



# **Gujarat University**

## **TECHNICAL SPECIFICATIONS**

### **Additional Items**

Tender No: GU/ESTATE/CULT/2018-19/01

**Tender Document For  
Construction of Computer Science, Central Research,  
Upasana performing arts, Library science & Transit  
House Building at Gujarat University**

## TECHNICAL SPECIFICATION OF GLASS FIBER REINFORCED CONCRETE

Glass fiber Reinforced Concrete (Sometime called Glass Reinforced Concrete.) is a mixture of cement, fine aggregate, water, chemical admixtures and **Alkali resistant Glass fibers** There are numbers of different manufacturing process: the most common are Hands Spray and Pre-mix,

Glass fiber reinforced Concrete (GRC ) is a material which today is making a significant contribution to the economics, to the technology and to the aesthetics of the construction industries worldwide.

***This environment friendly composite , with its low consumption of energy and natural raw material is being forming to a great variety of product and has won firm friends among designers, engineers and end users for its flexible ability to meet performance, appearance and cost parameter.***

Since its introduction in 1969 , GRC has matured and today's designers has available to him depending up on his performance requirement, a range of matrix modifier such as acrylic polymer, rapid set cement and additives to improve the long term stability of the material. ***Extensive independent tests and performance data are available on all aspect of matrix formulation.***

The **Alkali Resistant Glass fiber** is generally used at the 3-5 % level in the manufacture of factory finish pre fabricated product either by the spray process or using traditional concrete casting method. It is also used in the 1 – 2 % range for reinforced renders as a site applied mix and can also be used to control plastic shrinkage cracking, micro cracking and bleeding in site –cast concrete

### **A. Work Included**

- a. GFRC panel fabrication shall include all labor, materials, equipment, and related services necessary to manufacture the panels as indicated and described by the contract documents.
- b. GFRC panel erection shall include all labor, materials, equipment, and related services necessary for the erection of the panels as indicated and described by the contract documents.
- c. The GFRC manufacturer shall furnish all GFRC-embedded hardware; he shall furnish all loose connection hardware, unless specified elsewhere. The placement of the hardware in cast-in-place concrete will be the responsibility of that contractor placing the cast-in-place concrete.
- d. Furnishing and attaching all hardware required to be placed in the cast-in-place concrete or attached to the structure for the connection of the GFRC panels shall be clearly specified.
- e. Responsibility for the design and detailing of hardware attached to or cast into the support structure, as well as layouts for placement, should be specified.

### **B. Related Work Specified Elsewhere**

- a. Cast-in-Place Concrete - Placement of anchorage devices in cast-in-place concrete for GFRC panels.
- b. Precast floor and roof slabs, beams, columns, and other structural elements.
- c. Steel supporting structure and loose anchors, if applicable.
- d. Miscellaneous iron, anchor bolts or other anchorage devices required for installing GFRC panels.
- e. For exposed face of panels, responsibility should be specified if applicable. Generally done by the panel manufacturer.
- f. Insulation applied to GFRC panels.
- g. Counterflashing inserts and receivers, unless included in this section.
- h. Sealing joints between panels, or caulking between panels and other materials.
- i. Field touch-up painting of metal parts. Delete when specified in this section.

### **C. Design Responsibility**

GFRC panels shall be designed under the supervision of a registered professional engineer employed or retained by the manufacturer.

#### **D. QUALITY ASSURANCE –**

- 4.1 Acceptable Manufacturers
- 4.2 Manufacturer with a demonstrated capability to produce GFRC products of the quality and scope required on this project, and with a GFRC industry involvement of at least 10 years. Experience required is a minimum of 2 to 5 years. The manufacture of GFRC requires a greater degree of craftsmanship than most other concrete products, and therefore requires prequalification of the manufacturer. Plant certification, as provided in the Plant Certification Program, is satisfactory evidence. Or as approved by Engineer in charge
- 4.3 When requested by the Engineer, the manufacturer shall submit written evidence of having experienced personnel, physical facilities, established quality control procedures, and a management capability sufficient to produce the required units without causing delay of the project.

#### **E. Erector Qualifications**

- 5.1 Regularly engaged for erection of GFRC or architectural precast concrete panels similar to those required on this project, and the present erection management capability sufficient to erect the required units without causing delay of the project.

#### **F. Job Mock Up**

- 6.1 After standard samples are accepted for color and texture produce full scale unit meeting design requirements full scale samples or inspection of the first production unit are sometimes desired but the efforts of this requirement on scheduling must be considered. When a new design concept or new manufacturing process or other unusual circumstance indicates that proper evaluation cannot otherwise be made a mock-up may be justified.
- 6.2 Mock up to be the standard of quality for GFRC Panel work when accepted by Engineer. Use to Determine range of acceptability with respect to color and texture variations, surface defects and overall appearance. It is difficult to assess appearance from small samples .
- 6.3 Incorporate mock up into work in location reviewed by engineer in charge after keeping unit in plant for checking purpose.

#### **G. Submittals**

Prior to commencement of manufacture, submit samples representative of finished exposed face showing typical range of color and texture. If the back face of a GFRC unit is to be exposed, samples of the workmanship, color and texture of the hacking should be shown as well as the facing.

- 7.1 Sample Size: Approximately 12 in. x 12 in. (3.05 x 3.05 m) and of appropriate thickness, representative of the proposed finished product

#### **H. Drawings**

Prior to commencement of manufacture, submit samples representative of finished exposed face showing typical range of color and texture. If the back face of a GFRC unit is to be exposed, samples of the workmanship, color and texture of the hacking should be shown as well as the facing.

- 8.1 Production drawings, except for shape drawings, are not usually submitted for approval, except in special cases where the Engineer or Contractor agrees to assume responsibility. However, record copies are frequently requested. Guidelines for the preparation of drawings are given in the "PCI".
- 8.2 Architectural Precast Concrete Drafting Handbook.
  - Unit shapes (elevations and sections) and dimensions.
  - 8.2.1 Unit Shapes (Elevations and Sections) and dimensions

- 8.2.2 Finishes
- 8.2.3 Joint/Connection
- 8.2.4 Lifting/Erection inserts
- 8.2.5 Location and details of hardware attached to structure
- 8.2.6 Other items sprayed in panels.
- 8.2.7 Handling Procedures
- 8.2.8 Sequence Erection for special conditions
- 8.2.9 Relationship to adjacent material
- 8.2.10 Description of all loose, cast in and field hardware.
- 8.2.11 Shop drawings by same identification marks placed on panels
- 8.2.12 The manufactures shall not proceed with fabrication of any products prior to receiving approval of erecting drawings by the engineer shop drawings approval by engineer means that the engineer has reviewed the shop drawings for general or design compliance with contrary documents design approval by the Engineer means that the engineer has reviewed the design panel.

**I. Test Reports**

- 9.1 Submits on request, copies of test reports. Scheduled of required test is included in section 1.02G. Numbers of copies of test reports, and how reports should be distributed are included in testing laboratory Services Sections .

**J. Design Calculation**

- 10.1 Submit entire design calculation in line with all relevant Indian and international codes. Submission of calculation is necessary.

**K. Material –**

**Glass Fiber Reinforced Concrete-**

Glass Fiber Reinforced Concrete (GRC) is generally manufactured by either “Spray “or the “Pre Mix” vibrator casting process. The process chosen is normally dictated by factor such as strength requirement, size of mold, design of elements. As a general rules, larger items, such as building cladding panels are normally “Sprayed” whereas small item are manufactured from “Pre Mix” process.

**i. SPRAYED GRC PROCESS**

1. The water and admixtures ( and polymer if used ) are placed in a “ High Shear Mixture” and the sand/ cement are slowly added until smooth creamy slurry is achieved. The consistency of the slurry can be checked using a simple slump test kit. Mixing time is about 1 – 2minutes.
2. When ready the mix is transferred to a “Pump / Spray Unit” . The Pump conveys the slurry at a regulated rate of flow to the spray gun. At the spray gun fiber , in the form of a roving is chopped to a length of 25 – 32 mm and added to the slurry. The two materials are projected on to the mold surface using controlled air pressure from aircompressor The GRC material is s prayed and built up in thin layers until the required thickness is achieved normally 10 – 15 mm . Simple hand roller is used to compact the material inlayers.
3. The product is left in mould and covered with polythene to prevent moisture loss until 8 hrs. The product is then demolded.
4. After demoulding the GRC element is either cover with polythene or water cure for approximately 4 days. Alternately if polymer curing compound is used in mix then GRC element is can be exposed to the atmosphere immediately, although it is advisable to keep them from direct sunlight or severe conditions for day or two.

**ii. PRE-MIX GRC PROCESS**

1. The Sand and Cement are mixed dry and then the water/admixture and polymer ( If used ) are added, Generally Slow speed slurry / fiber blender mixer is used. With this type of mixer the fast speed is design to create smooth creamy slurry. This takes about 1 to 2 minutes The mixture is then switch to slow speed and fiber in the form of chopped strand (length approx. 20 mm ) is added slowly. The fiber is blended in to the mix for an approximately 1minute.
2. Once the mix is ready , it is pour in to mould which are vibrated using vibratingtable.
3. The product is left in mould to set and covered with polythene sheet to prevent moisture loss. The product is de mould nextday.
4. After de molding the product are cured under polythene sheet to maintain moist condition for approximately 4 days. Alternatively a polymer curing compound can be used as describe for the sprayedprocess.

**iii. FIBER**

1. Alkali Resistant Glass fiber for used in cement basedSystem
2. AR fibers are made by the continuous filament process. Molten glass is fed through a platinum (bushing ) which contain very large numbers of small holes ( tips ). The molten glass is pulling through bushing as a continuous fiber. It is passes through the fine water mist and is then pass over roller that applies an organic processing: The fibers are then wound on to a former to make a cake. This cake is then put through a time / temperature regime to cure the size. The cake are then either wound together to form a roving ( or cheese ) or put through a chopping unit to cut the fiber to required length ( Chopped / strand)
3. The selection of the type and amount of size used apex the end fiber product in term of stiffness, resistance to abrasion and can have other effect. The diameter is uniform with little variation. The alkali resistance is confirmed by the composition of glass itself and not on a protectivecoating.
4. The description of continuous filament glass fiber are usually asfollows
 

1.	Filament	A single fiber
2	Diameter	CF Glass fiber have a uniform cylindrical cross section normally between 10 – 20micron
3	Strand	A no of filament bonded together by thesize
4.	StrandTex	The weight (linerdensity) of the strand express In gm/Km . Typically commercialproducthas a strand Tex in the region of 20 –100
5.	Chopped	A length of strand cut a particular length. Usually these are in the range of 3 – 25 Chopped strands are used in GRC Pre mix process and to renders and concrete to Toughness and suppress cracking.
6	Roving	An assembly of CF fiber wound together to create a self-supporting product. Roving are used in GRC Spray process and continuous reinforcement
7	End Count	The no of strand collected together to form a roving
<b>8</b>	<b>Roving Tex</b>	The weight (Linear density) of the roving express in gm / Km. For e.g. if a roving ends of strand each having a strand tex of 76.5 the roving tex would be 32 x 76.5

**iv. Fineaggregates**

Fine aggregate or sand shall be washed and dried to remove soluble matter and permit accurate control of the water/cement ratio. The particle shape should be round or irregular and should have a smooth surface without honeycombing. For spray GRC, the maximum particle size shall be 1.2mm; for premix GRC, the maximum particle size shall be 2.4mm. In both cases the fine fraction, i.e. sand passing a 150 micron sieve, shall be less than 10% of the total weight of sand. Silica sands are widely

used and should conform to the specification in Table 1. Sands with a higher moisture content may be used provided the moisture content is known and the mix design is altered accordingly. Sands other than silica sands may be used but the producer should provide evidence of their suitability. Soft building sands must not be used.

**v. Admixtures**

Admixtures are permitted and their use is encouraged as they can enhance the properties of GRC. They should always be used strictly in accordance with the suppliers' recommendations and the producer must ensure that their use has no adverse effect on the product. Calcium chloride-based admixtures must not be used if the GRC component contains steel reinforcement, fixing sockets or other cast-in devices.

**vi. Pigments**

Powder pigments or dispersions may be used to produce colored GRC. The pigments should conform to international or national standards. The purchaser should recognize that colour variation may occur and must agree an acceptable range of variation with the producer.

**vii. Other component materials**

Other component materials (e.g. silica fume, metakaolin, fly ash, reinforcing fillers, admixtures, meshes), may be added to modify the properties of the mix. They must be used in accordance with the supplier's instruction and the producer must demonstrate that their use will not adversely affect the properties of the GRC.

**L. TYPICAL PROPERTIES OF GRC ( AT 28 DAYS )**

Properties	Spray method	Pre mix method
Glass fiber % by wt	5	3
Bending Ultimate Strength ( MOR )	Mpa 20 – 30	10 – 14
Elastic Limit (LOR)	Mpa 7 – 11	5 – 8
Tensile Ultimate strength (UTS)	Mpa 8 – 11	4 – 7
Elastic limit	Mpa 5 – 7	4 – 6
Shear Interlaminar Strength	Mpa 3 – 5	N /A
In planer strength Mpa 8 – 11	4 – 7	
Compressive Strength	Mpa 50 – 80	40 – 60
Impact Strength	Kg/ M2 10 – 25	10 – 15
Modules of Elasticity	GPa 10 – 20	10 – 20
Strain of failure %	0.6 – 1.2	0.1 – 0.2
Dry Density T / M3	1.9 – 2.1	1.8 – 2.0

**M. FABRICATION**

**a) Proportioning and Mixing**

- I. All measurements of mix constituents shall be carried out in a careful manner to achieve the desired mix proportions.
- II. The glass fiber and cement slurry shall be metered to the spray head at rates to achieve the desired mix proportion and glass content.
- III. These shall be checked in accordance with standard procedures described in "Recommended Practice for Glass Fiber Reinforced Concrete".
- IV. Cleanliness of equipment and working procedures shall be maintained at all times.

**N. Hand Spray Application**

These requirements apply to hand spray only. Some shapes or products lend themselves to machine spray (possibly with vacuum compaction and dewatering) which would require changes to these specifications.-

- I. Spray operators shall be trained personnel.
- II. A mist coat consisting of the matrix without fiber may if necessary be sprayed onto the form. The thickness of this coating shall generally not exceed 1/32 in. (0.79 mm) in order to avoid an unreinforced surface.
- III. Spray-up of the main body of material shall proceed before any mist coat has set.
- IV. Application shall be by spraying such that uniform thickness and distribution of glass fiber and cement matrix is achieved during the application process.
- V. Consolidation shall be by rolling or such other techniques as necessary to achieve complete encapsulation of fibers and compaction.
- VI. Control of thickness shall be achieved by using a pin gauge or other approved method.

**O. Cover**

Provide embedded anchors, inserts, and other sprayed in items with sufficient anchorage and embedment for design requirements.

**P. Curing**

- I. Immediately after the completion of spraying of the panel, a curing method shall be used to ensure sufficient strength for removing the units from the form.
- II. After initial curing, remove panel from form and place in a controlled curing environment. Panels shall be kept continuously wet for a minimum of 7 days in accordance with manufacturer's standard curing practice. The temperature shall be maintained between 60 F and 110 F (16 C and 43 C) during this period. Curing less than 7 days, temperature below 60 F, or atmosphere less than 95 percent relative humidity will reduce the material property values and hence design strengths. Accelerated curing with temperatures above 110 F (43 C) may be detrimental to strength.

**Q. EXECUTION**

**a) PRODUCT DELIVERY, STORAGE AND HANDLING**

- I. Delivery and Handling
  - i. Handle and transport units in a position consistent with their shape and design in order to avoid excessive stresses or damage. Panels shall be handled and transported so that panels are not subject to undue stress. If panels are "nested" or stacked vertically, consideration must be given to transfer of vertical load in order to prevent progressive crushing or other damage.
  - ii. Lift or support units only at the points shown on the erection shop drawings.
  - iii. Place no staining resilient spacers of even thickness between units
  - iv. Support units during shipment on no staining shock absorbing material.
  - v. Protect units from dirt and damage during handling and transport.

**b) Storage at job site**

- i. Store units to protect them from contact with soil, staining, and from physical damage. Units should never be placed directly on ground
- ii. Store units, unless otherwise specified, with no staining, resilient supports located in same positions as when Transported
- iii. Store units on firm, level, and smooth surfaces
- iv. Place stored units so that identification marks are easily readable.

**R. PRE-INSTALLATION RESPONSIBILITY**

**a) Contractor's Responsibility**

- I. The Contractor shall provide building lines, center and grades in sufficient detail to allow installation of the GFRC units.
- II. The Contractor shall provide true, level bearing surfaces. Construction tolerances for cast-in-place concrete, steel, masonry etc., should be specified in applicable sections of the specifications.
- III. The Contractor shall provide for the accurate placement and alignment of anchor bolts, plates or dowels on the structure.

**b) Fastening**

- I. Fasten GFRC units in place by bolting or welding or both as shown on approved erection drawings. Fastening detail should provide sufficient three-directional allowance to accommodate creep, thermal and moisture-induced panel movement, field tolerances, and dimensional changes in the structural frame of the building. Slotted and/or oversized holes in connections and attachments, or the use of special fasteners are the usual means to accommodate the above. Usually, panels are fixed at one point while the other connections have freedom to move.
- II. Field welding shall be done by qualified welders using equipment and materials compatible to the base material. Field welds should be avoided if possible or kept to a minimum. When field welding is required, the erector shall protect units from damage caused by field welding or cutting operations and provide non-combustible shields as necessary during these operations.

**c) Tolerance of Erected Units**

- I. **Tolerances for location of GFRC units shall be non-cumulative and as listed below. For erection tolerances not listed below, those given in PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products," shall apply.**
- II. **Face Width of Joint: Panel dimension 10 ft (3.05 m) or less  $\pm 1/8$  in. (4.77 mm) Panel dimension 10 to 20 ft (3.05 to 6.10 m)  $\pm 1/4$  in. (6.35 mm) Panel dimension greater than 20 ft (6.10 m)  $\pm 1/2$  in. (12.7 mm)**
- III. **Warpage: Maximum permissible warpage of one corner out of the plane of the other three shall be  $1/8$  in. (3.18 mm) per ft (305 mm) distance from the nearest adjacent corner, or 1/8 in. (3.18 mm) total after installation.**
- IV. **Bowing: Not over  $L/360$ , A. where L is the panel length.**

**S. Reference Codes & Guide**

GRCA "Methods of Testing Glassfibre Reinforced Concrete (GRC) Material"  
GRCA "Specifiers Guide to Glassfibre Reinforced Concrete"



### European Standards

- a. BS EN 1169: 1999: Precast concrete products — General rules for factory production control of glass-fibre reinforced cement products.
- b. BS EN 1170: 1998: Parts 1-8 Precast concrete products: Test methods for glass-fibre reinforced cement.
  - i. Part 1. Measuring the plasticity of the mortar— 'Slump test' method.
  - ii. Part 2. Measuring the fibre content in fresh GRC, Wash out test'.
  - iii. Part 3. Measuring the fibre content of sprayed GRC.
  - iv. Part 4. Measuring bending strength — 'Simplified bending test' method.
  - v. Part 5. Measuring bending strength — 'Complete bending test' method.
  - vi. Part 6. Determination of the absorption of water by immersion and determination the dry density
  - vii. Part 7. Measurement of extremes of dimensional variations due to moisture content.
  - viii. Part 8. Cyclic weathering type test
- c. BS EN 14649: 2005 Precast concrete products — Test method for strength retention of glass fibres in cement and concrete (SICTEST).
- d. BS EN 15422: 2008 Precast Concrete Products - Specification of glass fibres for reinforcement of mortars and concretes.
- e. BS EN 1169: 1999. Precast concrete products – General rules for factory production control of glass fibre reinforced cement.

### ASTM

- a) C948 Standard Test Method for Wet Bulk Density, Water Absorption and Apparent Porosity of Thin Section Glass Fiber Reinforced Concrete.
- b) C1229 Standard Practice for Preparing Coupons for Flexural and Washout Test for Glass Fiber Reinforced Concrete.
- c) C1229 Standard Test Method for Determination of Glass Fiber Content in Glass Fiber Reinforced Concrete
- d) C1230 Standard Test Method for Performing Tension Tests on Glass Fiber Reinforced Concrete [GFRC] Bonding Pads
- e) C1560 Standard Test Method for Hot Water Accelerated Aging of Glass Fiber Reinforced Concrete

# WATERPROOFING SPECIFICATIONS

**Waterproofing Membrane:** - Providing and applying 2 coats of WPM 004, two components acrylic modified flexible cementitious waterproof coating using brush / roller over well prepared dry surface, including sandwiching WPM Deck Web at all corners, cracks, construction joints and pipe penetrations, grinding all sharp edges, cleaning all surfaces to make them free from all contaminants, etc and complete as per manufacturer's specification.

## Materials & Workmanship

**Surface preparation:** All sharp edges and protrusions shall be grinded to make them flush with the surface. All floor and wall surfaces up to required height shall be cleaned to make it free from dirt, dust, loose particles, wax polish, efflorescence, laitance, curing compound and other contaminants by mechanical means and wire brushing.

**Note:** All new surfaces shall be allowed to cure and dry completely according to standard practice. The proper slope shall be provided to the outlet pipes. Any other miscellaneous items like covings, if required, shall be installed using polymer modified mortar admixed with E 135 (SBR, multipurpose concentrated liquid polymer additive and bonding agent), vertical bore packing shall be treated using B 30 (non shrink cementitious structural grout), horizontal bore packing shall be treated using polymer modified mortar admixed with E 135, cracks or construction joints, if found, shall be treated using polymer modified mortar admixed with E 135, etc.

**Waterproofing membrane:** WPM 004 (two component acrylic modified flexible cementitious waterproof coating) product consisting of part A and part B, which needs to be mixed together with adding 50% of water to part A in suitable size mixing vessel, using heavy duty slow speed drilling machine fixed with mixing paddle to obtain a uniform mix. Two coats of WPM 004 are required to achieve the correct thickness of 0.8 - 1.0 mm. Apply the first coat over well prepared surface. Install the WPM Deck Web (non-woven polyester glass filament reinforced reinforcing cloth) at all corners and pipe penetrations over the wet surface of WPM 004 by ensuring the WPM Deck Web is completely embedded in the coat of WPM 004 and allowed to dry completely. Apply the second coat of WPM 004 in opposite direction to the first coat and allow it to dry completely.

The rate shall be for a unit of one sq. meter.

## TECHNICAL SPECIFICATION OF POST TENSIONING WORKS

### POST TENSIONING WORKS

- i) Design the PT member (slab or beam) and submitting the same with calculations for Structural Engineer / Engineer in charge approval and subsequently revising the same as per the instructions.
- ii) Submission of Shop Drawings along with Design report & calculations for Post Tensioned members to the Structural Engineer / Engineer in charge for approval.
- iii) Providing, laying and stressing of monostrand unbonded post tensioning steel tendons including providing in concrete steel tendons of class II (grade 1860) including wires, sheathing grease as per specifications, including laying the same at desired location and height, including providing anchor plates on both sides (end plate or stressing plate as per site requirement), tensioning the cables with hydraulic jack and pump to achieve the stresses in each cable as per design requirement, including designing the same by adapt software and supervising complete work during casting etc. complete. Recorded checking of layout, elongation and cutting of the cables to be properly provided by the PT operator. Rate shall be inclusive of 5 years of maintenance.

Specifications of various components are: (as per pti specifications)

- (a) Cables: 12.7 mm nominal diameter low relaxation 7 wire strand of class II (grade 1860) to be used in unbonded mono strand post tensioning tendons conforming to IS-14268:1995 / ASTM A 416 having sectional area of 98.7 sq.mm. and unit weight of bare strand more than 0.775 kg/m.
- (b) Sheathing: Polyethylene or polypropylene with a minimum density of 0.941 gms/cm<sup>3</sup> & thickness 1.25 mm to properly cover the tendons against concrete and cement paste. (c) Grease: Should provide protection against corrosion to the pre-stressing steel and should provide proper lubrication between strand and sheathing, chemically stable and should not react to either tendons or sheathing (d) Anchor plate: 57x127 mm anchor plates made out of SG iron along with self locking locks for mono strand anchorage of unbonded tendons having enough strength to withstand corresponding design load. (e) Hydraulic jacks: Double acting mono strand stressing jack for 0.5 inch strands with a cylinder capacity of 20 tons, stroke 8.5" power wedge seater having internal pressure of 7575 psi. (f) Pump: 4 way reservoir valve type pump with remote motor control switch with motor of 1-1/8 HP (v) Supply of Chairs bars and support bars for Tendon supports at each floor level. (Reinforcement quantity shall be paid separately under Reinforcement).

vii) Filling of Recess pockets left out for Stressing. Providing safe working platform with hand rails for Stressing (Min 1000 mm from the working face). Tendon marking, Internal Logistics within the site. viii) Providing adequate additional working platform all around the slab edge (Not measured & Paid Separately) ix) Providing Qualified Engineers, Technicians and Skilled labours for PT works.

x) Providing Crane/Lifting equipment for PT Contractor. Design of Post Tensioning System, Providing, placing / installing in position Pre-stressing steel (Tendons) in the specified profile as per drawings, standard anchors, dead end anchors, sheathing, tendon supports, etc., stressing of strands using jacks and pumps, anchoring stressed strands, maintaining stressing data and records etc. complete. The rate shall be inclusive of all the above materials, labour and equipment required but shall be quoted and paid only in terms of running meter of post tension cable. No separate payment shall be made towards anchors, sheaths, (material, equipment or labour), stressing, equipment etc. This item covers only pre-stressing materials and corresponding activities. Concrete, formwork and reinforcement shall be paid separately under respective items. Proper design calculations, methodology, sequence of construction and post-tensioning activities, detailed drawings showing layout of strands/cables, anchorage details, profiles of cables etc. shall be submitted to the Structural Engineer / Engineer in charge for their approval prior to proceeding to execute the work. .

## **Material Specification**

### **7 Wire Unbounded Mono-strand**

#### ***Pre-stressing Steel:***

1. Low-Relaxation 7 wire Strand of with 12.7 mm nominal diameter shall conform to the requirements of IS 14268:1995 (reaffirmed 2013)
2. Yield Load: Not less than 180kN
3. Ultimate Strength: Not less than 1860N/mm<sup>2</sup>
4. Minimum Breaking Strength: Not less than 183.7kN
5. Modulus of Elasticity: At least 196,500N/mm<sup>2</sup>
6. Minimum Elongation: 3.5% for gage length of 600mm
- 7.

#### ***Sheathing Specifications:***

1. Sheathing Material: polyethylene or polypropylene
2. Minimum Thickness: 1.27mm
3. Inside Diameter: At least 0.76mm greater than the maximum diameter of the strand
4. Appearance: Sheathing shall provide a smooth circular outside surface and shall not visibly reveal lay of the strand.
5. Coverage: Sheathing shall be continuous over the entire length to be unbounded, and shall prevent intrusion of cement paste or loss of PT coating.

#### ***Grease Coating Specifications:***

1. Grease coating shall provide protection against corrosion to the Pre-stressing steel
2. It shall provide proper lubrication between the strand and sheathing
3. It should resist flow within anticipated temperature range of exposure
4. It should provide continuous non-brittle coating at lowest anticipated temperature of exposure
5. It should be chemically stable and non-reactive with Pre-stressing steel, reinforcing steel, sheathing material and concrete
6. The coating material shall completely fill the annular space between the strand and sheathing and shall extend over the entire tendon length

## **Anchor Plate**

### **Microstructure:**

- A. Graphite Type (As per ASTM A247 Plate I & III)
  - I. Form I & II (Spheroid or Nodular type)
  - II. Distribution A (Uniform Distribution)
  - III. Size: 6 – 8
- B. Nodularity: 90 – 95%
- C. Carbide: Less than 3%
- D. Pearlite: 35 – 40%

### **Mechanical Properties:**

Hardness Number: 170 – 230BHN

### **Material Grade:**

ASTM A 536 Grade 80-55-06

OR

IS 1865 Grade SG 500/7

### **Wedges**

#### Hardness:

- A. At Surface: 56 – 65HRC
- B. At Core: 40 – 46 HRC

#### Material Grade:

IS: 9175 (Part 20)-1986 Grade 20MnCr5

### **Construction Methodology**

#### Scope of Work for Mono-strand Unbounded Post-Tensioning System

1. Formwork shall be made (by general contractor) as per the forming plan issued by PRESTRESSING AGENCY / Structural Consultant. There is nothing special except the wooden sides (shall be provided by general contractor) required for drilling holes (by PRESTRESSING AGENCY) so that the cables can be passed through them at required places at certain height as per P-T detail.
2. Do not provide camber to any of the P-T elements (P-T slab or P-T beam) without prior consent to PRESTRESSING AGENCY.
3. In case of P-T beam, the steel cage (i.e. open stirrups near the supports up to 2m and closed stirrups in mid-span zone with continuous longitudinal steel only) is prepared (by general contractor) as per regular practice with the detail provided. Do not place extra top steel at this time.
4. Support bars are fixed (by PRESTRESSING AGENCY) at certain intervals and heights as per P-T drawing.
5. P-T cable to be placed over the support bars in PT beam (by PRESTRESSING AGENCY).
6. In case of P-T slab, bottom steel / mesh + extra bottom steel shall be placed (by general contractor) as per the drawings. The sequence of steel placement is shown in the drawing. Chairs (to be made by general contractor) are placed as required (by PRESTRESSING AGENCY).
7. P-T cable to be placed over the chairs in case of P-T slab (by PRESTRESSING AGENCY).
8. The wooden sides of P-T beam or P-T slab are marked and drilled (by PRESTRESSING AGENCY) at specific places. Anchorage assembly is fixed at the wooden side (by PRESTRESSING AGENCY). The side is then fixed up to its place (by general contractor) after or before installation of cable (as per site condition).
9. Cable is passed through the assembly and the extra length kept beyond the side for stressing wherever required as per drawing (by PRESTRESSING AGENCY).
10. After installation of P-T Cables, extra top steel shall be placed (by general contractor) in P-T beam and P-T slab as per drawing.
11. After installation of P-T Cables, Concealed conduits for electrical purpose must be placed (by Electrical Agency). ANY KIND OF ALTERATION IN PT CABLES ARE STRICTLY PROHIBITED while placing electrical conduits if there is any.
12. Final checking of the P-T system by the engineer of PRESTRESSING AGENCY on site. It is recommended that the steel detail got checked on site by the engineer from the Structural Consultant as well.
13. Concrete must be well compacted especially at surrounding of the anchorages as well as in remaining area with due care (RMC / Concrete Agency).
14. Cubes are cast on site (by RMC / Concrete Agency) for 5 day and 28 day strength testing as per respective codal provisions. Certain cubes required to test (by other agency) between 5 to 7 days depending on the commitment of strength gain by the concrete supplier in accordance with respective codal provisions.
15. Stressing is commenced (by PRESTRESSING AGENCY) once the target strength for stressing (25MPa) is ensured through the cube testing.
16. Stressing is performed as per stressing sequence already provided to the stressing personnel. Stressing platforms must be ready on site as well as electricity supply must be arranged on the floor (by general contractor) prior to stressing.
17. Elongations are measured on site; Stressing Record is generated (by PRESTRESSING AGENCY) for our internal approval. Post stressing status is conveyed to the Structural Consultant, General Contractor, PMC and Owner for shuttering removal (by PRESTRESSING AGENCY). Elongation Report is sent (by PRESTRESSING AGENCY) to the Structural Consultant for his reference.
18. Shuttering can be started (by general contractor) for the successive floor above.
19. Sufficient propping (re-shoring) shall be provided (by general contractor) to the floor(s) up to one or more levels down (based on the mass of the wet concrete according to the thickness of PT slab + size of P-T beam) on which this form-work is resting. Re-shoring below the lower floor shall be removed only after getting approval of de-shuttering (removal of shuttering) for the successive (above) floor through email from PRESTRESSING AGENCY.

## **TECHNICAL SPECIFICATION OF Expansion Joints WORKS**

### **Expansion Joints - Permoulded filler**

**Providing and laying in position approved quality pre-moulded 40 mm thick joint filler or Shalitex board or Capcell Board of "Supreme" or equivalent make, sealing in expansion joints of 40 mm thickness at all locations; including sand fill, edge preparation, cleaning, drying complete in all respects as per scope of work, detailed construction drawings, site sketches, and instructions of site engg. In charge.**

The item provides for expansion joints in R.C.C. frame structures for internal joints, as well as exposed joints, with the use of premoulded bituminous joint filler.

- 27.1. Premoulded bituminous joints filler i.e. performed strip of expansion joints filler shall not get deformed, or broken by twisting bending or other handling when exposed to atmospheric condition. Pieces of joints filler that have been damaged shall be rejected
- 27.2. Thickness of the pre-moulded joints filler shall be 25 mm. unless otherwise specified.
- 27.3. Premoulded bituminous joints filler shall conform to I S 1838-1961

### **M-28. Expansion joints-Copper strips & hold .fasts**

**Providing and placing polysulphide sealant, over Capcell board in the expansion joints in specified locations; including sand fill, edge preparation by machine cut, cleaning, drying complete in all respects as per scope of work, detailed construction drawings, site sketches, technical specifications and directions of Engineer-in charge.**

- 28.1. The item provide for expansion joints in R.C.C. frame structure for internal joints, as well as exposed joints, with the use of premoulded bituminous joints filler.
- 28.2. Copper sheet shall be of 1.25 mm. width and or 1 25 mm. width and the " U " shape in the middle. Copper strip shall have holdfast of 3 m.m diameter copper rod fixed to the plate soldered on strip at intervals of about 30 cm or as shown in the drawing or as directed. The width of each flange (horizontal side ) of the copper plate Jo be embedded in the concrete work shall be 25 mm depth of "U" to be provided in the expansion joint, in the copper plate shall be of 25 mm.

## **TECHNICAL SPECIFICATION OF Fabrication WORKS**

**Fabrication, Supply and Installation of Stainless Steel (Grade 304) railing using hand rail pipe section 2.5" and baluster as round/square pipe section 2" both these pipe wall thickness not less than 16 gauge; connected with SS square pipe 2" intermediate as per detail drawing of architecture and 8mm thick toughened glass fixed in between ss vertical members by the SS fixers. SS base plate of 100 x 8mm. The railing system shall be floor mounted with anchor faster and base plate of 4" having 8 mm thk. Completed as per detail drawing or as directed by the Architect / Engineering in charge with necessary fixtures fittings, brush finished, proper buffing & cleaning the welding marks etc. Shop drawing shall be submitted for approval.**

### **Structural Steel:**

- 1.1. All structural steel shall conform to I.S. 226-1965. The steel shall be free from the defects mentioned in I.S. 226-1975 and shall have a smooth finish. The material shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. Rivet bars, if any, shall conform to I.S. 1148-1973.
- 1.2. When the steel is supplied by the Contractor test certificates of the manufactures shall be obtained according to I.S. 226-1975 and other relevant Indian Standards.

### **Workmanship:**

- 2.1. The S. S. Grill shall be prepared as per the drawings or as directed for fixing to designed locations etc.
- 2.2. The grill shall be fabricated as per the sections shown in to the designs and patterns shown in the drawings and the weight shall be as directed and the joints shall be riveted or welded as shown in the plan or as directed. The grill so formed shall be fixed for stairs & for windows etc. as directed and as per specifications and erected in position. The grill shall be fixed with number of bolts and nuts of screws viz. bolt nut/screw per 30 cm. Of the length of outer strip subject to a minimum of 2 nos. on each side of the frame or as indicated in the drawings or as directed.
- 2.3. The bolts and nuts or screws shall be counter sunk and shall be fixed with the top of their heads flush with the face of frame strips.

**Mode of measurement and payment:**

- 3.1. No payment shall be made for weight of screws, bolts, nuts etc. Only weight of grill shall be paid.
- 3.2. The rate shall be for unit of one Rmt.

**TECHNICAL SPECIFICATION OF POLYCARBONATE PANEL SYSTEM WORKS**

Providing & fixing 8 mm thick Polycarbonate panel consist UV protected multicell / microcell structure having panel width of 600 / 900 mm to ensure best performance against wind load, live load, vibration & visual appearance made of DANPALON or TUFFLITE. Panel shall be manufactured with vertical standing seam at both sides of the panel. The height of the standing seam is minimum 15 mm to ensure best connector engagement. panel shall be fixed with snap on connector with conti. Double wall aluminum spacer along the standing seam to ensure best performance against wind up lift/herrican effect with a grip-lock double tooth locking mechanism. Panel shall be co-extruded UV protected. panel ends shall be sealed with anti-dust aluminum tape & aluminum profiles (mill finish) This includes the cost of labour incl. all accessories req. to fix this panels as per approved shades/color and direction of engg. In charge. Comp. As per detail drawing & design.

**Technical specifications:**

Providing and fixing of Multi / Micro cellular polycarbonate panel system (minimum 16 mm thickness) conforming to technical specifications mentioned below:

- Panel shall be minimum 8 mm thick with Multi / Micro cellular structure.
- Panels shall be co-extruded UV protected.
- Panel width shall be of 600/900 mm to ensure best performance for wind uplift, vibration, oil canning and visual appearance.
- The panels shall be uniform in Color with an integral Multi / Micro cellular structure.
- Panels shall be manufactured with vertical standing seam at both sides of the panel with height of the standing seam shall be 15mm to ensure best connector engagement.
- Snap on connector with conti. Double wall aluminum spacer along the standing seam to ensure best performance against wind up lift/herrican effect with a grip-lock double tooth locking mechanism.
  
- Panel ends shall be sealed with anti-dust tape & Aluminum Profiles (mill finish).
- Edges will be completed with Omega profile to prevent/protect end conditions.
- Color: As approved  
Light Transmission: As approved

1.1 Approved Make: DANPALON or TUFFLITE

2.0 Mode of measurements: unit in SMT. For payment plan area shall be considered

**TECHNICAL SPECIFICATION OF REST ROOM CUBICAL**

**Restroom Cubical: providing and installing ZMS SS Series Restroom Cubicles with all necessary tools hardware, labor, as per the company specs.**

**Providing & Fixing BESCO Cubicle partition system for toilet by using following Materials 12mm thick compact laminate with core of phenol resin treat papers with black color top layer treated with special melamine resin. Adjustable legs with bottom cap of SS 316, door lock with, gravity hinges with cover – combination of mild steel and Nylon PA6**

**And used following Accessories**

**Accessories Include:**

- 1. AlumuniumTop Rail (Stainless Steel Grade 304 with Satin Finish)**
- 2. SS Coat Hook with Door Stopper Option (Stainless Steel Grade 304 with Satin Finish)**
- 3. SS Gravity Hinges (Stainless Steel Grade 304 with Satin Finish)**
- 4. SS Latch cum Occupancy Indicator (Stainless Steel Grade 304 with Satin Finish)**
- 5. SS "U" Channel (Stainless Steel Grade 304 with Satin Finish)**

- 6. SS "F" Channel (Stainless Steel Grade 304 with Satin Finish)
  - 7. SS Palm Design Adjustable Foot (Stainless Steel Grade 304 with Satin Finish)
  - 8. SS Screws & Inserts (Stainless Steel Grade 304 with Satin Finish)
  - 9. Rubber Lining for Door Stopper
- Brand and Make: as approved by consultant.

## 2.0 Material & Workmanship

2.1 The relevant specifications of the above decrypted item shall be followed as per the specifications given in manual of ZMS Series of Marino Brand.

## 3.0 Mode of measurements and payment Each nos

### **TECHNICAL SPECIFICATION OF LIFT WORK**

LIFT WORK: Supplying, Erecting, Testing & Commissioning the passenger / stretcher Machine room Less (MRL) lift having following main features: [1] GEAR LESS LIFT DRIVE comprising of High Starting torque Lift duty 3 phase 440 V A. C. Permanent magnetic synchronous motor of proper rating with high efficiency shall be used. [2] Micro processor based / PLC, ACVVF, vector control drive with encoder feedback closed loop system shall be used for lift car and door operation which shall be full collective selective operation hall call demand response, UP/DOWN hall stops, Main, Up/ Down Contactor with overload and phase reversal relay and safety controls. [3] Car with M S platform with bracings of adequate size and to sustain the impact load cabin + passenger with safety factor of fire for steel and side panels of Stainless steel of sheet of grade 304 duty. Car ceiling will be S.S. finishes with aesthetic appearance with LED ceiling lights. Car flooring shall be of anti skid PVC with choice of colour of engineer in charge. Car doors shall be of stainless steel grade 304, hairline finish with centre opening / telescopic automatic doors. Car panel will also be S.S. 304 finished with emergency stop device, mechanical door safety device, facility of auto/ attended mode. All car panel buttons and all floor switches must be with brail language as per lift act. [4] All landing doors shall be fully automatic centre opening/ telescopic opening made of hairline finish steel grade of 304 with key holes and infrared curtains with Unlocking facility from outside. [5] Appropriate battery operated emergency light in the car along with alarm switch shall be provided. [6] Digital scrolling indicator system for up-down arrow along with floor position indicator shall be provided inside the car and at all floors. [7] Full height infra red curtain with multiple criss / crossing light beams shall be provided. [8] Automatic Rescue Device (ARD) shall be provided accordingly of passenger capacity. [9] Audio visual indication in the lift car showing over loading shall be provided such that doors kept open till excess load is removed. [10] Spring buffers/PU Buffers shall be provided. [11] Car fan with automatic sleep timer shall be provided. [12] Voice annunciator with suitable music shall be provided in lift car. [13] Self diagnostics system for operational and safety parameters shall be provided in control panel. [14] Mechanical over speed governor, door key holes in the floor doors, fireman switch shall be provided. [15] Lift machine hoisting arrangement in the lift machine room and monkey ladder for lift pit should be provided by the lift agency, along with the other steel structure works, foundations for the machine etc... [16] In the hoist way fascia plate shall be provided without any extra cost, where ever required as / if directed by engineer in charge. [17] Permanent wiring in lift machine room and lift well with proper numbers of light points, with fixtures, exhaust fan and plug points shall be provided by the agency. Power supply of 3 phase 440 V shall be made available by department in lift machine room. [18] Any civil/ electrical works for additional and alteration in lift shaft and machine room related to erection of lift shall be made by lift agency without any extra cost.(granite/marble fixing around all landing door openings are not in lift agency's scope.) [19] Agency has to provide all working drawings and documents and liaison services for obtaining all necessary permission from lift inspector and other authorities.

[20] As per statutory requirement of Got. Of Gujarat lift & escalator act 2000, lift agency has to provide - 1. Car top safety barricade, 2. Push & talk communication system. 3. Fireman's switch operation at Ground Floor

-FOR LIBRARY SCIENCE - 8 / 10passengers . Ground plus 3 upper floor with Rated Speed of 1.0 m/sec with micro proce/PLC control and ACVVVF. drive, Premium