



Gujarat University

TECHNICAL SPECIFICATIONS

FOR ADDITIONAL ITEMS

Tender No: GU/ESTATE/LBR/2017-18/01

For

**Construction Work of New Library Building at
Gujarat University.**

DESIGN CONSIDERATIONS AND REQUIREMENTS IN THE PRECAST CONSTRUCTION OF BUILDINGS:

1. Use of materials for plain and reinforced precast concrete & in-situ concrete shall satisfy the requirements of IS 456:2000.
2. Components of Precast RCC structure shall be designed for loads in accordance with I.S. 875 (Parts I to 5) and IS 1893-2002 (Part 1). In addition, loads that might be expected during handling, considered in the design.
3. Design of In-situ as well as precast structural units shall conform to the Design requirements of IS : 456 : 2000.
4. The permissible stresses for plain and reinforced precast concrete & in-situ concrete shall be in accordance with the requirements of IS : 456:2000.
5. Resistance to horizontal loading shall be provided by having appropriate moment and shear resisting joints or placing the shear walls. Where shear wall are provided, rotational stiffness of the floor wall joint is not to be considered.
6. Buttressing in the external walls shall be provided as external wall elements are not fully restrained on both sides by floor panels and that external wall panel connections are the weakest points in a precast panel building.
7. In all load bearing elements, adequate restraint shall be provided at corners of the building. These elements and the external ends of cross wall units should be stiffened either by introducing columns as connecting units or by jointing them to non- structural wall units.
8. All concrete to be used at site shall be Design Mix concrete Minimum grade of concrete for In-situ concrete and the precast concrete shall be of M-25 Grade as per IS : 456 : 2000.
9. High yield strength deformed bars or equivalent TMT bars of grade Fe 500 conforming to IS 1786-2010 shall only be used in all RCC work.
10. Bearing for Precast Units shall be as per clause 8.3 of IS 15916 : 2010. Slab panels shall be interconnected through joints at regular intervals to provide monolithic / diaphragm action.
11. RCC decking/topping reinforced screed shall be overlaid on precast panels for providing rigid diaphragm action, under seismic conditions.
12. In designing the prefabricated buildings over G+8 storeys, the possibility of progressive collapse of the structure should be considered, in which failure or displacement of one structural element causes failure or displacement of another element and results in partial or total collapse of the building.

Design Requirements for Safety Against Progressive Collapse

1. All buildings should be capable of safely resisting the minimum horizontal load of 1.5 percent of characteristic dead load applied at each floor or roof level simultaneously.
2. All buildings shall be provided with effective Horizontal Ties i.e,
 - a) Horizontal ties around the periphery.
 - b) Horizontal ties internally in both directions
 - c) Horizontal ties to columns and walls,Design considerations for the Horizontal Ties shall be as per clause 8.2.3.1 to 8.2.3.3 of IS 15915 : 2010.
3. All buildings of five or more storeys shall be provided with vertical ties. Design considerations of vertical ties for buildings of five or more storeys shall be as under: Each column and each wall carrying vertical load will be tied continuously from the foundation to the roof level. Reinforcement in vertical ties to be provided only to resist a tensile force equal to maximum design ultimate load (dead and imposed) received from any one storey. In situation where provision of vertical ties cannot be done, the element should be considered to be removed and the surrounding members designed to bridge the gap.

Joints:

A : Requirements of a structural joint:

- i. It shall be capable of being designed to transfer the imposed load and moments with a known margin of safety;
- ii. It shall accept the loads without marked displacement or rotation and avoid high local stresses;
- iii. It shall accommodate tolerances in elements;
- iv. It shall enable the structure to absorb sufficient energy during earthquakes so as to avoid sudden failure of the structure.

B :

Precast Components of the structure shall be designed for Fire rating of one hour. Fire rating for joints of the components shall be higher or at least equal to the Fire rating of connecting members.

C :

The appearance of precast components joint shall merge with architectural aesthetic appearance and shall not be physically prominent compared to other parts of structural components.

D :

Precast structures may have continuous or hinged connections subject to providing sufficient rigidity to withstand horizontal loading. When only compressive forces are to be taken, hinged joints may be adopted. In case of prefabricated concrete elements, load is transmitted via the concrete. When both compressive force and bending moment are to be taken, rigid or welded joints may be adopted. The shearing force is usually small in the column and can be taken up by the friction resistance of the joint. Here load transmission is accomplished by steel inserted parts together with concrete.

E :

When considering thermal shrinkage and heat effects, provisions of Expansion Joints as per IS 3414 : 1968(Reaffirmed 1995) shall be provided.

23. FOUNDATION

A.

Subsurface investigation shall be carried out indicating vertical sections of the strata, testing of soil samples on the site and in a laboratory for determining shear strength parameters, bearing capacity of the soil, permeability, index properties, water table, compressibility characteristics, swelling properties type & classification of soil and other geophysical information in the field to decide economical & sound foundation.

B.

The cement concrete foundation (plain or reinforced) should be designed in accordance with IS 456:2000 and masonry foundation in accordance with IS : 1905 (Latest version).

C.

Design Consideration for Spread of pad or Strip foundation shall be as per I.S. 1080: 1985 (Reaffirmed 1997).

E. Choice of Raft Type foundation

For fairly small and uniform column spacing and when the supporting soil is not too compressible, a flat concrete slab having uniform thickness throughout (a true mat) shall be provided. The slab may be thickened under heavily loaded columns to provide adequate strength for shear and negative moment. Pedestals may also be provided in such cases. A slab and beam type of raft shall be preferred in large column spacing and unequal column loads, particularly when the supporting soil is very compressible.

In cohesive soils, the effect of long term settlement due to consolidation shall be taken into consideration. In case the structure supported by the raft consists of several parts with varying heights and loads, expansion joints between these parts shall be provided.

F. Pile foundation:

When adequate load-bearing strata at shallow zone is not available Pile foundation may be provided. Choice of piling system shall be made based on the soil report values, load characteristics of the structure and the limitations of total settlement & differential settlement. Design Consideration for Piling system shall be as per relevant provisions in IS 2911(Latest version). The integrity testing of piles and other requirements shall be as per IS 2911(Latest version).

Composite construction with Precast elements and *cast-in-situ* construction

- a. Protrusions or recesses on the top surface of Precast concrete units shall be provided for necessary monolithic action between the cast-in-situ concrete and Precast units.
- b. The composite section should preferably be proportioned in such a way that the neutral axis of the composite section is located below the in-situ concrete slab. If the neutral axis is located inside the in-situ concrete slab, the portion of the slab below the neutral axis shall not be considered effective for computing moments of inertia or resisting moments except for deflection calculations. The modular ratio between precast concrete and cast in situ concrete shall be determined on the basis of values of moduli of elasticity for the two concretes.
- c. Differential Shrinkage and Creep of Concrete:- The effects of shrinkage & creep of cast-in-situ concrete on the prefabricated member shall be considered. It shall be ensured that stresses in the prefabricated member do not exceed the permissible stresses by more than 25 percent when these effects are superimposed on the stresses caused by the worst combination of other loads.
- d. Composite structures in which the *in-situ* concrete is assumed to act integrally with the precast beam shall be inter-connected to transfer the horizontal shear along the contact surfaces and to prevent the vertical separation of these units. Transfer of shear shall be by shear bars, castellation and by bond. The units shall further be tied together by the extension of web reinforcement.
- e. Ties - Separation of the component elements in the direction perpendicular to the contact surface shall be prevented by ties adequately embedded on each side of the contact surface; The spacing of such ties shall not exceed four times the thickness of the slab or 60 cm whichever is less. The minimum crosssectional area of the ties, in each metre of the span shall not be less than 0.15 percent of the contact area or 130 sq mm. All web reinforcement of the prefabricated unit shall be extended into the cast *in-situ* concrete.
- f. Bond Strength at the Inter-face - The inter-face shall always be made rough for effective bonding. The bond strength at the inter-face shall be checked for ultimate load. The ultimate values of the horizontal shear stress at the interface shall be calculated in accordance with the formula given under clause 6.5.2 of IS : 3935: 1966(Reaffirmed 1998). If the calculated shear stresses are more than the values given under no slip condition in Table 1 for strength of the in-situ concrete, it shall be taken that the slip has occurred. The design shall then be made taking a frictional shear resistance of 10 kg/cm² and the balance stress to, be resisted by steel shear connectors stressed to a maximum of 1340 kg/cm². The inter-face shear shall not, however, exceed the value given under the maximum permissible shear stress prescribed in Table 1 of IS : 3935: 1966(Reaffirmed 1998).
- g. Specifications and Design considerations shall be in accordance with IS : 3935: 1966(Reaffirmed 1998).

Seismic considerations:

- a. RC building frame system and shear walls shall be designed and detailed to comply with the requirements given in IS 4326, IS 1893:2016 and IS 13920.

ITEM DESCRIPTION: 100mm Precast Designer Wall:-

Design, supply and erection of 100 mm thick concrete decorative free standing wall panels of M-30/40 grade of concrete with proper graded aggregate, cement OPC 53 grade, admixtures confirming to IS 9103 with mould finish on one side and smooth trowel finish on other side with ready to paint surface including reinforcement steel, including mould cost, necessary corrugated ducts for connection including grouts, lifting hooks for erection. The material casting should take place in Synthetic Rubber / FRP mould manufactured by RECKLI or equivalent.

ITEM DESCRIPTION: GRC JALI:-

7.5.1 Scope:

Providing and Fixing of GRC Jali (Glass Fibre Reinforced Jali) 50 mm thick of required size, pattern, design, and colour with 50% area covered to be fixed on/between RCC / Block work Column or structural steel work with Dry Fixing method.

7.5.2 Applicable Codes:

As applicable

7.5.3 GRC General Specification:

Property	Units	Hand or Machine Spray	Vibration
Glass fibre(Weight%)		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 (LOR)	Mpa	7-11	5-8
Shear			
Interlaminar Strength	Mpa	3-5	N.A.
In-plane Strength	Mpa	8-11	4-7
Compressive Strength	MPa	50-80	40-60
Impact Strength	Kj/m ²	10-25	10-15
Elastic Modulus	GPa	10-20	10-20
Strain to Failure	%	0.6-1.2	0.1-0.2
Dry Density	T/m ³	1.9-2.1	1.8-2.0

GFRC Jali TECHNICAL SPECIFICATION

The jali shall be made from 53 grade White Portland Cement , Quartz, Fine Silica Sand, Alkali Resistant Glass Fibre , Super Plasticizers and UV Resistant Synthetic inorganic pigments . The

material casting should take place in Synthetic Rubber / FRP mould manufactured by RECKLI or equivalent.

7.5.4 Workmanship:

- The work shall include erection of all fasteners, flashing and capping for all edges, caps corners etc. The fixing detail as mentioned in Bill of Quantities and as per manufacturer's specification.
- The work will include cost of all labour, equipment's, materials, submission of shop drawing, cost of consumables, fasteners, washers etc.
- Fixing of (Glass Fibre Reinforced Jali) GRC Jali to be fixed on/between RCC / Block work Column or structural steel work with Dry Fixing method with appropriate steel frame work , using fasteners, and necessary hardware etc in Building Facade. The jali shall be securely fixed with stainless steel bolts and anchor fasteners(304 grade) of required size at specified locations. The fixing shall be done by the specialized approved agency as directed by Engineer-in-Charge.

7.5.6 Measurements:

The surface area (sq.mt) of Jali shall be measured for payment.

7.5.7 Rates: The rates shall be includes the cost of labour, material involved in all the operations described in Bill of Quantities.

ITEM DESCRIPTION: Calcium Silicate Ceiling.

Grid False ceiling work (helux board) Metal framed suspended ceiling comprises of G.I perimeter channel having 0.55 mm thickness, two unequal flanges of 20 and 30 mm and web of 27 mm is fixed to surrounding walls/partition using nylon sleeves and screws at 450 mm centres. Then intermediate channel (0.91mm thick) having two equal flanges of 15 mm each and a web of 45 mm is suspended from the soffit at 1220 mm centre with ceiling angle of width 25 mm x 10 mm x 0.55 mm thick, fixed to soffit with G.I cleat and steel expansion fasteners. Ceiling section of 0.55 mm thickness having knurled web of 50.5 mm and flanges of 26 mm each with lips of 10.5 mm are then fixed to the intermediate channel with connecting clips across to the Intermediate channel, at 610/457 mm centers. 8 mm thick square/tapered edge Hilux Calcium Silicate Boards are then screw fixed along/across the ceiling sections with 25 mm long self drilling & tapping screws having Phillips head with under head cutter, at 200 mm centres through the Hilux Calcium Silicate Board fillets.

Jointing and Finishing

The joints of the face boards are finished with specially formulated jointing compound and 48 mm wide fibre tape to provide seamless finish.

Note:

G.I. perimeter channel and supporting materials are to be provided to make any opening for light fittings, diffusers etc. and should be supported properly to maintain the integrity of the ceiling, and should be charged extra.

ITEM DESCRIPTION : STRUCTURAL GLAZING SYSTEM

Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels, including:

(A) Structural analysis and design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)-cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation and drainage and protection against fire hazard including:

(B) Fabricating and supplying serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon seperator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.

(C) Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment , including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.

(D) Providing and fixing in position flashings of solid aluminium sheet 1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.

(E) Making provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete. This item includes cost of all inputs of designing, labour for fabricating and installation of aluminium grid, installation of glazed units, TandP, scaffolding and other incidental charges including wastages etc., enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item includes the cost of getting all the structural and functional design including shop drawings checked by a structural designer, dully approved by Engineer-in-charge. The item also includes the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory, field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over of the building for occupation. In the end, the Contractor shall provide a water tight structural glazing .having all the performance characteristics etc. all complete as required, as per the Architectural drawings, as per item description, as specified, as per the approved shop drawings and as directed by the Engineerin- Charge.

Measurements:

The area of Glazing shall be measured in Sq.mt.

ITEM DESCRIPTION : Water Proofing

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.

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.