting foil pack holder with foil pack into hit - dispenser, pushing release trigger, retracting plunger, and inserting foil pack holder into the appropriate dispenser.

Discarding 3 initial triggers of the adhesive. An extension tube attachment shall be connected to the mixer nozzle and shall be attached to the mixer nozzle on one end with piston plug attached on other end for ensuring the required embedment. The piston plug should touch the bottom of drilled hole. Joints of flexible extension pipe with nozzle & piston plug at both ends shall be taped for secure non leak joints.

The length of the extension tube from the piston plug attachment inside the bored hole should be such that a clear marking of Embedment is visible on the extension pipe flushing with the bored hole neck. Dispense the chemical in the drilled holes using dispenser gun. Piston plug works on the principle of back pressure and evenly distributes the chemical in the drilled hole. Post visible confirmation, extension pipe shall be gradually pulled out.

A rebar of required diameter with a marking of Embedment length shall be inserted in the pre grouted hole, within the gel time of the hit RE 500 V3/RE 500 V4 (or, in the circular & twisting motion to the complete depth resulting in visible confirmation of marking on rebar to flush with bored hole neck. Allow the curing to occur within the specified time limit. Curing time may vary

as per site conditions. Rebar should not be disturbed during the initial setting time for the stated temperature of base material so that the anchor achieves its full design strength. rate shall include drilling through over burden, all type of soils, weathered /hard rock with either rotary/pneumatic percussion method, cleaning the holes, rebars, adhesive grout etc. all complete. Rates shall include pull out test on selected anchors [approx. 2% of total anchors] to confirm the anchor capacity.

Rock Anchors with Hilti Epoxy Chemical RE500V4 with respective depths

For FE500, Full Steel Capacity=0.87*Fy*Ast			
Dia of Rebar	Full Steel Capacity uplift (MT)	Min Embedment Depth(mm)*	Bond strength of RE500V4 with Indian Rock
12mm	4.91	310	4.3 N/mm2
16mm	8.74	410	
20mm	13.65	510	
25mm	21.34	640	
32mm	34.96	810	
40mm	54.6	1050	

3.5 Particular Specifications of Post Tensioned Concrete

Part 1 General

1.1 Summary

- A. The Client shall propose the specialist Post-Tensioning Agency/ Vendor from within the List of Approved Makes in the tender document along with his bid based on given design.
- B. Provide labour, materials, necessary equipment, and services to complete the posttensioned concrete work, as indicated on the drawings and as specified.
- C. Provide additional materials required for post-tensioned cast-in place concrete not otherwise specified and perform job site post-tensioning operations necessary to complete the work as shown and specified.

1.2 Submittals

- A. Delivery of all post tensioning materials including high tensile strand, post-tensioning anchorages, GI ducts, wedges with consumables, etc.; as per detailed specifications.
- B. Providing all necessary equipment to carry out the post tensioning works as per detailed specifications including mobilization and de-mobilization of the PT equipment's, materials, labours, etc.

C. Providing experienced and specialized post tensioning engineers and technicians for supervision of lying of strands, fixing of bursting link, fixing of chair bars for tendon supports, low point marking from the centre of the span on either side, etc.

D. Laying / Installation of strands, ducts, anchor blocks and wedges, stressing and grouting of the PT tendons, cut off strands as per the shop drawings and detailed specifications.

E. Preparation and submission of "As-built" drawings on completion of works.

F. Demarcation of tendons with approved paint at the soffit of PT slabs and PT beams.

G. Contractor shall obtain In Principle approval of Post-Tensioning Agency/ Vendor from PM before award of the job.

1.3 Quality Assurance

Codes and Standards: Comply with provisions of the latest edition of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

Strand quality in Accordance with - IS: 14268 - Class-II

Material standard and workmanship - IS:456-2000, IS: 800-1984, IS: 1786

Methodology accordance with IS: 1343-2012, IS: 3414, BS: 8110-1997, BS: 8007

Plain and reinforced concrete – Practice (American standard) ACI 318-08

B. Specialty Firm Qualifications: Firms with at least 5 years successful experience including projects of similar or larger scope and complexity.

C. Foreman Qualifications: Person with not less than 3 years field experience in foreman's capacity on projects of similar or larger scope and complexity.

Part 2 – Products

2.1 High Tensile Sheet

A. HT steel to be used in all pre-stressing work shall conform to relevant Codes of Practice listed in this technical specification. Each consignment or batch of HT steel supplied at site shall be accompanied by the manufacturer's test certificate. Steel should be from the original iron or producers (like TATA, DP Wires, Usha Martin). Other steel can be used only after prior approval of the Engineer-in-charge.

B. If so desired by the PM, additional tests on samples of steel taken from the site consignment shall be carried out by the Contractor at an approved laboratory and at Contractor's own cost and the Engineer-in-charge shall be given necessary facilities to witness such tests.

C. The material (wires) shall be stored in weatherproof sheds on damp proof platforms at least 300 mm above ground level to avoid contamination with soil, ground water, etc.

D. The HT steel before being incorporated in the works shall be free from loose rust, scales, grease, and similar other deleterious matter liable to adversely affect its bond with concrete/grout. It shall also be free of kinks, notches, and other mechanical defects liable to adversely affect its strength.

E. HT steel shall be supplied in strength straight length or in large diameter coil to lay out straight.

1. The Technical Details of HT steel/ strands are as follows:

Nominal Diameter - 15.2 / 12.7 mm

Nominal Area – 140 / 98.7 mm²

Nominal Weight - 1.11 / 0.785 kg/m

Minimum Ultimate Strength - 1860 N/mm²

Modulus of Elasticity - 195 KN/mm²

Minimum Braking load per Strand 260.5 / 183.7 KN

Relaxation (low) - 2.5% at 0.70 UTS after 1000 hrs

Temporary Corrosion Protection - Approved make.

Identification - Metal Tag for each coil

Certificates - Mill Certificate for each shipment

2.2 Tools and Tackles

The Contractor shall procure his own stressing jacks, pumps, sheathing and such other appurtenances as are necessary for the workmanlike execution of the work and as are prescribed by the makers of the respective system. The Contractor shall furnish to the PM all the pertinent information of the pre-stressing system adopted by him. The decision of the PM as regards the system of pre-stressing to be adopted, the adequacy of precautions, etc. Shall be final and binding on the Contractor and no claim whatsoever will be entertained on this account.

2.3 Mono Strand or Multi Strand Jacks

Jacks to be used for stressing at the stressing anchorages shall be as per the detailed specifications of the specialist PT vendor.

2.4 Mixer

The mixers shall be specially designed for the purpose of mixing and agitating the grout and carrying out the grouting operation in single unit requirement. They shall enable the grout constituents to be metered accurately and a homogeneous mix shall pass to the pump. The recommended pressure to be maintained on complete grouted tendon with a lock-off nozzle is at 3 to 5 bars or as specified by the specialist Post- Tensioning (PT) vendor.

2.5 Sheathing

In case of post tensioned pre-stressed work all tendons shall be properly encased in galvanized metal sheathing of proper diameter till the final stressing of the tendon is done. The sheathing shall be strong enough to bear the cable weight or any other incidental loads and impact applied during construction. It should also be flexible enough to adopt smooth curvature of the tendons. The strength and the connection of the same with anchorage other pieces of sheathing shall be leakage-tight in order to avoid ingress of cement slurry inside the duct during concreting and leakage of grout during grouting. Suitable acceptance test for achieving the same may be called for by Engineer-in-charge. The thickness of metal strip forming sheathing shall not be less than 0.24 mm for sheathing up to 48 mm Internal Diameter (ID) and 0.30 mm for sheathing upto 60 mm. ID. Higher thickness may be specified for larger diameter. The density of galvanizing shall not be less than 35 gm/m² on each surface.

2.6 Anchorages

- A. In post tensioning systems for bonded tendons, following anchorages are available.
- B. Stressing Anchorage: At this anchorage, the strands are stressed, anchored and the tendon forces transferred to concrete.
- C. Dead End Anchorage: The principal feature of this anchorage is the bulb shape end formed on each strand by splaying out the individual wires. The force is transmitted into the concrete by bearing at the bulbs and bond in the exposed length of the strands.
- D. The anchoring device shall be such as to hold the pre-stressing tendons firmly and permanently and be strong enough to resist in all respects, force equal at least 92% of bearing strength of the pre-stressing element in anchors. The minimum elongation of wires when tested for above should not be less than 1.8%. The anchorage shall transfer effectively and distribute evenly the entire force from the pre-stressing tendons to the concrete. The anchorage shall be adequately protected against damage and corrosion by encasing them in concrete.
- E. The maximum permissible slip or take-up during the seating of anchorage shall be specified by the manufacturer and this shall form part of performance specification for the anchorages accepted for the work. This slip is not exceeded during the actual execution of work.

Part 3 – Execution

3.1 Tendons

The strands shall be continuous over the entire length of the tendon and joint shall not be permitted. The tendon shall be carefully and accurately located in the exact position and profile and the method of fixing them shall be such that they are not displaced during placing or compaction of concrete and during tensioning (stressing). Type of fixture used for positioning of tendons shall be such as not to give rise to friction greater than prescribed codal limits. The fixtures and the entire scheme of positioning tendons will be dully approved by the Engineer-in-charge.

3.2 Stressing

- A. After the concrete has reached the required strength as well as has achieved prescribed age, stressing operation may be undertaken. The pre-stressing job shall be done under the

supervision of an experienced supervisor approved by the PM and in the presence of an authorized representative of the PM. The prestressing force shall be determined by both of (a) and (b):

1. Measurement of steel elongation. Required elongation shall be determined from average load-elongation curves for the prestressing steel used.

2. Observation of jacking force on a calibrated gauge or load cell or by use of a calibrated dynamometer.

a. Cause of any difference in force determination between (a) and (b) that exceeds 5% for pre-tensioned elements or 7% for post-tensioned construction shall be ascertained and corrected.

b. Variations beyond the limits shall be reported to the Engineer-in-charge.

c. The instructions given on the drawings shall be carefully followed. The Contractor shall submit 3 copies of the entire stressing and elongation data to the Engineer-in-charge in prescribed form. The data so forwarded will bear signatures, Engineer-in-charge, and the Contractor's supervisor present during stressing. The data shall be true and faithful record of the actual measurements at site. All stressing results should be approved by Engineer-in-charge before cut-off strands.

d. All the equipment such as dial gauges, etc. Will be checked periodically, and check certificates obtained for record.

3.3 Grouting

A. All the tendons will be fully grouted as early as practicable as and not later than 2 weeks after they are finally stressed unless otherwise permitted by the PM. The grout shall be made to the consistency of thick paste with water-cement ratio not exceeding 0.60.

B. The grouting holes shall be left in concrete at such places and in such manner as directed by Engineer-in-charge. The cable ducts will be first cleansed by passing compressed air through them in order to see than no obstructions to passage of grout exist. After flushing the ducts thoroughly as indicated above, grout will be injected under a pressure of 3.5 to 6 kg/cm² from one end till it overflows at the other end of the duct. Grouting shall be continued till all the water in the duct is expelled and the consistency of the grout emerging at the end is the same as that of the grout being pumped in. The exit will then be plugged, and grouting continued till pressure gauge consistently records the pressure of grout being injected.

C. Grout consists of:

Ordinary Portland cement - 50 kg bags

Water - Portable water

Grout additive type - Approved make

Water/ Cement ratio - 0.35-0.43

Additive/ Cement ratio - 0.5% -1% by weight of cement

Bleeding - Max 2% after 3 hours; Max 4% at any time; and the water shall be absorbed after

24 hrs.

Compressive Strength - Min 17 N/mm² at 7 days, Min 30 N/mm² at 28 days

Mixing sequence and Time - Water-Cement-Additive and Minimum 3 minutes

D. Necessary tests of consistency, bleeding and strength shall be carried out for finally deciding upon the grout mix.

E. Testing

1. The following tests shall be carried out to determine the most suitable mixes:

a. Viscosity (flow time): (i.e. Trial Mix Purpose only)

b. Viscosity test will be executed by means of flow cone.

c. Flow time measured with a stopwatch.

d. Measurement is carried out directly and 10 minutes after mixing. The flow time should not exceed max 13 to 18 seconds.

2. Bleeding: (i.e. Trial Mix Purpose only)

a. Measurement is carried out to determine the effect of the additive.

b. For bleeding tests, plastic or glass containers are used. Containers must be placed in horizontal plan.

c. Fill the container up to approximately 100 mm and measure the exact height.

d. Bleeding: Shall not exceed 2% after 3 hours, shall not exceed 4% at all times, and e. The water shall be absorbed after 24 hrs.

f. If the above values cannot be achieved, the grouting formula is to be changed and the test will be repeated.

3. Measurement for Compressive Strength of Grout Cubes

a. 6 samples of cubes of size 100 mm x 100 mm x 100 mm will be taken and tested for 7 days and 28 days strength.

b. The minimum cube strength should be as below: 7 days: min. 17 N/mm² (3 cubes).

c. 28 days: min. 30 N/mm² (3 cubes).

F. In case failure of grouting occurs, with immediate effect the cable duct needs to be flushed with water first and then by compressed air and re-grouting shall be done within 24 hours.

G. In case of an interruption of grouting operation (more than an hour), the grout shall be flushed with water and Compressed air.

3.4 General Workmanship

A. Sequence of work should adhere to the following guidelines:

1. Place bottom layer of rebars in slab and beam.
2. Lay post –tensioning tendons to correct profiles.
3. Place top layer of rebar in slabs and beams.
4. For edge beams where tendons are anchored open links shall be used. Top longitudinal rebars and closing links are to be placed after tendons are installed.
5. It is of paramount importance that the main Contractor and the specialist PT vendor shall ensure that the placement of rebars do not interfere with tendon Profiling. Should there any conflict, priority should be given to correct tendon placement.

B. Placement Procedure of Tendons

1. The tendons are usually assembled on site. The procedure is as follows:
 - a. Positioning and fixing of block-outs for stressing anchorages to the edge formwork or construction joint formwork.
 - b. Cut hole to the edge formwork for each anchorage to accommodate protruding strands (by main Contractor).
 - c. Place tendon according to tendon layout.
 - d. Fabrication of dead-end anchorages.
 - e. Lay tendons to correct profile with support bars and chairs.

C. Important

1. All tendon profiles shall be measured from formwork level.
2. Do not damage duct with tie bars or formwork.
3. Avoid stepping on duct placed.
4. Check visually the axis of ducts placed and fixation at support before concreting.
5. Repair any damage with tapes.
6. Pour concrete carefully and avoid any damage of duct and profile by vibrator.
7. Limit state of Serviceability (Cracking) shall adhere to criteria Type 2 as per IS 1343 clause 19.3.2.

D. Tolerance of tendon profile is recommended as follows:

1. Slab tendon vertical ± 5 mm (at lowest and highest points).
2. The horizontal ± 150 mm (to avoid small openings for Mechanical and Electrical services or other obstructions, if necessary).
3. If the above tolerance exceeds the PM should consulted.

4. pre-stressed concrete cables will be laid such that their profile is a smooth curve unless otherwise specified.

a. The alignment tolerances shall be as under:

Member with a depth of	Tolerance in direction of depth "d" of Members
Up to 210 mm	Tolerance $\pm d/40$
210 mm – 1000 mm wide	± 5 mm
More than 1000 mm	± 10 mm
	Tolerance in direction of width of Members @ level of tendon
Up to 210 mm	± 5 mm
210 mm – 1000 mm wide	± 10 mm
Slabs and Beams more than 1000 mm	± 21 mm

5. Tendon extensions will be measured up to 1 mm accuracy. The total pre-stressing force applied to a beam shall not vary more than $\pm 5\%$ from the design force specified and measured in terms of the total elongation of all the tendons in that member.

6. In the case of slabs this variation shall be measured and restricted over a range of 5 consecutive tendons.

E. Stressing

1. Tendons which are stressed at both ends may be stressed from one end followed by the other. The sum of elongation from both ends is then compared with the total theoretical extension.

a. The Stressing Procedures are as follows:

1) Initial stressing to 25% of the total force can commence any time after the concrete has attained minimum cube strength of 25 N/mm² for M35 grade of concrete and 30 N/mm² for M40 grade of concrete.

2) A mark is made on the strands after initial stressing.

3) Sequence of stressing at this stage is not important.

4) No elongation measurement is done during real stressing. This is due to a varying degree of slacks in each strand and therefore, measurements made at this stage would prove erroneous.

5) Proceed with 100% stressing after the concrete has attained the strength required as mentioned above.

6) Measurement of elongation then be made (say x mm). As the "datum" mark is from the previous 25% stressing. The measurement made would only reflect the elongation of the strand from 25% to 100%.

7) Due to the wedge draw-in upon release of jack pressure, the measurement made in item (f), i.e. X mm, should include an additional 6 mm (approximately).

8) In order to obtain the full elongation of the strands extrapolation of the measurement made is done as follows:

$$\text{Actual elongation } 75\% = (x + 6 \text{ mm})$$

$$(0\% - 100\%) = 1.333 \times (x + 6 \text{ mm})$$

9) For elevated slab construction the stripping of formwork can be carried out after full stressing of the slab is completed. The intermediate props are to provide at the interval of 1.50 m spacing if the construction or design load of the proposed next above slab is more than the completed floor slab. However, the PM would have to be consulted before removal of formwork.

NB: For tendon less than 10 m in length theoretical strand elongation is used as a guide rather than criteria for acceptance.

F. Cut-off

After completion of stressing work and approval of stressing records by the PM, excess length of strands is to be cut-off by means of a grinding disc or fibre disc cutter minimum 20 mm from the edges.

G. Tendon Stressing Report

Stressing result for each tendon shall be recorded during the stressing operation. Copies of records shall be submitted to Engineer-in-charge for review.

H. Safety Precautions

1. Special precaution shall be taken when working near tendons, which have been tensioned or are in the process of being tensioned.
2. Do not stand behind the jack during all stressing conditions.
3. Test reports for steel Tendons for ultimate Tensile Failure strength and elongation (0.2% proof stress) shall be submitted by the vendor at least 10 days before being taken up for execution. The frequency of sampling shall be 4 samples for every 60 T of material procured.

3.5 Acceptance criteria and remedial measures for different failures during stressing and de-shuttering activity

A. Types of Failures and Standard Procedures –

1. Honeycomb (voids) in Concrete and Casting Head Failure:

a. In case of failure of tendons occur due to honeycomb in concrete or failure of casting head then; following measures are to be adopted at site.

b. De-shuttering Procedure for PT Slab and PT Beams:

- i. If above failure (a) occurs at single tendon within one column bay then, normal de-shuttering can be adopted, and no extra remedial measures are required for de-shuttering.
- ii. If same failure (a) occurs in two tendons within one column bay then, de-shuttering can be done but all remaining tendons within same column bay can be stressed to 430 bar pressure instead of 410 bar pressure.
- iii. If above failure (a) occurs in more than two tendons within one column bay then, there is no need to hold entire slab de-shuttering except for slab area of full column bay where failure can occur. Hold de-shuttering till replacement of casting head, fresh concreting, and successful stressing.
- iv. In case of above failure - In PT beam then, do not de-shutter PT beam bottom till replacement of casting head, fresh concreting, and successful stressing. Adjacent slab can be de-shuttered if stressing is over successfully.

c. Procedure for Replacement of Casting Head, Concreting and Stressing.

- i. If failure (a) occurs then, first de-stress all strands and remove old, voided concrete behind casting head by hacking within appropriate area as marked.
- ii. After removal of old voided concrete, remove old casting head and fix a new casting head at same position and do a fresh concreting of same grade with proper needle vibrator to ensure void free concreting. Also, at the same time take sufficient number of cubes for concrete to check required strength.
 1. After getting required concrete strength then, go for normal stressing procedure.
- b) If successful stressing done then, site in-charge can give note for de-shuttering (if any de-shuttering area is on hold due to failure).

2. Strand Slip/ Strand Cut during stressing activity due to failure of Bearing Plate, Barrel and Wedge:

- a. In case of failure of tendons occur due to Strand Slip then following measures to be adopted at site.

i. De-shuttering Procedure for PT Slab and PT Beams

- a) If above failure (b) occurs at single tendon within one column bay then, normal de-shuttering can be adopted, and no extra remedial measures are required for de-shuttering.
- b) If same failure (b) occurs in two tendons within one column bay then, de-shuttering can be done but all remaining tendons within same column bay can be stressed to 430 bar pressure instead of 410 bar pressure.
- c) If above failure (b) occurs in more than two tendons within one column bay then, there is no need to hold entire slab de-shuttering except for slab area of full column bay where failure can occur. Hold de-shuttering till any special remedial measures are given by specialist PT Vendor.

3. Failure of Dead End due to Honeycomb (Voids) in Concrete:

a. In case of failure of tendons occur due to honeycomb in concrete at dead End then following measures to be adopt at site –

A. De-shuttering Procedure for PT Slab and PT Beams

a) If above failure (c) occurs at single tendon within one column bay then, normal de-shuttering can be adopted, and no extra remedial measures are required for de-shuttering.

b) If same failure (c) occurs in two tendons within one column bay then, de- shuttering can be done but all remaining tendons within same column bay can be stressed to 430 bar pressure instead of 410 bar pressure.

c) If above failure (b) occurs in more than two tendons within one column bay then, there is no need to hold entire slab de-shuttering except for slab area of full column bay where failure can occur. Hold a de-shuttering still de-stressing of strands, replacement of fresh concreting and successful stressing.

B. Procedure for Replacement of Concrete and Stressing

a) If failure (c) occurs then, first de-stress all strands and remove old, voided concrete at dead end by hacking within appropriate area as marked by specialist PT Vendor.

b) After removal of old voided concrete make sure bulking end is in order. Otherwise redo bulking end and place fresh concrete of same grade with proper needle vibrator to ensure void free concreting. Also, at the same

c) time take sufficient number of cubes for concrete to check required strength.

d) After getting required concrete strength, go for normal stressing procedure.

e) If successful stressing is done then, site in-charge can give note for de- shuttering (if any de-shuttering area is on hold due to failure).