



SRPL Building System (Waffle-Crete)

User should check the validity of the Certificate by contacting Member Secretary, BMBA at BMTPC or the Holder of this Certificate.

Name and Address of Certificate Holder:

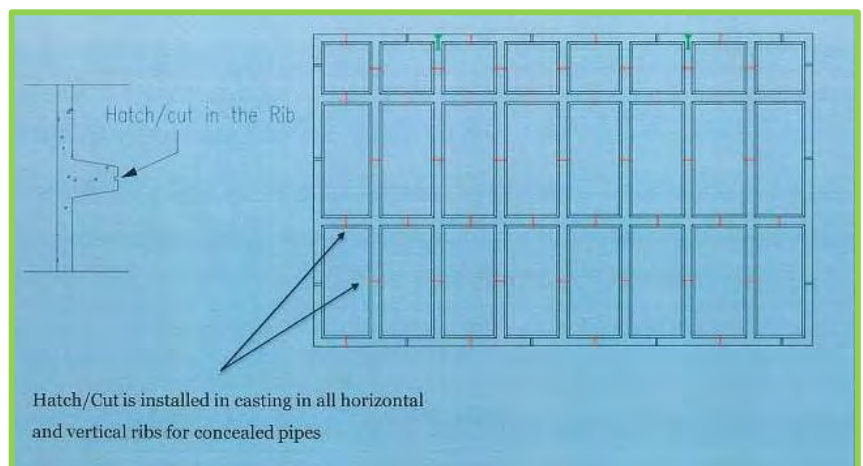
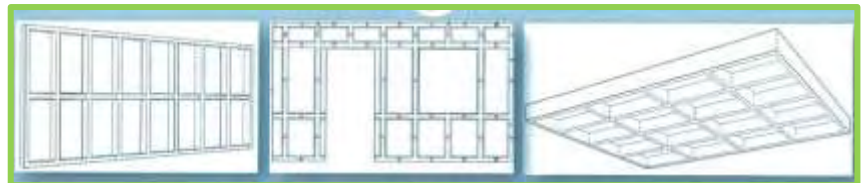
**M/s Shaival Reality Pvt. Ltd.
Maharaja Palace, Near Vijay
Char Rasta, Navrangpura,
Ahmedabad -- 380009**

Performance Appraisal
Certificate No.

PAC No **1021-S/2015**

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PERFORMANCE APPRAISAL CERTIFICATE

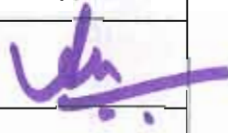
FOR

SRPL BUILDING SYSTEM (WAFFLE-CRETE)

ISSUED TO

M/s SHAIVAL REALITY PVT. LTD.

STATUS OF PAC NO. 1021-S/2015

S.No	Issue No.	Date of Issue	Date of renewal	Amendment		Valid up to (Date)	Remarks	Signature of authorized signatory
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PART 1 CERTIFICATION

1.1 Certificate Holder

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1.2 Description of system

1.2.1 Name of the System – SRPL Building System

1.2.2 Brand Name – Waffle-Crete

12.3 Brief Description –SRPL (Waffle-Crete) Building system shall consist of large, structural, ribbed panels of reinforced precast concrete, bolted together and the joints between the panels shall be caulked to form the walls, floor and pitched or flat roofs of buildings. The surface of each panel shall consist of 51 mm thick slab or skin, stiffened with the ribs around the perimeter and across the panel, giving an overall panel thickness of 152 mm or 203 mm. In single storey buildings, floors are constructed using precast reinforced concrete floor panels supported on precast concrete grade beams on well-compacted earth. The walls are constructed of 152 mm thick wall panels of precast reinforced dense concrete. For buildings of more than one storey, the walls shall be supported on foundations designed by the engineer. The design of buildings including the foundations shall be the responsibility of a professional engineer. A concrete apron shall be laid around the perimeter of buildings where there is a danger of water or wind erosion of the ground adjacent to the building. Where the engineer considers the building site to be unsuitable for suspended floors and grade beams, the walls shall be supported on a conventional cast-in-situ concrete strip footings. Metal or timber window and door frames shall be incorporated into the wall panels during casting or fitted after erection into openings that are formed in the panels during casting. Internal walls shall consist of reinforced precast concrete ribbed panels as described above, conventional masonry walls or concrete walls. Where precast concrete panel or masonry internal walls are used in single storey buildings, these shall normally be erected on a concrete surface bed or on concrete strip footings and not on suspended floor.

Services like water supply and electricity shall be normally accommodated in preformed slots in the ribs of panels, before the walls are lined.

The casting can be done in casting yard while foundation is done, which reduces the construction time. Curing time is reduced by trapping the moisture generated from the concrete.

The building after construction can be shifted from one place to another as the structure is joined using bolt connections.

The Waffle-Crete system consists of the following core elements:

- Lightweight insulated precast insulated molds
- Insulated curing covers that shall be used in conjunction with Waffle-Crete molds
- Specialized equipment shall be designed for use with Waffle-Crete molds and covers
- A construction methodology for casting and erecting concrete panels with molds and equipment.

Concrete panels cast in molds and then covered with a curing cover shall be removed from the mold and erected. Modular panels and bolted connections speed the erection process. The system can be utilized for a variety of structural applications.

The insulated mold and insulated curing cover is shown in Fig. 1.



Fig. 1

1.3 Type of Precast Concrete Panels & Walls

1.3.1 *Standard* reinforced precast concrete wall, floor and roof panels are 2.43 m wide and are manufactured in lengths of 3.65 m, 4.26 m,

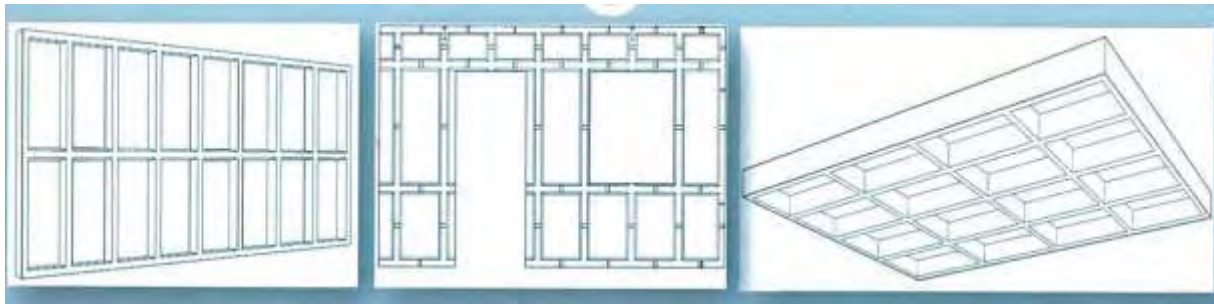
4.87 m, 5.48 m, 6.09 m & 7.31 m. The surface of each panel shall consist of a 51mm thick slab, stiffened with tapered ribs around the perimeter and across the panel. The ribs shall be at approx. 1214 mm centres in one direction and 610 mm in the other and give an overall panel thickness of 152 mm or 203 mm, as required. Panels for single or double storey building shall be either 152 mm or 203 mm thick but panels for buildings over two floors high shall always be 203 mm thick.

- 1.3.2** *Harmonized reinforced* precast concrete wall panels are 2.58 m high and are manufactured in lengths of 3.65 m, 4.26 m, 4.87 m, 5.48 m, 6.09 m & 7.31 m. All harmonized panels shall be 152 mm or 203 mm thickness. The surface of these panels shall consist of a 51 mm thick slab, stiffened with ribs around the perimeter and across the panel. The ribs shall be at approx. 610 mm centers, with two horizontal ribs along its length, one approx. 836mm from the bottom and the other 418 mm from the top. These panels shall be used for window/door and window cut-outs. Harmonized wall panels shall be used when a different elevation treatment is require, so that the top two ribs are continuous around the perimeter of the building, above window and door openings. A wide range of external finishes and textures can be applied during casting of any of the panels.

1.3.3 *Accessory Panels*

- a) *Eave panels* shall be used as decorative building trim and also cover waffle voids that may be exposed on the edges of cut roof panels.
- b) *Grade beams* shall be used to cast a first floor foundation. Grade beam panel shall be keyed to fit floor panel ribs.
- c) *Stair panels* shall include an adjustable blockout to cast concrete stairs of variable width up to 2.44m. Stair molds shall be available in 3.66m & 6.10m lengths with 164mm risers.

These panels are shown in Fig. 2 and details of these panels are given in Figs 4 & 5.



Standard wall panel

Harmonized wall panel

Ceiling/floor panel

Fig. 2

1.3.4 *Waffle-crete Floor Slabs*

Thickness of concrete of topping may vary for different requirement of fire ratings.

Floor slabs with a 60 minute fire-resistance rating shall require a minimum of 38 mm concrete topping and floor slabs with a 120 minute fire-resistance rating shall require a minimum concrete topping of 75 mm or cladding to the underside.

Where ribbed panel require a 60 minute fire- resistance rating, the cladding to the underside of the floor shall consist of 12.7 mm thick x-rated gypsum plasterboard of 63.5 mm x 35 mm x 0.71 mm thick on galvanized steel channels at 600 mm centers fixed to the ribs of the panels with 18 gauze steel galvanized wire wound around threaded 6 mm dia. galvanized steel fasteners hand-driven into a previously drilled hole in the rib of the floor panel.

When ribbed panel require a 120 minute fire- resistance rating, two layers of 12.7 mm thick x-rated gypsum plasterboard are used, fixed as for floors with a 60 minute fire- resistance rating. A 120 minute fire-resistance rating shall also be required for wall, floors and ceilings that enclose emergency routes in buildings.

The joints between the plasterboard shall be sealed according to the manufacturer's recommendations.

Floor slabs with a 30 minute fire-resistance rating shall not require a concrete topping.

Thickness of concrete topping may vary for different requirement of fire-ratings.

1.3.5 *Type of Walls*

1.3.5.1 There are six types of internal and external walls which shall be used in conjunction with brick or concrete masonry walls etc. The wall panels shall be 152 mm or 203mm thick overall.

- i. *Type 1* 152 mm or 203 mm panels, unlined.
- ii. *Type 2* Wall panels lined on one side with 12.7 mm thick x-rated gypsum plasterboard on 38 mm x 38 mm timber studs

- at 600 mm centers fixed to the panel ribs with screws into nailer blocks cast into concrete at 600 mm centers.
- iii. *Type 3* Wall panels lined on one side with 12.7 mm thick X-rated gypsum plasterboard of 63.5 mm x 35 mm x 0.71 mm thick on galvanized steel studs spaced at maximum 450 mm centres fixed to the ribs of the panels with 18 gauge steel galvanized wire wound around threaded 6 mm dia. galvanized steel fasteners hand-driven into a previously drilled hole in the rib of the floor panel.
 - iv. *Type 4* Wall panels lined on one side with two layers of 12.7 mm thick X-rated gypsum plasterboard on galvanized steel studs with staggered joints similar to those used in Type 3 wall fixed to the panel ribs in the same manner as wall Type 3.
 - v. *Type 5* Wall panels lined on one side with 12.7 mm thick X-rated gypsum plasterboard on top hat section galvanized steel channels fixed to the panel ribs as for wall Type 3 and insulated with 150 mm thick glass fibre.
 - vi. *Type 6* Wall panels lined on one side with 12.7 mm thick X-rated gypsum plasterboard on timber studs fixed to the panel in the same manner as for wall Type 2 and insulated with 50 mm thick glass fibre.

1.4 Technical Requirements

1.4.1 Design Requirements

- (a) The foundations of whatever type must be designed by a professional engineer in accordance with IS 1904:1986, after investigations of the soil conditions.
- (b) The structural design of every Waffle-crete building including roof construction shall be the responsibility of the professional engineer of M/s Shaival Reality Pvt. Ltd. The structural design shall comply with all the relevant Indian Standards, including IS 456:2000, IS 875 (Part 1, 2 & 3):1987, IS 1893 (Part 1):2002, IS 13920:1993 & National Building Code of India 2005. Reference shall also be made to the design recommendations given in Waffle-Crete's design manual and specifications.
- (c) The strength of connections between components and with recessed bolts shall be determined by test before use.
- (d) In addition to conventional structural design aspects, the design of the building shall address the following:
 - Stability of gable walls

- Bracing of façade walls against wind loads
 - Structural integrity and resistance to progressive collapse due to accidental damage to local elements.
- (e) Where the specified minimum concrete cover to the steel reinforcement cannot be attained or galvanized or epoxy coated steel is to be used, the particular concrete mix and spacers required shall be specified by the engineer.
- (f) All precast concrete floor, wall and roof panels and grade beams shall also be designed for loading conditions during de-molding, transportation and erection.
- (g) Where galvanized steel roof sheeting is used and is designed to perform a structural function, it shall be protected against corrosion for life of the building.

1.4.2 *Manufacturing Requirements*

- (a) Cement complying with the requirements of relevant Indian Standard shall be used. Any additives or plasticizers used in the concrete shall conform to IS9103: 1999 and drawings shall be in accordance with the manufacturer's instructions. Additives that promote corrosion shall not be used in the reinforced concrete.
- (b) All precast concrete components shall be manufactured in accordance with relevant Indian Standards.
- (c) All precast concrete components shall be adequately cured. Components shall be removed from the molds only when the concrete has attained 75% of the strength specified by the engineer.
- (d) The precast concrete components shall only be lifted and supported at the points designated by the certificate holder.
- (e) The concrete for all the precast concrete components shall have minimum cement: water ratio of 2 by mass.
- (f) All precast concrete components shall be free of honey-combing and any patching or remedial work to minor damage shall be in accordance with the relevant Standard. Mortar used for such work shall have a sand cement ratio equal to the aggregate: cement ratio of the concrete.
- (g) Deviations with regard to length, height, straightness and finished surfaces of all precast concrete components shall not exceed those specified in IS 10505:1983. In addition all precast concrete panels shall be manufactured with the limits specified below:
- i. The panel thickness shall not vary by more than -3 mm and + 6 mm.

- ii. The slab (skin) thickness shall not vary by more than ± 2 mm
- iii. The panel shall not be more than 3 mm out of square per 3 m length, measured on the diagonal.
- iv. All anchors and inserts shall be within 9 mm of the centre line location shown on the drawings
- v. Blockouts and reinforcement shall be within 6 mm of the position shown on the drawings.

1.4.3 *Erection Requirements*

- (a) Panels shall be correctly aligned and the jointing shall be executed in accordance with the specification.
- (b) Damaged precast concrete components i.e. those that are badly chipped or that could badly effect structurally because cracks penetrate to the reinforcement or that are cracked or broken right through shall not be used.
- (c) As a precautionary measure against possible damage to the precast concrete components during tightening of the connections, the thread and bolt or anchor rod size together with the appropriate tightening torque for the particular thread and bolt/rod size, in each case, shall be specified by the engineer responsible for design of the structure.
- (d) All steel bolts, threaded rods, washers and nuts at connections, between panels and all anchor bolts shall be protected against corrosion.
- (e) Any drilling of holes in the precast concrete components shall be carried so as not to impair its structural integrity.
- (f) All bolts, rods, nuts, washers etc. for anchoring the precast concrete components to the concrete surface bed, foundations or grade beams, or which are used at joints between precast concrete panels, external walls or roofs, shall be hot-dip galvanized steel in accordance with IS 4759:1996.
- (g) Horizontal joints between concrete components shall be grouted solid. The non-shrink grout shall generally be injected or rammed in, or vibrator rod used to ensure that the joint is completely filled for the full width. On the exterior of the building, the joint must be partially raked out to allow for the sealant.
- (h) All external joints between concrete components shall be weatherproofed by means of a sealant.
- (i) The specified width between concrete components is 9 mm for vertical joints and 12 mm for horizontal joints.

- (j) The precast components shall not be chased.
- (k) For fire protection all steel connections shall be protected by coating all exposed surfaces with 2 mm dry film thickness of an intumescent coating.
- (l) Where precast concrete roof panels are used, they shall be bedded in 4:1 sand: cement mortar on the sloping tops of the wall panels at gable ends.
- (m) Where suspended precast concrete floors are used, the long and cross ribs of precast concrete floor panels shall be fully bedded in 4:1 sand: cement mortar 12 mm thick (nominal) in the recesses of the precast concrete grade beams.

1.5 Manufacturing Process

1.5.1 Process of manufacturing of the panels is as follows:

- i) Waffle-Crete components shall either be cast on site or in casting yard. An inverted panel or a concrete surface bed shall be used as a base on which the components shall be casted.
- ii) The heavily quality insulated plastics and aluminium molds shall be blocked off at any point if a particular non-standard sized panel is required.
- iii) Holes for bolted connections between components shall be usually formed during the casting of the components. The location of certain bolted connections in the building, shall however, make it necessary to drill the hole on site through the preformed hole in the rib of the panel, into the adjoining panel or into the cast-in-situ concrete component. Specially tapered, wedged-shaped galvanized steel washers shall be used for the bolted connections. (See Figs. 7-9)
- iv) Metal, RCC or timber window and door frames shall be fitted in the block-outs left for the purpose. Where required, sleeves and boxes for conduits and services shall be cast into the panel ribs.
- v) Steel rod and mesh reinforcement shall be placed in the mold as specified by the professional engineer responsible for design of the building. Spacer blocks shall be used to correctly locate the reinforcement to ensure that the specified concrete cover is achieved. The blocks shall be exposed on one side of the panel to facilitate the nailing or screwing of timber or steel studs for wall linings or ceilings to the panels.

- vi) Concrete with 28-day cube strength of at least M 35 MPa shall be poured into the molds from ready mix trucks / dumpers or other suitable means.
- vii) Specially designed vibrator shall be used to strike off and compact the concrete in one operation. If necessary, the surface of floor panels shall be hand finished to produce a surface to which the floor finishes shall be easily applied.
- viii) The insulated plastics and aluminium cover to the molds keep the heat and moisture during curing of the panels. The trapped heat and moisture accelerate the curing process and components generally cure overnight.
- ix) The concrete components shall be lifted using specially designed lifting beam, or with cable slings and embedded lifting anchors at appropriate positions. The components, still with the mold attached, shall be lifted about 100 mm above the casting bed, the cover removed, the corner bolts loosened and the mold stripped from the panel by using downward pressure on the mold sides. A form release agent shall also be used. The panels are handled by using Swift lift system which is shown in Fig. 3.
- x) The panels shall be stacked horizontally on top of each other, supported on timber spacers and stored in the casting yard until required at site.
- xi) Panels shall be de-molded after checking the results by rebound hammer
- xii) Molds shall be stacked in the casting yard and curing of panels shall be done
- xiii) The panels shall be transported to the erection location by trailer
- xiv) The panels shall be lifted using crane and fixed on the location by connection bolts
- xv) After connection bolts are fixed, panels shall be covered with high strength chemicals
- xvi) Thereafter, finishing items like flooring, door & window fixing and painting etc. shall be done.

Manufacturing Process Flow Chart is given in Annex II.

1.6 Assessments

1.6.1 Scope of Assessment

- 1.6.1.1** Scope of assessment includes conformance of manufactured pre-cast concrete wall and floor/roof panels to the specified requirements for use in the building construction.

1.6.2 Basis of Assessment

Assessment of the suitability of the SRPL Building System manufactured as load bearing wall and floor/ roof slab etc. is based on:

- i) Inspection of production and erection facilities at site during visit of the TAC members and IOs
- ii) Design review of the structural design of G+3 Apartment building for IHSDP Project Anand Nagarpalika by the Superintending Engineer, Design (R&B) Circle, Gandhinagar
- iii) Quality Assurance System followed by the Certificate holder for quality control of the system.
- iv) Standard Fire Endurance Test Programme conducted on Precast Concrete Wall Panel System by Warnock Hersey Professional Services Ltd., Coquitlam, USA
- v) Load Test on Waffle-Crete Floor panel by Van Doren Industries, Inc, Kansas, USA
- vi) Report on Heat Transfer Measurements Of Waffle-Crete Wall panel system by Butler Manufacturing Co., Missouri, USA
- vii) Sound Transmission Loss Report Of Waffle-Crete International, Inc by Coffeen Frickle & Associates, Inc, Kansas, USA
- viii) South Africa Agreement Certificate No. 97/260 for Waffle-Crete Agreement System of Waffle-Crete International Inc

1.7 Use of the SRPL Building System

1.7.1 The system shall be used for low rise mass housing projects, commercial buildings, manufacturing facilities, retaining walls etc.

1.7.2 Special Aspects of use:

- i) The building to be constructed using SRPL Building System shall be in accordance with the specifications and manufacturing & construction process prescribed by the manufacturer and designed by competent structural Engineers.
- ii) Plumbing & Electrical services, Doors & windows and Utilities etc. shall be governed by the provisions and details agreed between the manufacturer and developer.
- iii) Buildings to be constructed with the SRPL Building System should be constructed only with technical

support or supervision by qualified engineers and builders, based on structural designs and Seismic evaluation & Wind forces carried out to comply with prevailing standards; this is applicable even for low-rise and affordable mass housing to provide safety of structures.

- iv) It is strongly recommended that structural engineers and building designers associated with precast construction should be thoroughly familiar with the various structural aspects. It is also recommended that Architects and Construction Engineers who undertake such building design and construction gain familiarity with the properties and materials, characteristics of SRPL Building System and its applications.
- v) The panels shall be handled with a crane of capacity of about 35 MT having a boom length of about 35 meter and sufficient space should be available for movement of the crane.

1.7.3 Experience in actual use

The manufacturer has constructed 944 dwelling units for Anand Nagarpalika under IHSDP Project and Dahod Nagarpalika in Gujarat.

1.8 Scope of Inspection

Scope of inspection included the verification of production, performance and erection at site including competence of technical personnel and status of quality assurance in the factory.

1.9 Manufacturing and Erection Facilities

Manufacturing and erection facilities available were found to be suitable to produce and erect the precast concrete panels as per the specifications.

1.10 Conditions of Certification

1.10.1 Technical conditions

1.10.1.1 Raw materials and the finished panels and walls shall conform to the requirements of the prescribed specifications.

1.10.1.2 The production capability and quality of the panels vis-à-vis requirements specified and competence of the technical persons for design and proper erection of the panels at site shall need

verification for each plant/ establishment engaged in the production and execution of the system.

The design assumptions, detailed calculations, references to necessary and detailed design drawings shall be made available on demand, if required. The structural design calculations should clearly demonstrate structural integrity and stability including connection details.

1.10.2 Quality Assurance

The Certificate Holder shall implement & maintain a quality assurance system in accordance with Scheme of Quality Assurance (SQA) given in the Annex I attached with this Certificate.

1.10.2.1 Structures using the panels shall be designed as per Clause 1.5 and executed as per provisions of this PAC.

1.10.3 Durability

The Certificate Holder shall provide necessary structural warranty ensuring durability of the system to the user, on demand.

1.10.4 Handling of User Complaints

1.10.4.1 The Certificate holder shall provide quick redressal to consumer/ user complaints proved reasonable & genuine and within the conditions of warranty provided by it to customer/purchaser.

1.10.4.2 The Certificate holder shall implement the procedure included in the SQA. As part of PACS Certification he shall maintain data on such complaints with a view to assess the complaint satisfaction and suitable preventive measures taken.

1.11 Certification

1.11.1 On the basis of assessment given in Part 3 of this Certificate & subject to the conditions of certification, use & limitations set out in this Certificate and if selected, installed & maintained as set out in Part I & II of this Certificate, the system covered by this Certificate is fit for use set out in the Scope of Assessment.

PART 2 CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

2.1 General

2.1.1 The PAC holder shall manufacture the panels & walls in accordance with the requirements specified in the SRPL Building System.

2.2 Specifications for the System

2.2.1 Specifications

Specification for the raw materials and finished product shall be as per performance criteria when tested in accordance with the company standard & relevant Indian Standards listed in this Certificate.

2.2.2 Raw Materials

- (i) *Rebar* shall be Fe 415/485 in accordance with IS1786:2008 and of thickness 12 mm, 16 mm & 20 mm.
- (ii) *Wire mesh* shall be of 6mm thickness IS1786:2008 @ 300 mm c/c.
- (iii) *Connection bolts* M 16x160 mm, M 16 x 380 mm & M 16x310 mm shall conform to ASTM A 307 Gr A/ IS 1363 (Part1-3):2002
- (iv) *Anchor bolts* HIT V M16 & HY 200R Chemical shall confirm to ASTM A 307 Gr A/ IS 1363 (Part 1- 3) :2002
- (v) *Concreting* shall be of M 30 grade concrete in accordance with IS 456:2000, without fly ash and coarse aggregate shall be not more than of 20mm size. Water-cement ratio shall be 0.40. Mix design with additives shall have compressive strength of 19 N/mm² in 18-24 hours.
- (vi) *Swift lift Anchor* shall have two anchors in each wall panel and four anchors in each floor panel. Spacing of anchors shall be according to cut-outs provision in respective panel.

2.2.3 Inspections & Testing

- Shall be done at appropriate stages of manufacturing process and execution process.
- The inspected panels shall be stored carefully to ensure that no damage occurs during transportation.
- As part of quality assurance, regular in- process inspections shall be carried out by the trained personnel of the PAC holder.

2.3 Erection Procedure

- 2.3.1** (i) The properties of the soil on site shall be established by a professional engineer and the foundations and floors designed accordingly.

(ii) The conventional cast-in-situ concrete foundations and surface beds with thickened edge beams or footings, shall be constructed on site in accordance with IS 1904:1986. The surface beds shall be laid on well compacted earth. The precast concrete grade-beam foundations and suspended concrete floors shall be used only on suitable level sites where stormwater drainage is designed by a competent engineer.

(iii) When suspended floor panels and foundations are used, the grade beams shall be located under the longitudinal external walls of the building. They shall be placed in position on the surface of the ground on well compacted and levelled earth, laid end-to-end with butt joints. Butt joints in the grade beams shall be located so that they are not in line with the joints between the floor panels or the joints between the wall panels above. The floor panels shall then be hoisted into position on top of grade beams so that the ribs at both ends of each panel are bedded in 4:1 sand: cement mortar 12 mm thick (nominal) in the recesses of the grade beams to provide uniform support to the floor.

(iv) Where the span between the grade beams on either side of the building is such that it is necessary to use two or more floor panels across the width of the building, the ends of the panels at the joints where they meet shall be supported by additional grade beams, laid parallel to the external grade beams.

(v) A continuous damp-proof membrane of a suitable plastic material, at least 0.25 mm thick, shall be provided under conventional concrete foundations and surface beds. Where suspended floors and grade beams are used, bituminous paint conforming to IS 158:1981 and at least 400µm thick shall be applied to the recesses in the grade beams, before the precast floor panels are placed in position to prevent rising damp.

(vi) The wall panels shall be hoisted and set in a vertical position, onto hardwood shims on the panel floor, concrete footing or surface bed, to create a space of uniform thickness under the bottom ribs of the wall panels, for the grouted joint. The vertical joints are $9 \text{ mm} \pm 3 \text{ mm}$ wide and the horizontal joints $12 \text{ mm} \pm 3 \text{ mm}$ wide. All shims used are approx. 80 mm square. During erection, the structure is not stable and is adequately braced until the roof has been erected and all the connections made.

(vii) After levelling and aligning the wall panels on the shims, these shall be bolted to the floor panels and grade beams, or to the cast-in-situ concrete surface bed or foundations. This shall be achieved by drilling holes at 1.2 m centres, through the preformed holes in the bottom ribs of wall panels into the grade beams or foundations below and inserting 16 mm or 19 mm dia. galvanized steel or stainless steel anchor bolts or threaded rods depending on the design. Where suspended floor construction is utilized, the walls at gable ends shall be bolted directly to the suspended floors as there are no grade beams under the end walls of the building.

(viii) Where threaded galvanized steel or stainless steel rods are used instead of anchor bolts, the ends of the rods shall be embedded in epoxy grout in holes drilled into the concrete, in strict accordance with the manufacturer's instructions. The holes in ribs of the walls panels shall not be recessed at the top so tapered, wedge shaped galvanized steel or stainless steel washers shall be used. After tightening the nuts or bolts, the horizontal joints between the wall panels and the foundations, surface bed or suspended floor or shall be filled with a non-shrink sand-cement grout.

(ix) Sand-cement grout having a compressive strength of 35MPa at 28 days shall be used in all horizontal joints between precast concrete components, unless otherwise specified by the engineer. A vibrator rod shall be used to ensure that the grout completely fills the joints.

(x) Intermediate floors shall always consist of panels which are bolted together. There are three types of floor to wall connections. In the first case the floor panel shall be supported on top of an external wall, in the second case two floor panels shall be supported on an internal wall and in the third case a floor panel shall be supported on a ledger beam.

(xi) Staircases which are of precast concrete shall be deigned in the normal manner and bolted to the supporting structure. At the beginning of a rise, the staircase shall be bolted with a 19 mm dia. vertical expansion anchor through a 76 mm x 76 mm 38 mm recess in the first step to the supporting structure. At the upper end of the rise, the staircase shall be fixed with a minimum of three 19 mm dia. x 254 mm long expansion anchors through the floor.

(xii) On the outside of the building, the grout shall be partially raked out of the horizontal joint all round between the bottom of the external walls and the floor, concrete surface bed or footing to allow for the insertion of butyl rubber rope, followed by a bitumen impregnated foam plastics backer rod or bond breaker and caulked with one component polyurethane sealant. Before the sealant is applied to any of the joints between concrete components, particular care shall be taken to ensure that the concrete surfaces are clean and dry.

(xiii) The adjoining vertical ribs of the external panels shall be bolted together with 12.7 mm dia. galvanized steel or stainless steel bolts at 1.2 m centres through preformed or drilled holes for 152 mm thick panels or 20 mm dia. bolts at 1.2 m centres for 203 mm thick panels. Hardwood or shims shall be used as spacers in the vertical joints between panels to maintain the dimensional accuracy of the panels. In addition, at corners of the building, the external longitudinal eaves and gable end walls are, in addition bolted together with 6 mm thick steel angle connectors, located on inside of the building at the top of the walls. Details of some of the different types of wall connections and joints used are shown in Figures.

(xiv) The vertical joints between external wall panels shall be caulked on the outside of the building with one component polyurethane sealant a bitumen impregnated foam plastics backer rod or bond breaker. Alternately, a vertical wall connection shall be used at T-intersections between internal and external wall and at the vertical wall connection between external walls. The internal wall shall be connected to the bolts in the external wall with 12.7 mm dia. galvanized steel hook bolts, nuts and washers. Shims about 10 mm thick shall be placed in the joint before tightening and grouting solid. Internal wall panels shall also be bolted to the horizontal or vertical ribs of external wall panel.

2.3.2 *Roof Construction and Gable Wall*

(i) Triangular wall in-fill panels shall be hoisted into position on hardwood shims on top of the end walls of the building and bolted together through the adjoining outer horizontal ribs with 12.7 mm dia. galvanized steel or stainless steel bolts at 1.2 m centres. The horizontal joint between the gable wall infill panel and the end below shall be grouted solid with sand-cement mortar and sealed externally as described above.

(ii) Precast concrete roof panels which span between the gable ends shall be hoisted into position on the sloping tops of the gable wall panels and bedded in 6 mm thick 4:1 sand: cement mortar, to form a pitched roof. The pitch shall generally be 30°.

(iii) Galvanized steel plates, 60 mm long x 100 mm wide x 10 mm thick, at 2.4 m centres and cast into the ribs on the underside of the roof panels on either side of the ridge, shall be connected at the apex by welding a steel rod at the joint between each pair of plates. The ribs on the underside of the roof panels at gable ends shall then be bolted to the protruding ribs of the gable infill wall panels with 12.7 mm dia. galvanized steel bolts or threaded rods, nuts and washers. Mild steel angle cleats, each 205 mm long x 100 mm wide x 6 mm thick, shall be fixed at 1.2 m centres to the top of the eaves walls with 12.7 mm dia. mild steel threaded rods, nuts and washers.

(iv) Depending on the structural design of the building and span of roof, the roof shall be supported at its apex by a ridge beam spanning between the gable wall infill panels at each end.

(v) The adjoining roof panels shall be bolted together with 12.7 mm dia. galvanized steel or stainless steel bolts at 1.2 m centres, through preformed or drilled holes in the ribs of the panels. Before fully tightening the bolts, butyl rubber rope shall be inserted into the joint between the panels, followed by a bitumen impregnated foam plastics backer rod or bond breaker and the joint shall be caulked externally with one compound polyurethane sealant or equivalent. A reinforced, liquid applied, acrylic or bitumen emulsion waterproofing system (non-woven felt $110 \pm 10\text{gm}^2$) shall be applied in strips over all joints between roof panels, including along ridge of the roof, in strict accordance with the manufacturer's specifications.

(vi) Flat roof shall consist of 152 mm or 203 mm thick precast reinforced ribbed wall panels bolted together and covered with a conventional waterproofing system on screed. Precast roof copings shall be bolted to the roof panels with 12 mm dia. bolts at 1219 mm centers.

(vii) Internal walls on suspended floors shall usually be constructed of timber with 12.5 mm thick gypsum plasterboard cladding on both sides. Conventional burnt clay or concrete masonry internal

walls shall usually be erected on conventional concrete surface beds and foundations. The internal walls shall generally extend to underside of the roof, or to conventional horizontal ceilings fixed to ceiling joists. Alternately, they extend to underside of the floor panels above. Gypsum plasterboard ceilings shall be fixed to underside of the ribs of sloping roof panels with hardened steel nails at 220 mm centers.

(viii) Internal walls shall also be plugged and screwed by means of steel brackets and bolts to the adjacent vertical ribs of the external walls at T-junctions and bolted or plugged and screwed to concrete surface beds or precast floors. Where junctions between internal cross-walls and external walls do not occur at ribs, the space between vertical end rib of the internal wall and the slab backing (skin) of the external walls shall be completely filled with cement mortar. Walls shall be lined internally with 12.7 mm plasterboard sheets, fixed directly to the concrete ribs with glue and hardened steel nails.

The panel erection details are shown in Figs. 6 to 13 of Annex III.

2.3.3 *Windows, Doors, Services and Attachment of Fittings*

Timber or steel window and door frames shall be fitted into preformed openings in the wall panels and sealed all round with silicone sealant, unless they have been cast in during manufacture of the panels. Electrical and plumbing services shall be installed in the preformed notches on inside of the wall panels, or through sleeves cast into the ribs.

The installation of electrical and plumbing services is shown in Figs. 14 to 15 of Annex III.

Sanitary fittings, cupboards, shelving, and other heavy fittings shall be attached to the walls with galvanized steel bolts taken through holes drilled in the backing skin of the wall panels, or with expansion bolts fixed to the panel ribs.

2.3.4 *Protection against corrosion and finishes*

Steel bolts, anchor bolts, nuts, washers, threaded rods, brackets and cleats used at connections and joints in external walls, roofs, floors and foundations are hot-dip galvanized in accordance with IS 4759:1996 and coated with a metal primer, a good quality bituminous paint or epoxy painting or they are of stainless steel. In coastal areas or other aggressive atmospheric environments, these connectors and anchors and the heads of bolts on the outside of the building shall be coated with a good quality metal primer or

bituminous paint before the joints are grouted or the bolt heads are covered with mortar. Alternately, these connectors shall be of stainless steel. All other such steel components used outside of the building shall be either galvanized or coated with a good quality primer or bituminous paint. Before coating, all welds are thoroughly cleaned and brushed.

The exterior surface of roofs and external walls shall be painted with two coats of suitable exterior grade acrylic emulsion paint. Painting of remainder of the building shall be carried out in accordance with the manufacturer's requirements.

2.4 Maintenance Requirements

Maintenance of the external walls is recommended at every 5 to 6 years and would entail recoating with suitable exterior grade emulsion paint. Redecoration internally will depend upon usage, but may be expected at 3 to 5 years. Any corrosion that occurs on exposed metal bolts or other connecting devices should be removed and the bolts etc. recoated with a good quality bituminous paint, metal primer and epoxy.

The strips of waterproofing over joints and along the ridge of precast panel roofs should be recoated approx. 3 to 5 years with a compatible acrylic or bituminous emulsion waterproofing in accordance with the manufacturer's instructions.

The polyurethane sealant used externally in the joints between the concrete components should be inspected periodically and replaced when necessary with a similar compatible sealant.

2.5 Selection & Installation

2.5.1 The user/installer is responsible for proper selection and erection at site as per manufacturer's instructions.

2.5.2 Choosing size and thickness

Appropriate size and thickness of the panels shall be chosen to suit the requirements of the user.

2.6 Skilled /Training needed for installation

Workers shall be trained/ oriented on handling of panel and its erection, support system, clamping system, infilling of reinforcement and concrete etc. with all required safety measures taken including heavy hats, protective shoes etc. PAC holder shall arrange training of workers, as required in this regard.

2.7 **Manuals**

A site Erection Manual shall be provided by the manufacturer for each project incorporating the SRPL Building System.

2.8 **Responsibility**

- Specific design using SRPL Building System is the responsibility of the designer with the instructions, supervision and approval of Shaival Reality Pvt. Ltd.
- Quality of maintenance of the building is the responsibility of the building owner.
- Providing necessary facilities and space for movement of machines and vehicles is the responsibility of the building developer.

PART 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 **Basis OF Assessment**

- 3.1.1 The technical assessment was done as per provisions of the Standards listed in Part 5 of this Certificate.

3.2 **Site Inspections**

Inspection of manufacturing and erection process was done by the TAC members and IOs on the construction of 512 Dwelling units Housing (G+3) at Bharuch Nagarpalika, Bharuch (Gujarat). Firm has got necessary manufacturing machineries and equipment at site as per the process description given for manufacturing and erection of the panels.

3.3 **Usage of the System**

The manufacturer has executed the following projects:

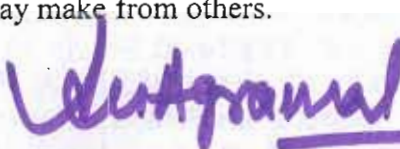
<i>S. No.</i>	<i>Name of Project</i>	<i>Name of Client</i>	<i>No. of Dwelling units</i>	<i>Year of construction</i>
1.	Construction of dwelling units under IHSDP for slums of Anand Nagarpalika	Anand Nagarpalika	464	2013-14
2.	Construction of dwelling units of Dahod Nagarpalika	Dahod Nagarpalika	480	2014-15

PART 4 STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

- 4.1 The certificate holder shall continue to have the product reviewed by BMBA.
- 4.2 The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.
- 4.3 The quality of the product shall be maintained by the certificate holder. Complete testing facilities shall be installed for in-process control.
- 4.4 The product user should install, use and maintain the product in accordance with the provisions in this Certificate.
- 4.5 This certificate does not cover uses of the product outside the scope of this appraisal.
- 4.6 The product is appraised against performance provisions contained in the standards listed in Part-V. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.
- 4.7 Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part V to this Certificate)
- 4.8 The certificate holder agrees to inform BMBA of their clients with details of construction on six monthly basis.
- 4.9 The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.
- 4.10 If at any time during the validity period, PACH is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, PAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.

- 4.11 In granting this Certificate, BMBA takes no position as to:
- The presence or absence of patent or similar rights relating to the product;
 - The legal right of the Certificate holder to market, install or maintain the product;
 - The nature of individual installations of the product, including methods of workmanship.
- 4.12 BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.
- 4.13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.
- 4.14 In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.
- 4.15 The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product.
- 4.16 The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.
- 4.17 The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others.



Dr. Shailesh Kr. Agarwal
Chairman, TAC

Place: New Delhi

Date of issue 16.11.15

Chairman, TAC & Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation (Govt. of India)
Core 5A, 1st Floor, India Habitat Centre, New Delhi
New Delhi-110 003

for and on behalf of

PART 5 LIST OF STANDARDS & CODES USED IN ASSESSMENT

5.1 Standards - These Standards are referred for carrying out particular tests only and do not specify the requirement for the whole product as such.

5.1.1 IS 158:1981 – Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali and heat resisting

5.1.2 IS 456:2000 – Code of Practice for Plain and Reinforced Concrete

5.1.3 IS 875 (Parts 1, 2 & 3):1987 – Code of Practice for Design Load of Buildings and Structures

5.1.4 IS 1363:2002 -- Hexagon Head Bolts, Nuts and Screws of Product

5.1.5 IS 1367:2002 – Technical Supply Conditions for Threaded Steel Fasteners

5.1.6 IS 1786: 2008 – High strength deformed bars and wires for concrete reinforcement

5.1.7 IS 1893(Part 1):2002 – Criteria for Earthquake Resistant Design of Structures

5.1.8 IS 1904:1986 – Code of practice for design and construction of foundations in soils – general requirements

5.1.9 IS 2062:1992 – Hot Rolled Medium and High Tensile Structural Steel

5.1.10 IS 2095 (Part 1):2011 – Specifications for gypsum plasterboards -plain

5.1.11 IS 4326:1993 – Code of Practice for Earthquake Resistant Design and Construction of Buildings

5.1.12 IS 4759:1996 – Hot Dip Zinc Coating on Structural Steel Products

5.1.13 IS 7215:1974 – Tolerances for Fabrication of Steel Structures

5.1.14 IS 9103:1999 – Concrete admixtures

5.1.15 IS 10505: 1983 – Code of practice for construction of floors and roofs using precast concrete waffle units

5.1.16 IS 13920: 1993 – Code of practice for ductile detailing of RCC structures subjected to seismic forces.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **SRPL Building System (Waffle-Crete)** bearing the mark manufactured by M/s Shaival Reality Pvt. Ltd. is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No. 1021-S/2015** is awarded to **M/s Shaival Reality Pvt. Ltd., Ahmedabad.**

The period of validity of this Certificate is as shown on Page 1 of this PAC.
This Certificate consists of pages 1 to 45.



On behalf of BMTPC Board of Agreement Chairman, Technical Assessment Committee (TAC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Poverty Alleviation, Government of India, New Delhi, India

Place: **New Delhi**
Date: **16.11.2015**

PART 6 ABBREVIATIONS

Abbreviations

BMBA	Board of Agreement of BMTPC
BMTPC	Building Materials and Technology Promotion Council
CPWD	Central Public Works Department
ED	Executive Director of BMTPC
IO	Inspecting Officer
MS	Member Secretary of BBA
PAC	Performance Appraisal Certificate
PACH	PAC Holder
PACS	Performance Appraisal Certification Scheme
SQA	Scheme of Quality Assurance
TAC	Technical Assessment Committee (of BMBA)

PERFORMANCE APPRAISAL CERTIFICATION SCHEME - A BRIEF

Building Materials & Technology Promotion Council (BMTPC) was set up by the Government of India as a body under the Ministry of Housing & Urban Poverty Alleviation to serve as an apex body to provide inter-disciplinary platform to promote development and use of innovative building materials and technologies laying special emphasis on sustainable growth, environmental friendliness and protection, use of industrial, agricultural, mining and mineral wastes, cost saving, energy saving etc. without diminishing needs of safety, durability and comfort to the occupants of buildings using newly developed materials and technologies.

During the years government, public and private sector organizations independently or under the aegis of BMTPC have developed several new materials and technologies. With liberalization of the economy several such materials and technologies are being imported.

However, benefits of such developments have not been realized in full measure as understandably the ultimate users are reluctant to put them to full use for want of information and data to enable them to make informed choice.

In order to help the user in this regard and derive the envisaged social and economic benefits the Ministry of Housing & Urban Poverty Alleviation has instituted a scheme called Performance Appraisal Certification Scheme (PACS) under which a Performance Appraisal Certificate (PAC) is issued covering new materials and technologies. PAC provides after due investigation, tests and assessments, amongst other things information to the user to make informed choice.

To make the PACS transparent and authentic it is administered through a Technical Assessment Committee (TAC) and the BMTPC Board of Agreement (BMBA) in which scientific, technological, academic, professional organizations and industry interests are represented.

The Government of India has vested the authority for the operation of the Scheme with BMTPC through Gazette Notification No. 1-16011/5/99 H-II in the Gazette of India No. 49 dated 4th December, 1999.

Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website: www.bmtpc.org

ANNEX I
(Clause 1.10.2)

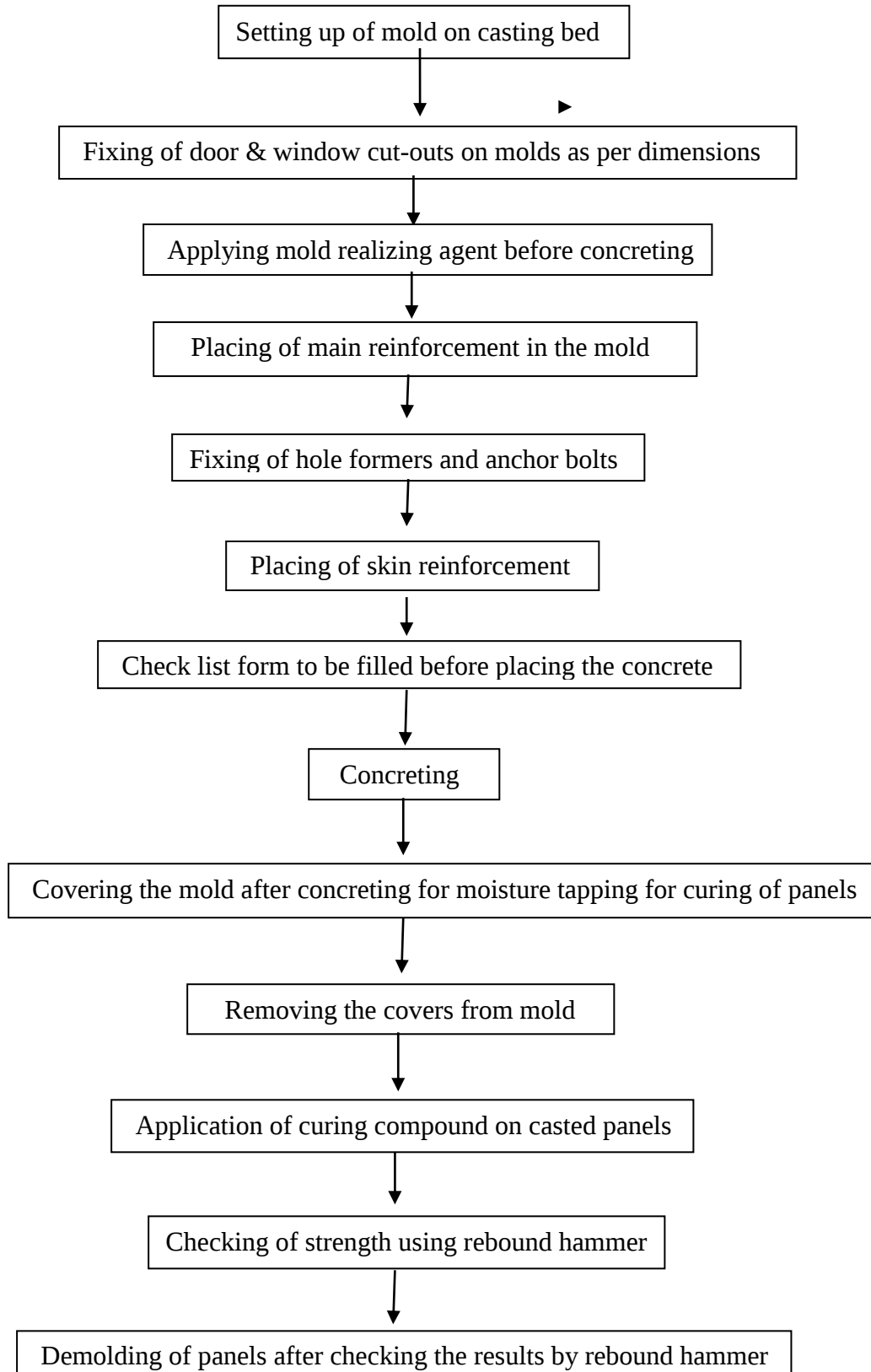
QUALITY ASSURANCE PLAN FOR SRPL BUILDING SYSTEM (WAFFLE-CRETE)

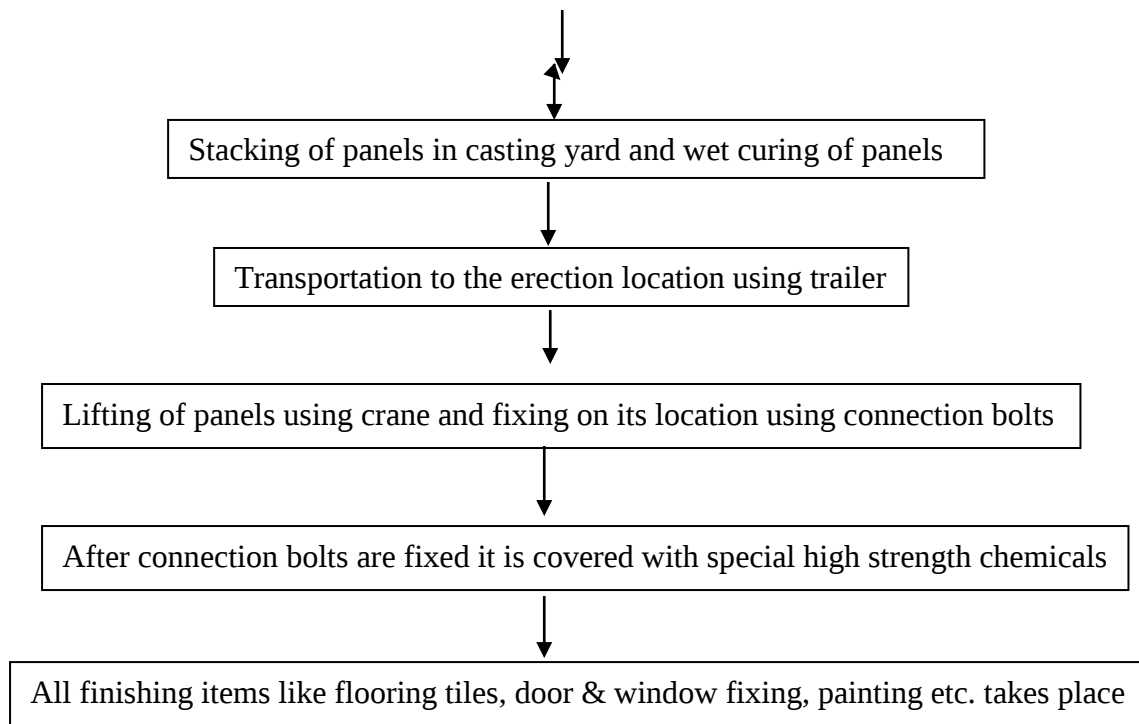
S.No	Description	Test required	Result required	Frequency of Testing
I. Cement				
1.	Setting time i) Initial ii) Final	50 --100 tonne – 2 100-200 tonne – 3 201-300 tonne – 4 301-500 tonne –5 501-800 tonne --6 801-1300 tonne -7	Not less than 30 minutes Not greater than 600 minutes	50 --100 tonne – 2 100-200 tonne – 3 201-300 tonne – 4 301-500 tonne –5 501-800 tonne --6 801-1300 tonne -7
2.	Fineness test	1 test per 5 samples	80% content should pass from 0 micron sieve	1 test per 5 samples
3.	Consistency	As per requirement		As per requirement
4.	Fineness test by specific surface	1 test per 5 samples	OPC=235cm/gm PPC+300cm/gm	1 test per 5 samples
5.	Chemical test	1 test per 5 samples	Magnesium Oxide < 6% Sulphur trioxide < 2.75%	1 test per 5 samples
II. Aggregate: Coarse and Fine				
A	Fine Aggregate			
1.	Silt content	1 test per 150 cum (10 kg sample)	Shall not be more than 3%	1 test per 150 cum (10 kg sample)
B.	Coarse Aggregate			
1.	Gradation test	I test per 50 cum	As per IS 2386:1963	2 tests per season
2.	Impact test	I test per 50 cum	As per IS 2386:1963	2 tests per season
3.	Abrasion test	I test per 50 cum	As per IS 2386:1963	2 tests per season
4.	Soundness test	I test per 50 cum	As per IS 2386:1963	2 tests per season
III. Concrete				
1.	Concrete cube strength	Upto 5 cum –1 set 6-15 cum -2 set 16-30 cum - 3 set 31-50 cum - 4 set 51 & above -5 set (for each 50cum or part thereof)	As per IS 456:2000	Upto 5 cum –1 set 6-15 cum -2 set 16-30 cum - 3 set 31-50 cum - 4 set 51 & above -5 set (for each 50cum or part thereof)
2.	Workability	Once per each shift	As per IS 456:2000	Once per each shift
3.	Slump test	Once per each shift	As per IS 456:2000	Once per each shift
4.	Hardened concrete	Cubes 7 & 28 days as directed	As per IS 456:2000	Cubes 7 & 28 days as directed
IV. Water				
1.	Chemical test	Once in a season per source	TDS = 3000mg/lit Sulphates = 500 mg/lit	As per source

			Chlorides = 2000 mg/lit (PCC),1000 mg/lit (RCC) Carbon = 200 mg/lit Non-carbon=3000mg/lit	
V. Steel Fe 500				
1.	Physical test	One per 40 tonnes per diameter	As per IS 1786:1985	One per 40 tonnes per diameter
2.	Chemical test	One per 40 tonnes per diameter	As per IS 1786:1985	One per 40 tonnes per diameter
3.	Corrosion resistance test, if reqd.	One per 40 tonnes per diameter	--	
4.	Manufacturer TC	Consignment		
VI. Bricks				
1.	Efflorescent test	20 bricks out of 2000	As per IS 1077:1992	20 bricks out of 2000
2.	Water absorption test	32 bricks out of 3500	Not greater than 20% of weight	32 bricks out of 3500
3.	Compressive strength	50 bricks out of 50000	Average 35 kg/sqcm	50 bricks out of 50000
VII. Connection Bolts				
1.	M 16x160 mm bolts	As per manufacturer's specifications	U.T.S= 414 N/mm ² min. Elongation = 18% min.	As per ASTM A 307 Gr A
2.	M 16x380 mm bolts		U.T.S= 414 N/mm ² min. Elongation = 18% min.	As per ASTM A 307 Gr A
3.	M 16x310 mm bolts		U.T.S= 414 N/mm ² min. Elongation = 18% min.	As per ASTM A 307 Gr A
VIII. Anchor Bolts				
1.	HIT V M16	3 Anchor bolts per building	4 Tonnes	Pullout test as per manufacturer's specifications
2.	HY 200R Chemical			

ANNEX II
(Clause 1.5)

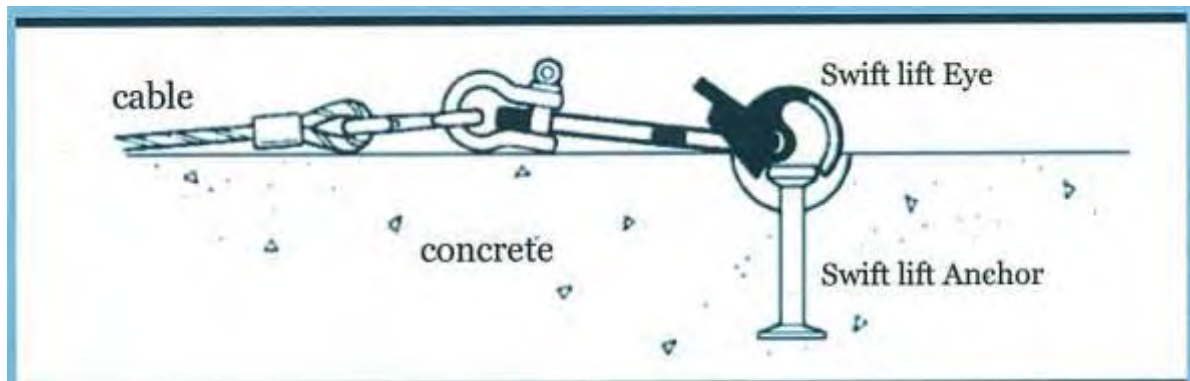
PROCESS FLOW CHART





ANNEX III
(Clause 2.3.2 to 2.3.4)

DRAWINGS



Swift Lift System
Fig. 3

Standard Panel Sizes	
W-12	3.6481m
W-14	4.2576m
W-16	4.8673m
W-18	5.4769m
W-20	6.0865m
W-24	7.3057m
special sizes available	

[illegible]

LONGITUDINAL SECTION

— 12 —

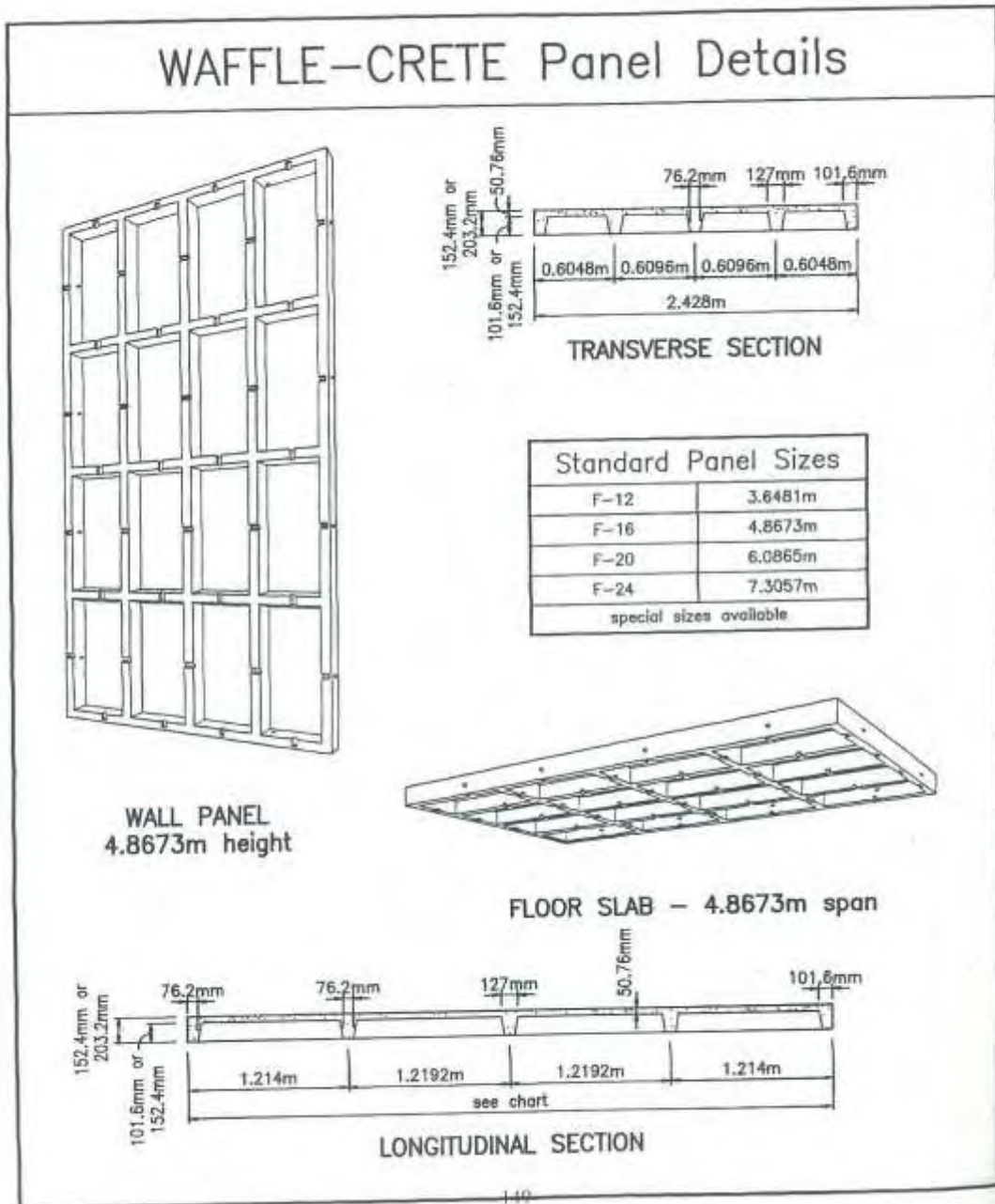


Fig. 5

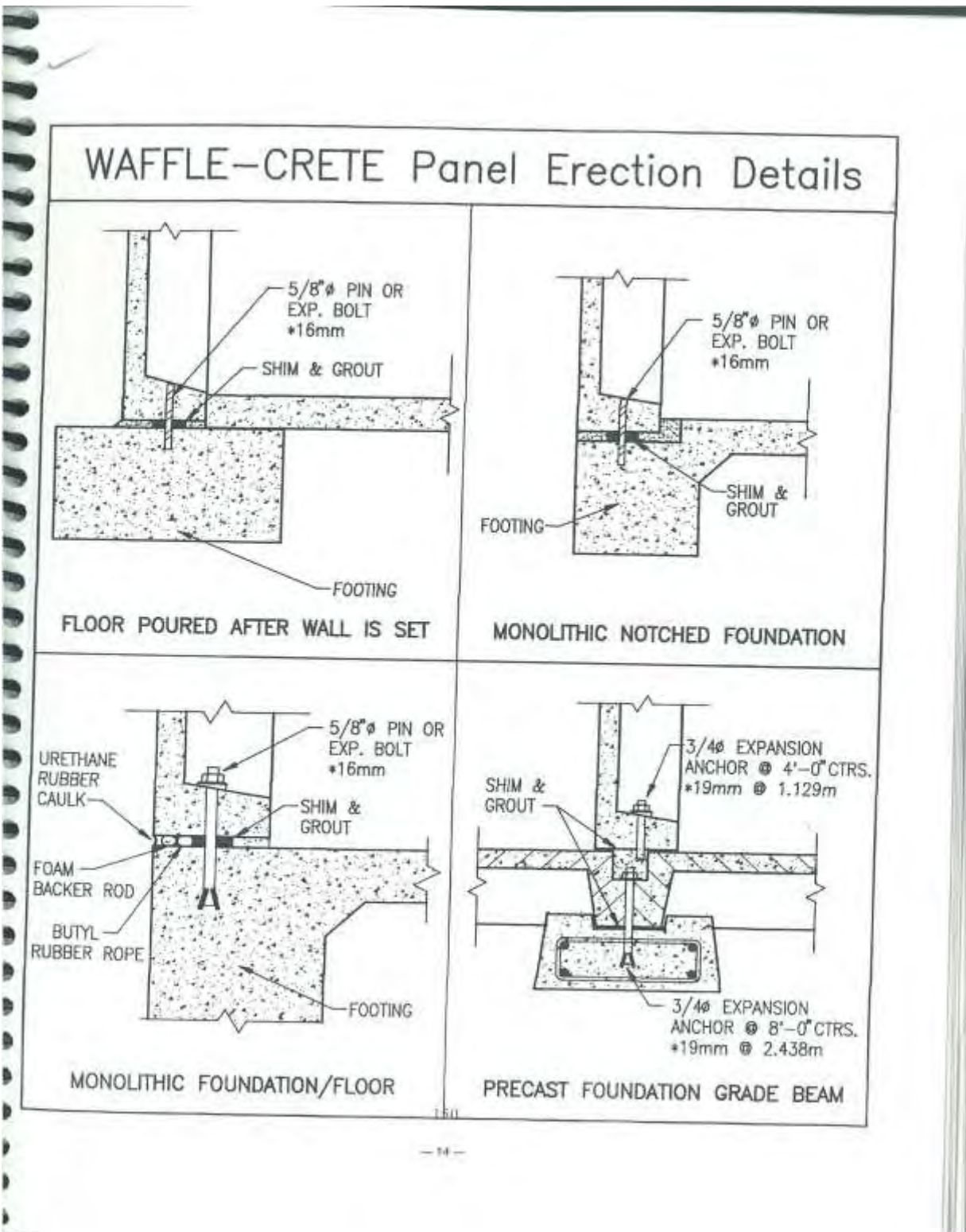
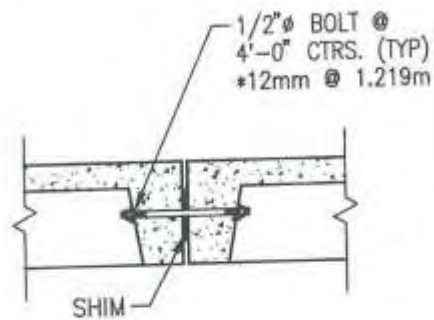
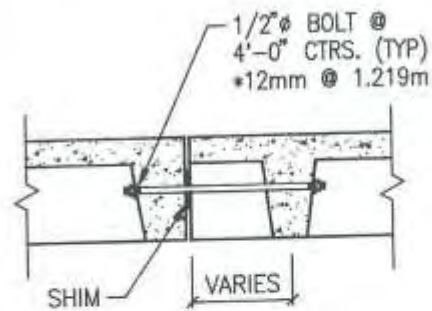


Fig. 6

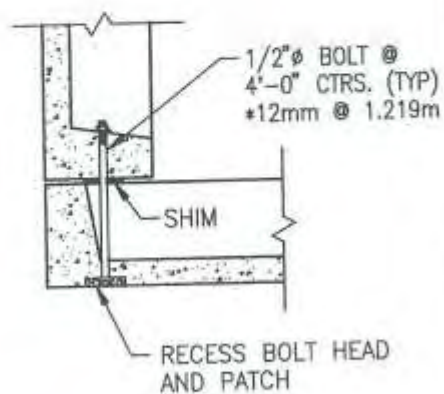
WAFFLE-CRETE Panel Erection Details



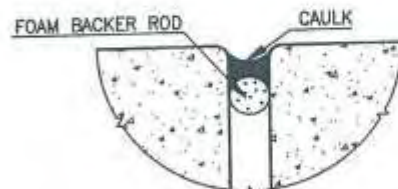
PANEL TO PANEL CONNECTION



PANEL TO PANEL CONNECTION
(WITH PARTIAL PANEL)



CORNER CONNECTION
PLAN VIEW



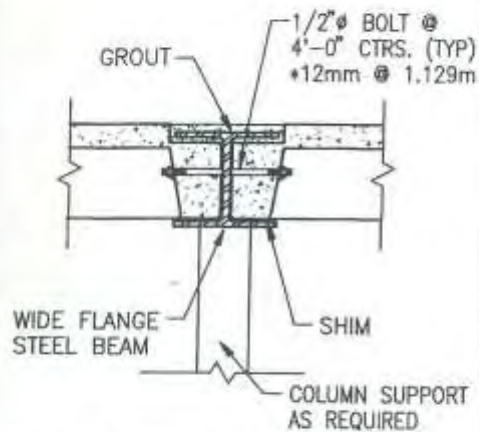
NOTE:

1. Sealant thickness shall be no more than 1/2 the joint width.
2. Concrete shall be clean and dry before caulk is applied.
3. Caulk shall only be bonded on 2 sides. Foam backer rod or other bond breaker shall be used in joint.
4. Caulk shall be applied as per manufacturers recommendations.

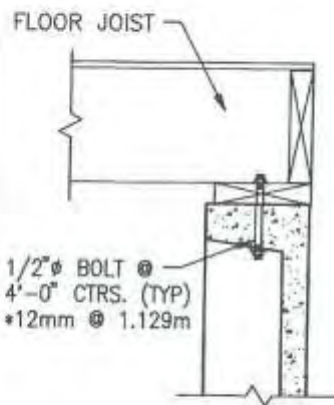
TYPICAL CAULK JOINT

Fig. 7

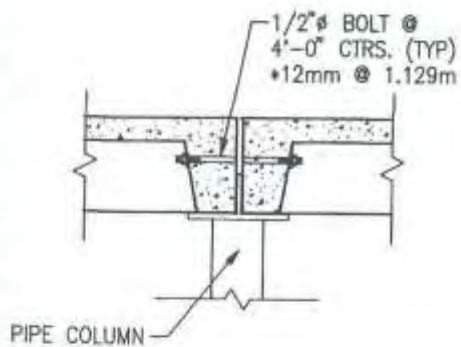
WAFFLE-CRETE Panel Erection Details



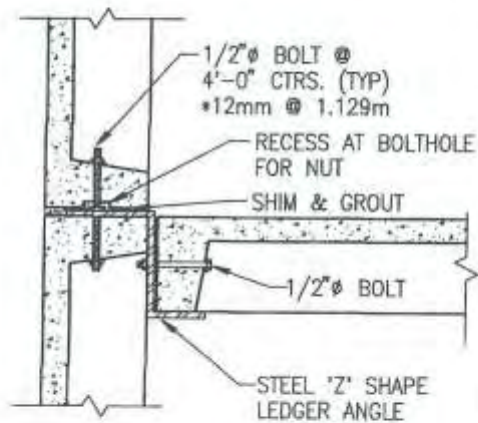
STEEL BEAM FOR FLOOR PANEL FOR OPEN AREAS



WOOD FLOOR TO WALL CONNECTION



COLUMN SUPPORTING 2 OR 4 PANELS AT CORNERS



WALL TO FLOOR CONNECTION (OPTIONAL FOR CONCEALED FLOOR)

52

— 18 —

Fig. 8

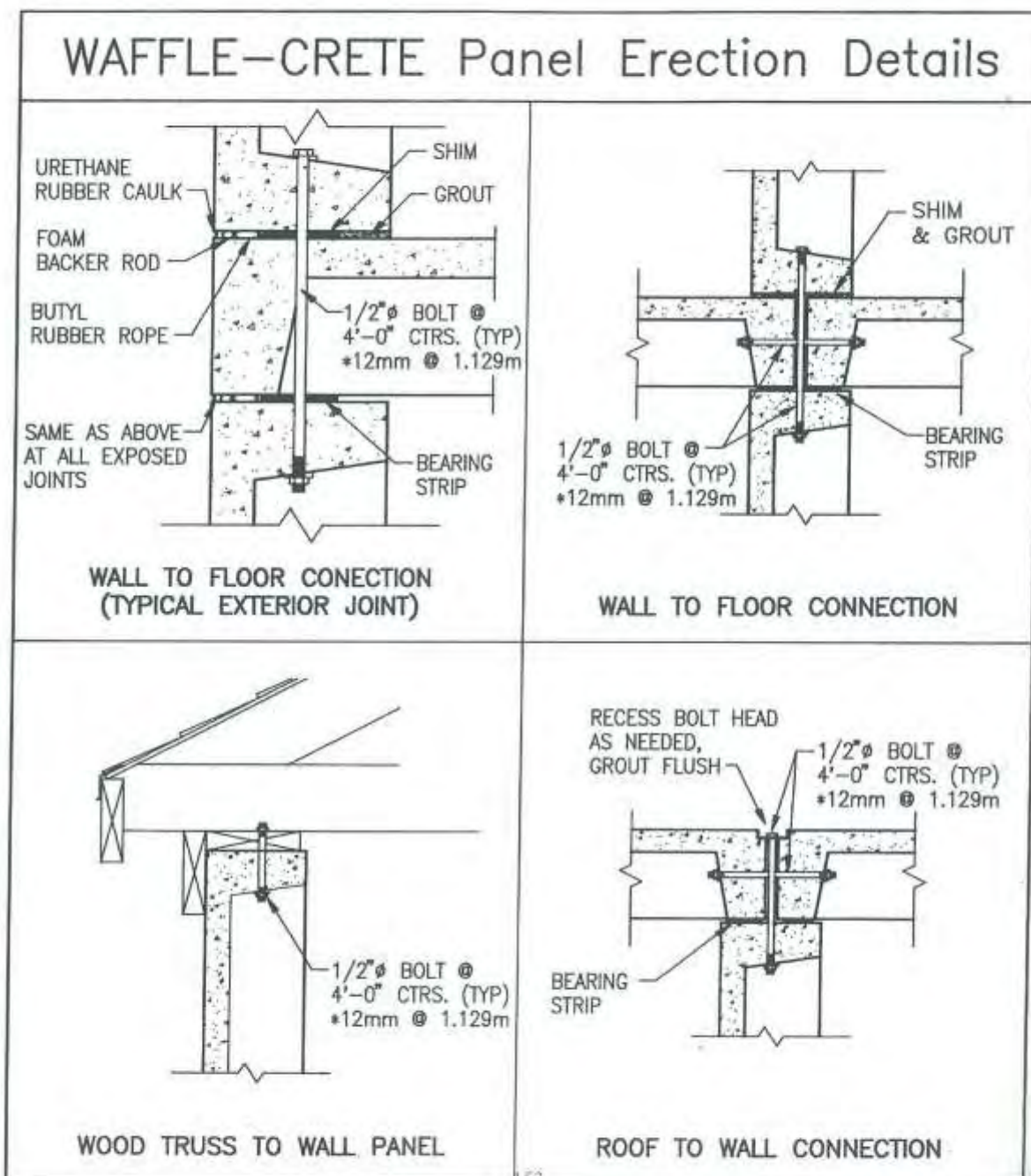


Fig. 9

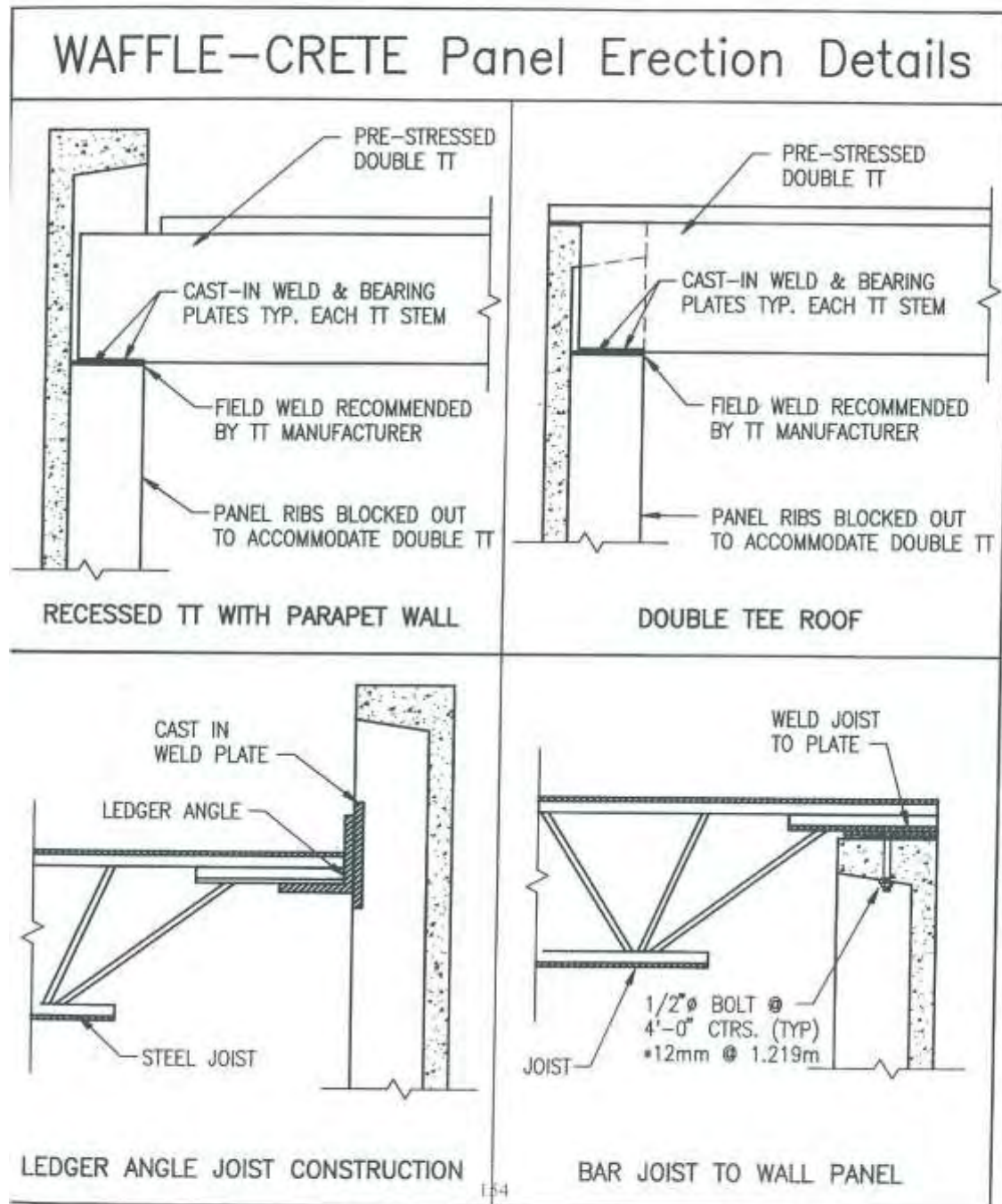


Fig. 10

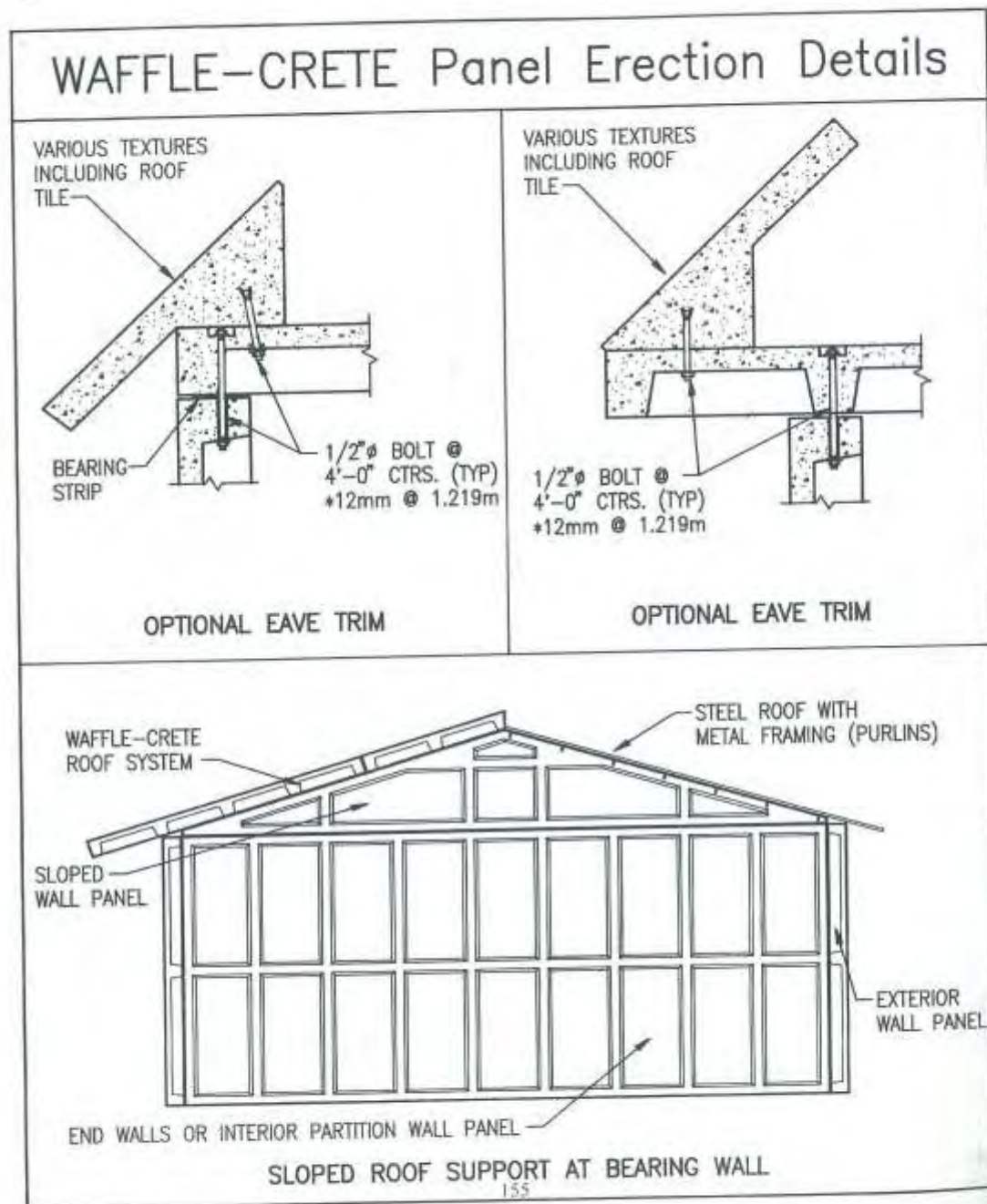


Fig. 11

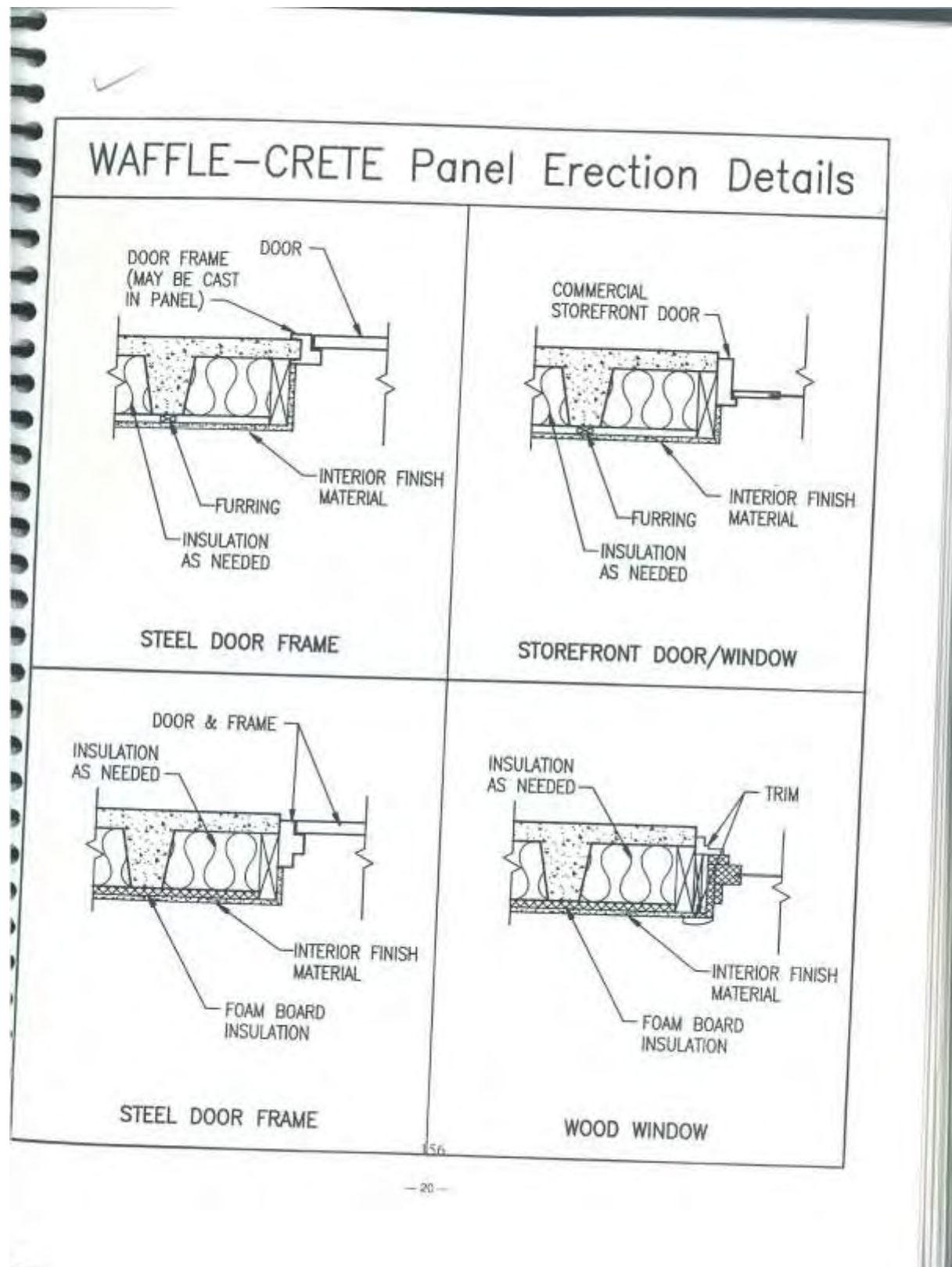
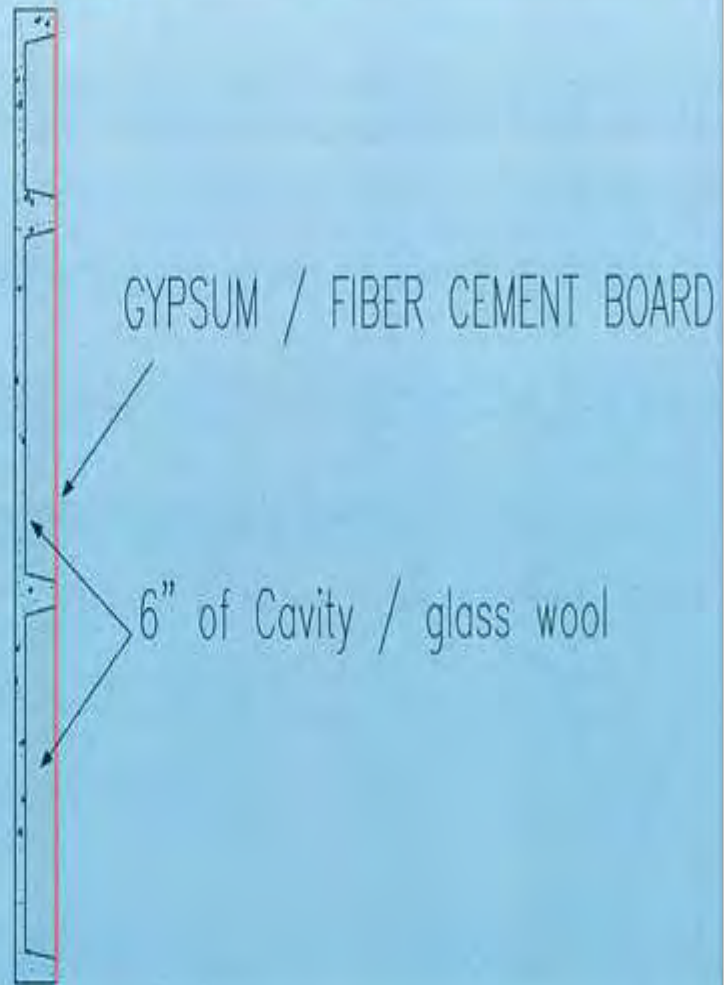


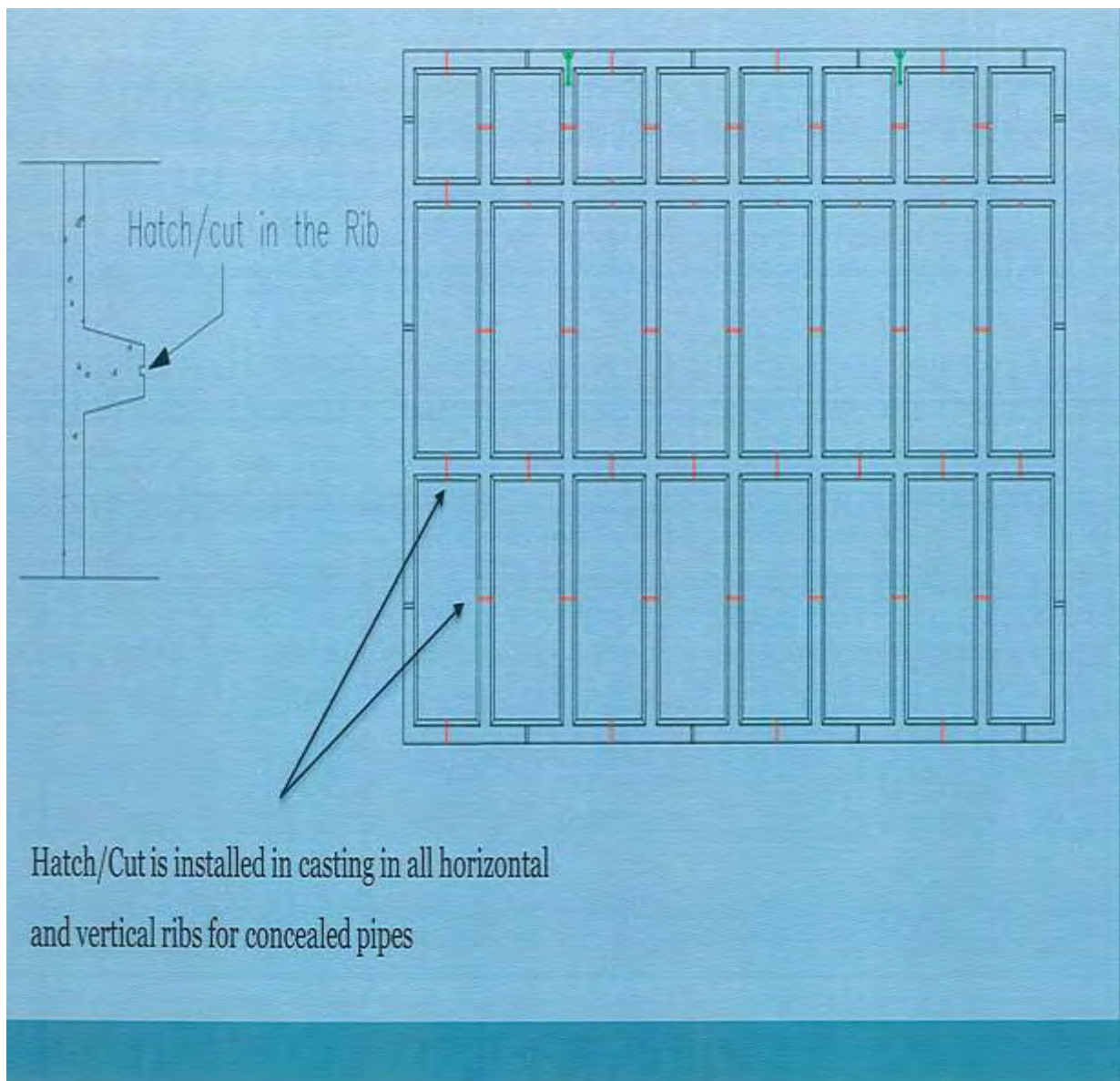
Fig. 12

- The Ribs are covered with sheetrock or fiber cement board with adhesive and can be painted
- Various cladding materials can be used like wood, stone, metal etc. depending on design
- Each panel is designed to have cavity of 6" giving natural insulation
- The cavity can also be filled by glass wool to get further insulation



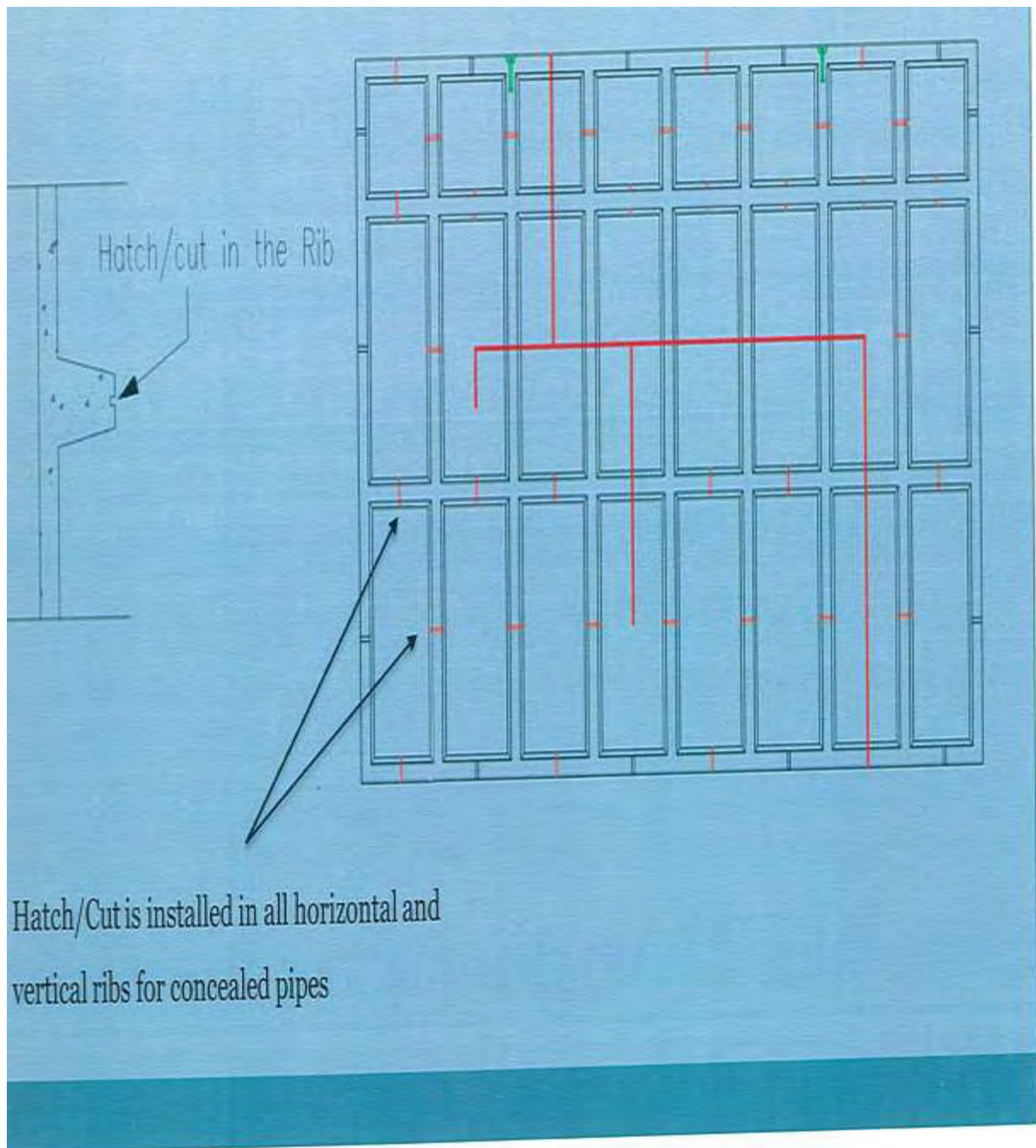
Internal Finishing

Fig. 13



Concealed Electrification & Plumbing

Fig. 14



Concealed Electrification & Plumbing
Fig. 15