# Gujarat University

## *ADDITIONAL TECHNICAL SPECIFICATIONS*

CIVIL WORK

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

**Tender Document**
**For**
**Conservation, restoration of Heritage Tower Building & Redevelopment of surrounding 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 andPre-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 look 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, appetence 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 matrixformulation***.

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. WorkIncluded

a. GFRC panel fabrication shall include all labor, materials, equipment, and related services necessary to manufacture the panels as indicated and described by the contractdocuments.
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 contractdocuments.
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-placeconcrete.
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 clearlyspecified.
e. Responsibility for the design and detailing of hardware attached to or cast into the support structure, as well as layouts for placement, should bespecified.

### B. Related Work SpecifiedElsewhere

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

### C. DesignResponsibility

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 CFRC 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 incharge
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 theproject.

**E. ErectorQualifications**

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 theproject.

**F. Job Mock Up**

6.1 After standard samples are accepted for color and texture produce full sacle unit meeting design requirements full scales 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 access 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 heron as well as thefacing.

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

**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 heron as well as thefacing.
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 "PC!.
8.2 Architectural Precast Concrete DraftingHandbook.
Unit shapes (elevations and sections) anddimensions.
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 isnecessary.

**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 GRCPROCESS**

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,althoughitisadvisabletokeepthemfromdirectsunlightorseverconditionsfordayortwo.

***ii.*** **PRE-MIX GRCPROCESS**

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 |
| ***8*** | ***Roving Tex*** | 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 beused

***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 componentmaterials**

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 theGRC

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

| **Properties** | **Spraymethod** | **Pre mixmethod** |
|---|---|---|
| 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 Interlaminer 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 andMixing**

**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 glasscontent.

**III.** These shall be checked in accordance with standard procedures described in "Recommended Practice for Glass Fiber ReinforcedConcrete".

**IV.** Cleanliness of equipment and working procedures shall be maintained at alltimes.

**N. Hand SprayApplication**

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 trainedpersonnel.

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 unreinforcedsurface.

III. Spray-up of the main body of material shall proceed before any mist coat hasset.

IV. Application shall be by spraying such that uniform thickness and distribution of glass fiber and cement matrix is achieved during the applicationprocess.

V. Consolidation shall he by rolling or such other techniques as necessary to achieve complete encapsulation of fibers aridcompaction.

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 theform.

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) maybe detrimental tostrength.

**Q. EXECUTION**

**a) PRODUCT DELIVERY, STORAGE ANDHANDLING**

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 otherdamage.

ii. Lift or support units only at the points shown on the erection shopdrawings.

iii. Place no staining resilient spacers of even thickness betweenunits

iv. Support units during shipment on no staining shock absorbingmaterial.

v. Protect units from dirt and damage during handling andtransport.

**b) Storage at job site**

i. Store units to protect them from contact with soil, staining, and from physical darnage. Units should never be placed directly onground

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 smoothsurfaces

iv. Place stored units so that identification marks are easilyreadable.

**R. PRE-INSTALLATIONRESPONSIBILITY**

a) Contractor'sResponsibility

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 thespecifications.

III. The Contractor shall provide for the accurate placement and alignment of anchor bolts, plates or dowels on the structure.

b) Festering

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 oversize 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 tomove.

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- combustibleshields as necessary during theseoperations.

**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 ±^/ls in. (4.77 mm) Panel dimension 10 to 20 ft(3.05to6.10m)+''lsin.– 14in.(4.77mm,6.35mm)Paneldimensiongreaterthan20ft(6.10m)+1/4in.—^/is in. (6.35 mm, 7.95 mm)**

**III. Warpage: Maximum permissible warpage of one corner out of the plane of the other three shall be fha in, per ft (5.2 mmlm) distance from the nearest adjacent corner, or 1I8 in. (3.18 mm) total afterinstallation.**

**IV. Bowing: Not over L/360, A. where L is the panellength.**

**S. Reference Codes &Guide**

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

GRCA “Assessment of GRC Test Results” GRCA “Approved Manufacturer Scheme (AMS).

**European Standards**

a. BS EN 1169: 1999: Precast concrete products — General rules for factory production control of glass-fibre reinforced cementproducts.

b. BS EN 1170: 1998: Parts 1-8 Precast concrete products: Test methods for glass-fibre reinforcedcement.
   i. Part 1. Measuring the plasticity of the mortar— 'Slump test'method.
   ii. Part 2. Measuring the fibre content in fresh GRC, Wash outtest'.
   iii. Part 3. Measuring the fibre content of sprayedGRC.
   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 drydensity
   vii. Part 7. Measurement of extremes of dimensional variations dueto moisture content.
   viii. Part 8. Cyclic weathering typetest

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 glassfibres for reinforcement of mortars andconcretes.

e. BS EN 1169: 1999. Precast concrete products – General rules for factory production control of glassfibre reinforcedcement.

**ASTM**

a) C948 Standard Test Method for Wet Bulk Density, Water Absorption and Apparent Porosity of Thin Section Glass Fiber ReinforcedConcrete.

b) C1229 Standard Practice for Preparing Coupons for Flexural and Washout Test for Glass Fiber ReinforcedConcrete.

c) C1229 Standard Test Method for Determination of Glass Fiber Content in Glass Fiber ReinforcedConcrete

d) C1230 Standard Test Method for Performing Tension Tests on Glass Fiber Reinforced Concrete [GFRC] BondingPads

e) C1560 Standard Test Method for Hot Water Accelerated Aging of Glass Fiber ReinforcedConcrete

## TECHNICAL SPECIFICATION OF SPRINKLER SYSTEM

**1. Scope of Work:**

1.1. The work consists of supply, installation, commissioning and testing sprinkler irrigation systems for the
Gujarat University Tower Building garden.

1.2. The Irrigation Designs are based on a Flow Rate of 300 l/min at a pressure of 5 Bar. It is the responsibility of the Irrigation Contractor to confirm that the Flow Rate is available on the site, prior to commencement of the installation.

1.3. The design is based on a Flow rate of 250l/min @ 5.0Bar. It is the contractor's responsibility to check that
this flow is available on site, prior to commencement with the installation. This may change as per Condition of site

**2. PERSONNEL**

2.1. All workmanship shall be of the highest standards and shall comply with the specifications of the manufacturer of the equipment used

2.2. Only the highest grade of materials as specified shall be installed. It is the Irrigation Contractor's responsibility to ensure that materials conform at all times to the specifications and design.

2.3. Any deviation from the Specified material in the Bill of Quantities shall require prior writtenpermission from the Engineer inCharge Changes without permission may void the design guarantee.

**3. PREVIOUS EXPERIENCE**

3.1. Bidder must submit reference of similar recently completed work. as per pre-qualification criteria .

**4. EXCAVATION AND REINSTATEMENT**

4.1. The Contractor shall be responsible for the installation of all underground work from the existing water main pipeline to the irrigation main line and from here to the various sprinklers or parts of the irrigation system. This work includes removal of grass, excavation of the pipe trenches to the required lines and levels, installation of pipes fittings and all other accessories required by the installation, reinstatement of the excavations with backfilling material and reinstatement of grass. All reinstatement shall be strictly to the approval of the Engineer In Charge. Only the highest grade of materials as specified shall be installed. It is the Irrigation Contractor's responsibility to ensure that materials conform at all times to the specifications and design.

4.2. All piping shall be installed such that they have a minimum soil cover of 400mm below finished grade.

4.3. If rock or other adverse conditions preclude the installation at the prescribed depth, the Engineer In Charge written permission must be obtained for installation at a shallower depth andadequate protection shall be provided to piping at the contractors cost.

4.4. Trenches shall be back-filled and compacted to prevent subsidence and backfill surrounding the pipe shall be free of rock

**5. RUBBLE REMOVAL**

5.1. At the Mount Pleasant site the Contractor shall remove excess material, spoil or unsuitable material (no plastic or wood) from the site to the Gujarat University Road Transfer Station at **no**

**charge** tothe contractor.

5.2. At Gujarat University Tower garden Site contractor shall remove and dispose excess material, spoils or Unsuitable material away outside the Gujarat University Campus boundary limits irrespective of lead involved by means of mechanical transport or any other equivalent means, keeping Gujarat University indemnified of any liabilities from statutory / local bodies. Allcomplete as specified & directed by EIC.

## 6. PIPING AND PIPELAYING

6.1. All piping shall be installed according to manufacturer**'**s specification.

6.2. All piping shall not at any time under working conditions be subjected to pressures in excess of the pressure rating.

6.3. Only piping and fittings made from a material suitable to site soil conditions shall be used (PH etc.)

6.4. A pressure-reducing valve shall be installed at each water connection point to reduce the pressure to a maximum pressure to be determined by the Irrigation Designer. The valve shall be a hydrodynamic pressure reducing valve that shall allow a constant setting of downstream pressure between 3Bar and 7Bar, regardless of upstream pressure and under closed valve conditions. The Pressure Reducing Valve shall be capable of operating at upstream pressures of up to 15 Bar. A diaphragm valve with pressure reducing pilot shall **ONLY** be permitted if a brass pilot is fitted, which can operate at the prescribed pressures.

6.5. The Mainline piping shall be a UPVC/High Density Polythene Pipe to ISI standards and shall bare ISI Certification and as per IS-4987-Latest Revision. The piping shall be coupled together with SAB compression fittings as specified inthe bill of quantities. The Compression Fittings shall be true PN16 fittings and shall have both as per IS-4987-(Latest Revision) and ISI Certification and shall bear the ISI mark on the fittings.

6.6. The Spray line piping (15mm – 25mm diameter) shall be Low Density Polythene Pipe of a quality approved by the Irrigation Designer. The piping shall be class 6 and shall be specificallymanufactured to accommodate the Full Flow Fittings specified in the Bill of Quantities. Spraylinepiping (32mm diameter and larger) shall be a High Density Polythene Pipe ISI certified and shall bear the ISI mark.

6.7. Pipe shall be laid in trenches true to line and level as shown on the drawings.

6.8. Trench width shall be kept as narrow as possible; generally not wider than pipe diameter plus 600mm.

6.9. The bedding and backfilling shall be done in layers not thicker than 150mm each, carefully compacted to the same density as the surrounding ground.

6.10. All pipes shall be laid and jointed strictly in accordance with the pipe manufacturer's instructions.Couplings, connectors, etc. shall be of the same pressure rating as the pipe material and securedagainst bursting pressures or thrusts. All bends and fittings, which can generate thrust, shall belaid either with couplings, which transfer thrusts to the pipe, or with appropriately sized thrustblocks.

6.11. No substitution of pipes with a lower pressure rating or size shall be accepted. Pipes of a higherpressure rating and/or larger size may be accepted, subject to approval by the Irrigation Designer,and at the rates tendered for the relevant pipe in the tender document.

6.12. All pipelines shall be thoroughly flushed prior to installation of Valves and Sprinklers.

6.13. All Products are Made in India.

## 7. SPRINKLERS

7.1. Providing and fixing of pop up sprinkler full /part circle having radius of throw 6.7m - 15.2m & flow of 0.09-0.16 Ltr/ sec at an operative pressure of 2.5-4.5 kg/cm sq. The sprinkler is gear driven rotary type with RC technology having 3/4" bottom inlet, with slip clutch mechanism and heavy duty retract spring memory arc, non-strippable and brass reinforced nozzle turret. The sprinkler shall have multi-function pressure activated wiper seal for low pressure operation. The sprinkler shall have internal seal a metric device which prevents low head drainage up to 3.1m. And hence pudding and erosion. the body of sprinkler is non-corrodible heavy duty ABS plastic 5505.

7.2. It shall have a slip clutch mechanism for quick adjustment on installation.

7.3. It shall have a heavy duty cover with a heavy duty retraction spring to assure positive pop-down.

7.4. It shall have a water lubricated durable gear mechanism

7.5. It shall have a pressure activated, multi-function wiper seal that positively seals against the pop-up stem to keep debris out of the rotor and to clean debris from the pop-up stem as it retracts.

7.6. The sprinklers shall be capable of emitting between 0.09-0.16 Ltr/ sec through a radius of from 12 m to 18 m (unadjusted).

7.7. All pop-up sprinklers shall be installed on a piece 25mm triple swing joint riser pipe, which will be fitted on the sprayline to the pop-up. The pop-up sprinklers shall be installed to grade

7.8. All Products are Made in India.

## 8. PUMP

8.1. Supply, installation ,testing and commissioning of 3 phase, 10 HP monoblock submersible pump

8.2. Pump Should be made of Copper rotor and Copper Winding

8.3. Pump body Should be made out of stainless steel 304

8.4. Approved make are Crompton, kirloskar, Lubi of as approved by Engineer In Charge/ Consultant.

8.5. Pump Should having 12 m head with discharge 5000 PM approx.and including making all GI pipe connections to all the fountains of item no. 1 including making one out let connection to drain the water of the pool by using same pump. Water proof cabling of suitable size to be supplied and laid properly from pump to control panel including jointing etc. The above work includes all kind of material i.e. cement, bricks, ball valves, unions, other fittings etc. if needed to complete the work

## 9. COMMISSIONING

9.1. The system shall be pressurized to the design of its components. If required by the Irrigation Designer, the Mainline shall be pressurized to its nominal pressure for a period of 24 hours. Glycerin-filled pressure gauges shall be installed, and the resultant pressure drop shall be monitored over this period.

9.2. All pipes, fittings and sprinklers shall be leak free.

9.3. All sprinklers shall be set to cover the arc and radius as per the design and to the satisfaction of the Engineer In Charge/Consultant

9.4. Upon completion of the installation, the Irrigation Contractor shall arrange for a handover meeting

with the Engineer In Charge/Consultant

9.5. This will involve a walk-through of the site and the compilationof a snag list which must be completed within one week of the walk-through meeting.

9.6. Only upon completion of the Snag List and handover of As-built Drawings and Operation Manuals shall the system be deemed as Handed Over.

9.7. Pump shall have at least 2 Years of Manufacturing Warranty.

**10. GUARANTEE**

10.1. The terms and conditions of the guarantee for the completed systems shall be clearly stated and shallnot be for less than 12 months from the date of hand over

**11. AS BUILD DRAWINGS**

11.1. An as-built drawing to scale shall be provided upon handing over the system

11.2. The drawing must clearly indicate:

11.3. The position of sprinklers and turf valves, their model and make.

11.4. The groups of sprinklers which operate simultaneously.

11.5. The position, sizes and classes of piping.

11.6. The position and class of the mainline clearly distinguishable from the sprayline piping

11.7. The position and class of the mainline clearly distinguishable from the sprayline

**12. VALIDITY PERIOD**

12.1. As Per Tender Validity.

**13. COMPLETION PERIOD**

13.1. As Per Tender terms and condition.

## TECHNICAL SPECIFICATION OF STONE CLEANING

### 1. Overview

The specified work was going to executed at Gujarat University Clock Tower building located near L D Engineering collage University Road.

### 2. PERSONNEL

2.1. All workmanship and material used in sand stone cleaning work shall as per guideline of Archaeological Survey of India.

2.2. Only the higher grade of material as specified shall be used and to be installed. It is Contractor responsibilityto ensure that material confirm at time to the specification and design.

2.3. All workmanship shall be of the highest standards and shall comply with the specifications of the manufacturer of the equipment used

2.4. Any deviation from the Specified material in the Bill of Quantities shall require prior written permission from the Engineer in Charge.

### 3. Scope of Work

3.1. Sand stone shall be cleaned with liquid Ammonia Chemical of 5% solution and other chemical cleaning agent as approved by conservation architect/Consultant.

3.2. Cleaning should be executed in a way of chemical treatment by removing all the marks, ink and colour damages ,unwanted matter such as carbon, stubborn dirt's, scale, graffiti and certain kinds of Paints, Ficus and Ivy Growth, lichen growth from the surface.

3.3. Soft fiber / plastic bristled brushes may be used to scrub the stone surfaces.

3.4. Special Care should be taken to use the system gently avoiding any damage to the substrate surface. The cleaned surface shall be misting rinsed with water/pressure water jet and air-dried ect

3.5. Double scaffolding system (cup lock type) on the exterior side of building/structure, upto40metre height, above ground level, including additional rows of scaffolding in stepped manner as per requirement of site, made with 40mm dia M.S. tube, placed 1.5 meter center to center, horizontal & vertical tubes joint with cup & lock system with M.S. Tubes, M.S. tube challis, M.S. lamps and staircase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for execution of work of cleaning and/ or pointing and/ or applying chemical and removing it thereafter. The scaffolding system shall be stiffened with bracings, runners, connecting with the building etc, wherever required, if feasible, for inspection of work at required locations with essential safety features for the workmen etc., complete as per directions and approval of Engineer-in-charge.

3.6. Providing and application of Bostik's 'paveseal SB clear' - Acrylic, surface sealer and hardener. Cleaning the surface of all the loose dirt etc. - Applying a first coat of primer after applying primer coatdries out applying two coat of Bostik 'Elasto plaster' on cleaned surface with minimum time to dried out each coat. Work shall be executed on manufactures specification.

3.7. Sample of two square meters in four different locations shall be done for prior subject to approval of the consultant/Engineer In Charge for further work to be undertaken

3.8. Disposal of dismantled derbies and cleaning of area.

### 4. Safety Protection :

4.1. Work shall be executed with taking care of all necessary safety protection such as safety mask all

PPE.

4.2. Liquid ammonia used for cleaning work. Safety mask and Glass should use during the application and cleaning work.

4.3. Work shall execute with taking all precautions to safeguard, ventilators, windows, doors etc.

4.4. Suitable covering of exiting window, vent/wooden door etcso as to avoid any damage to the building/structure.

**5. Detail Description:**

Heritage stone chemically treated cleaning for marble/sand stone as instructed by Consultant. The stained stone areas on the façade and other areas shall be cleaned with liquid Ammonia Chemical of 5% solution and other chemical cleaning agent as approved by conservation architect/Consultant. Cleaning should be executed in a way of chemical treatment by removing all the marks, ink and colour damages ,unwanted matter such as carbon, stubborn dirt's, scale, graffiti and certain kinds of Paints, Ficus and Ivy Growth, lichen growth from the surface. Soft fiber / plastic bristled brushes may be used to scrub the stone surfaces. Care should be taken to use the system gently avoiding any damage to the substrate surface. The cleaned surface shall be misting rinsed with water/pressure water jet and air-dried ect and restored with a protective silicon coating. Scope shall be all-inclusive (Including the structural scaffold -Cup lock Type and cleaning and pointing), of supply and application of one coat of primer and two protective coating of Bostik's 'Paveseal SB Clear' or as approved by Consultant and Sample of two square meters in four different locations shall be done for subject to approval of the consultant/Engineer In Charge for further work to be undertaken. The rate shall including of cost of material, cost of laboure ,sampling, testing, cleaning adjoining premises after work completed , work shall executed with taking all precautions to safeguard, ventilators, windows, doors etc. by suitable covering so as to avoid any damage to the building/ structure. During execution all necessary safety protection PPE, scaffolding, cost of silicon coating etc complete as per specification and directed by Engineer in Charge. (Note: Bidder is strongly advised to visit the site for realistic assessment of the work. No extra claim shall be entertained later.)