



Lost-in-Place Formwork system – Plaswall Panel System (For Structural Applications)

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 FTS Buildtech Pvt. Ltd.
302, Vishakha Arcade, Opp
Courtyard Hotel, Behind
Mogaveeria Bhavan School,
Off Veera Desai Road, Azad Nagar,
Andheri (West), Mumbai - 400058
Tel: 022-26786545

Performance Appraisal
Certificate

PAC No.: **1034-S/2018**
Issue No. **01**

Date of Issue:
12-03-2018



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PERFORMANCE APPRAISAL CERTIFICATE


FOR

**Lost-in-Place Formwork System – Plaswall Panel System
(For Structural Applications)**

ISSUED TO

M/s FTS Buildtech Pvt. Ltd., Mumbai

STATUS OF PAC No.: 1034-S/2018

S. No.	Issue No.	Date of Issue	Date of renewal	Amendment		Valid up to (Date)	Remark	Signature of authorized signatory
				No.	Date			
1.	2.	3.	4.	5.	6.	7.	8.	9.
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CONTENTS

PART 1 CERTIFICATION	3
1.1 Certificate Holder	3
1.2 Description of System.....	3
1.3 Uses & limitations of the System	4
1.4 Basis of Assessment	5
1.5 Manufacturing Machinery & Equipment	6
1.6 Fabrication of Panels.....	6
1.7 Conditions of Certification	7
1.8 Certification	8
PART 2 CERTIFICATE HOLDER'S TECHNICAL SPECIFICATION	8
2.1 General	8
2.2 Specifications for the System	9
2.3 Design parameters	9
2.4 Construction, Installation of Panel & Jointing Procedure.....	10
2.5 Inspection & Testing	18
2.6 Manuals	19
2.7 Skills/ training needed for installation	19
2.8 Warranties provided by the PAC holder	19
2.9 Responsibility	19
PART 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE	20
3.1 Assessment	20
3.2 Tests Performed	20
3.3 Execution of Projects	21
PART 4 STANDARD CONDITIONS	23
PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT	25
CERTIFICATION	27
PART 6 ABBREVIATIONS	28
PERFORMANCE APPRAISAL CERTIFICATION SCHEME – A BRIEF	29
ANNEX I QAP	30
ANNEX II Process Flow Chart	31
ANNEX III Panel Accessories	32
ANNEX IV Connection Details	34
ANNEX V Data	39

PART 1 CERTIFICATION

1.1 Certificate Holder: M/s FTS Buildtech Pvt. Ltd
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Off Veera Desai Road, Azad Nagar,
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1.2 Description of System

1.2.1 *Name of the System* – Lost-in-Place Formwork system – Plaswall Panel System (For Structural Applications)

1.2.2 *Brief Description* – Plaswall Panel System is a lost in place formwork, where two fiber cement boards (FCB) of 6mm thickness each and HIMI spacers (High Impact Molded Inserts) bonded between two sheets of FCB in situ are erected to produce straight-to-finish panels. A monolithic structure is then created by filling the entire structure with M20 or higher grade of concrete as per the design. Additional load capacity can be obtained by providing extra reinforcing bars and/or by increasing grade of the concrete. The firm imports the fibre cement board (FCB) manufactured by Hume Cemboard Industries, Malaysia for use in the construction of structures.

An Isometric View of the Plaswall is shown in Fig. 1 below:

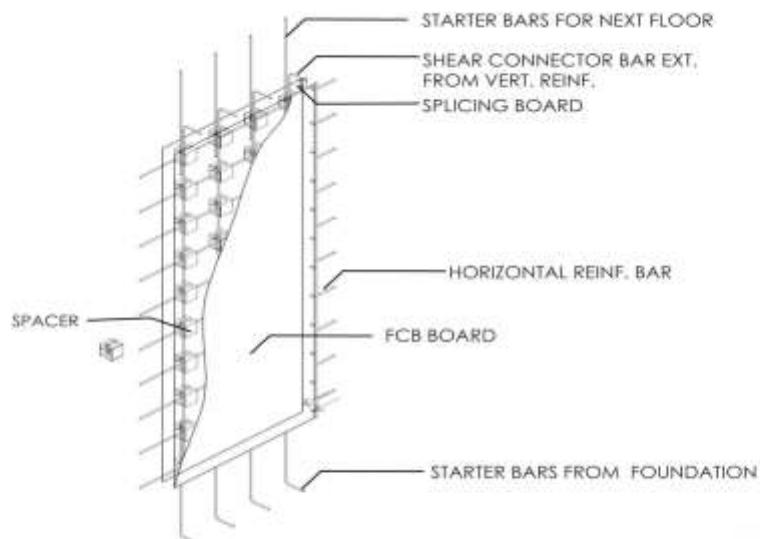


Fig. 1 Isometric View

1.2.3 Size of Panels

1.2.3.1 Size: Panels are normally produced in sizes and dimensions as given below:

Length: 2400mm/3000 mm

Width: 1200 mm

Thickness: 87 mm, 112 mm, 137 mm, 162 mm & 230 mm including two fibre cement boards of 6mm thickness each.

Dimensional sketches are shown in Fig. 2.

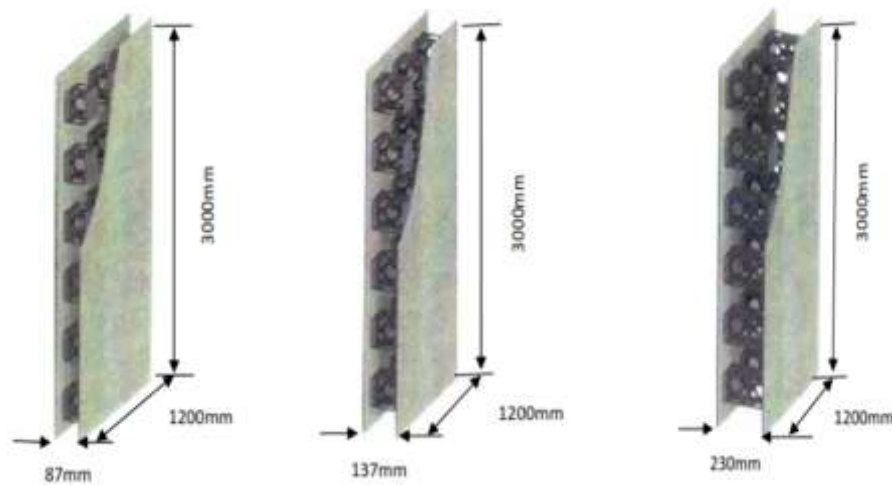


Fig. 2 Dimensional sketches

1.3 Uses, Limitations and Critical details of System

1.3.1 Uses:

Plaswall panels may be used upto G+3 storey residential and commercial buildings, villas, apartments, factories and malls, etc.

1.3.2 Limitations/precautions to be taken for using Plaswall on the basis of performance, safety, geo-climatic Conditions:

- The nail may be hammered directly on the wall by using hammer, however, the hole shall be first drilled by using drill machine and then the plastic sleeves or rawl plugs be inserted for fixing the screws. Screws shall be such which give at least 25 kg holding capacity.
- Chisel shall not be used to chase directly on the wall for embedment of additional services. Instead 100 mm grinder machine shall be used to cut out exact portion of wall and then rendering of the wall be done with mortar and putty.
- If wall tiles are to be changed, walls shall not be hacked for fixing new tiles for bonding. Instead, cementitious tile

adhesive shall be used which will act as bonding agent between the wall and tile instead of mortar.

- Since all the walls are shear walls and load carrying members, the end user must take consent of the contractor/FTS/Structural engineer before demolishing complete wall from the building.

1.4 Basis of Assessment

1.4.1 *Scope of Assessment*

- 1.4.1.1** Scope of assessment included conformance of manufactured panels upto G+3 storey residential and commercial buildings, villas, factories and malls, etc.

1.4.2 *Basis of Assessment*

Assessment of the suitability of the Lost-in-Place Formwork System — Plaswall is based on:

- (i) Evaluation of Structural Design of G+2 storey 30m x 40m Villa Project at Cupertino, Bangalore using Plaswall Technology by IIT Bombay
- (ii) Design of a G+2 storey with Roof Deck Residential Villa Project at Djibouti, Africa.
- (iii) BBA Agreement Certificate No. 16/5380 pertaining to Greenspan Permanent Shuttering Systems on which Plaswall Technology is based.
- (iv) Report on Thermal Transmission Properties of Plaswall (Load bearing walls) by calculation method by Material Lab,
- (v) Small –Scale Fire Resistance Test on a 110mm thick panel by Firelab, Glenstantia, South Africa
- (vi) Testing of Plaswall Panel for Fire Resistance at the Forest Products Research & Development Institute Fire Testing Laboratory, Philippines as per ASTM E152-58.
- (vii) Quality Assurance of Fibre Cement Board, Plastic Spacers, Glue Putty for jointing and foaming agent used in the manufacture of wall panels shall be as per relevant Indian Standards/ specifications of the manufacturers of these products.
- (viii) Assessment of quality assurance procedures implemented for Quality Assurance Scheme followed by the Certificate holder for process control as per Quality Assurance Plan attached at Annex I.

1.5 Production Machinery & Equipment

The manufacturer has installed the following major equipment in the plant in 2011 for production and installation of Plaswall panels, as reported:

Sl.No.	Name of the Machine	Make/Year	Capacity	No.
1	2	3	4	5
1.	Recessing Machine	---	3HP	1
2.	Shearing Machine	Atlas Machine Tool	10HP	1
3.	Injection Molding Machine	K2 Machinery	120Tons	1

1.6 Fabrication of Plaswall Panels

1.6.1 Fibre cement edge recessing

- After cutting fibre cement sheets to the desired dimensions, the edge of the sheets shall be recessed using recessing machine. (Figs. 3 & 4)



Fig. 3 Recessing Machine



Fig. 4 Sheer Recessing

1.6.2 Panel Fabrication

- Plastic pallets and jigs shall be arranged perpendicular to each other
- Fibre sheet shall be laid in alignment with respect to pallet and jig setup
- Marking of spacer with use of specific stencil positions shall be done on the sheet
- Glue @ 250gm min. is the standard consumption. Reusable bottom angles shall be laid as per alignment of walls where panels are to be installed.
- Spacers shall be placed where glue is applied and kept in linear manner for 4 to 5 hours.
- Glue shall be applied on upper faces of spacers and upper

- sheet is laid perfectly in line with lower sheet. (Fig. 5 & 6)
- Ten number of panels shall be fabricated on each side of jig and stacked on pallets. (Fig. 7)
- These panels then shall be cut as per the specified dimensions and sizes such as rectangular, square, curves etc.



Fig. 5



Fig. 6



Fig. 7

1.6.3 *Joint Splicing*

- Joints between two panels shall be fixed by using FCB strips 50 mm wide inside the panel with help of glue, screws and tacking pins. (Figs. 8 & 9)



Fig. 8 Splicing

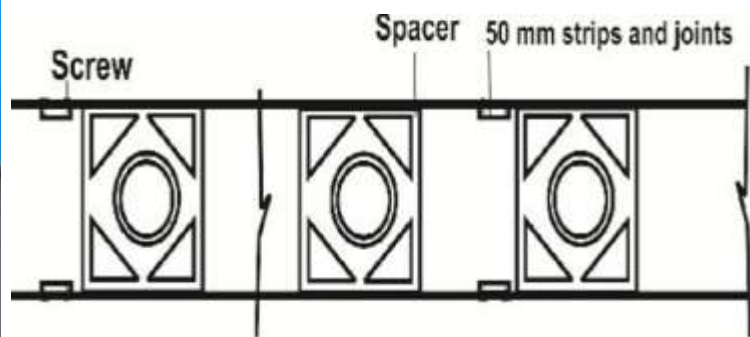


Fig. 9 Tongue and Groove Systems

Process flow chart is shown in Annex II.

1.7 **Conditions of Certifications**

1.7.1 *Technical Conditions*

1. Raw materials and the finished wall panels shall conform to the requirements of the prescribed specifications.

2. FTS Buildtech shall provide full details of manufacture and erection of the panels to the agency who may be engaged for production and construction.
3. The Certificate is being issued after visit to the site and satisfactory test results of the panels from NABL Accredited labs/ Institutes as per Indian conditions and Standards.

1.7.2 *Quality Assurance*

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

1.7.3 *Handling of User Complaints*

1.7.3.1 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.

1.7.3.2 The Certificate holder shall implement the procedure included in the Scheme of Quality Assurance (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.

1.8 **Certification**

1.8.1 On the basis of assessment given in Part 3 of this Certificate & subject to the Conditions of Certification, uses & limitations set out in this Certificate and if selected, installed & maintained as set out in Parts 1 & 2 of this Certificate, the panels covered by this Certificate are fit for use as 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 in accordance with the requirements specified in the relevant Standards. In addition it shall follow the specific requirements of various materials used in the manufacture of these panels. (Part 5)

2.2 **Specifications**

2.2.1 *Raw Materials*

- (i) OPC shall conform to relevant grade of Indian Standard.
- (ii) Sand and aggregate shall conform to IS 383:2016.
- (iii) Reinforcement shall conform to IS 1139:1966.
- (iv) Fibre cement board shall be 100% asbestos free and of Type A, Category 3 min. as stipulated in IS 14862:2000.
- (v) Recycled plastic spacers made of High Impact Molded Inserts shall conform to the specifications of the manufacturer M/s Comfort Plast, Mumbai
- (vi) PU Adhesive Glue shall conform to the specifications of the manufacturer.
- (vii) Foaming Agent shall conform to the specifications of the manufacturer.
- (viii) Putty shall conform to IS 419:1967.

2.3 Design Parameters

- Plaswall Panels shall be produced using fibre cement board, spacers, glue, cement and sand to form walling material.
- All concreting work shall be done in accordance with IS 456:2000 with regard to workmanship and materials.
- Reinforcing steel shall be of Grade Fe 415 or as per client requirement and shall conform to IS 1139:1966. Reinforcement shall be placed according to the specifications, depending on the application and shall be determined by structural calculations performed according to the IS 456:2000.
- M20 or higher grade of concrete as per the design shall be used in foundations, wall and slab construction and mix should be prepared in accordance with Clause 9.2 of IS 456:2000.
- In seismic prone areas requiring seismic resistant construction, relevant provisions of IS 875 (Part 1, 2, 4 & 5):1987, IS 875 (Part 3):2015, IS 1893 (Part 1):2016, IS 4326:2013 and IS 2016 shall apply.
- Foundation shall be specifically designed in accordance with provision given in IS 1904:1986 and taking into consideration the properties and weight of Plaswall Panels.
- In addition, any other requirement regarding safety against earthquake need to be ensured by the designer as per prevailing codal requirements.
- M/s FTS Buildtech shall provide design data for good practices and as ready reckoner for users.
- The system is intended for use where Architectural drawings are available and satisfy the various requirements. The Architect and Engineer designer team of the concerned

developer/owner (client) is responsible for the drawings and overall building design to comply with the various regulatory requirements applicable to the area.

- M/s FTS Buildtech through the use of chartered Engineers will help the builders / developers in proper design and installation of Plaswall Panels in the building for each project.

Typical design details are given at Annex V.

2.4 Construction, Installation and Jointing Procedure of Plaswall

2.4.1 Construction of Various types of Foundation & Footing

2.4.1.1 Determining foundation type as per requirement

Flow Chart of Foundation is shown in Fig. 3

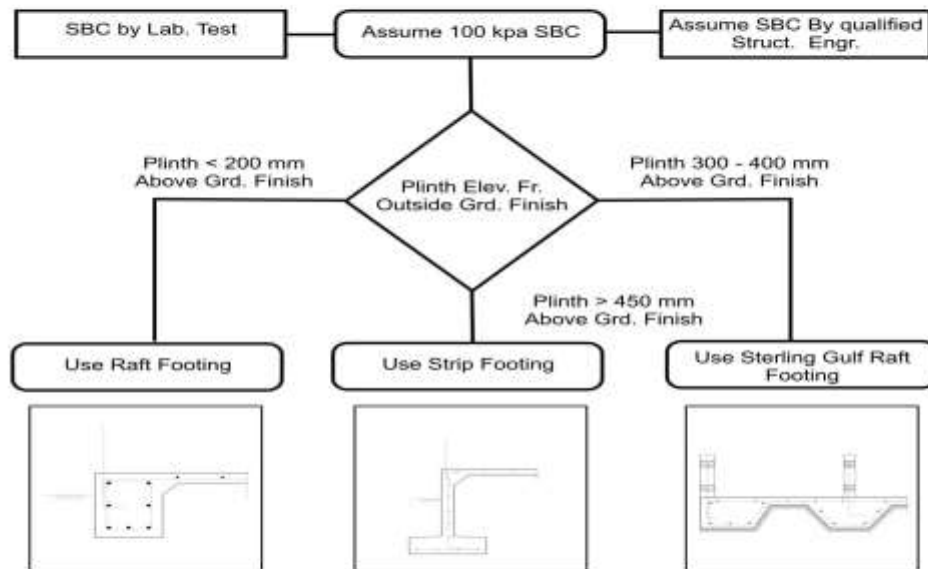


Fig. 3 Flow Chart of Foundation

2.4.1.2 General Guidelines

- Vegetation and top soil including roots, dirt and any degradable material shall be removed to min. depth of 200 mm.
- Actual elevation shall be verified to match with desired plinth level. If no cut-fill is required, excavation shall be carried out as indicated in the foundation plan size and details
- Batter boards and reference marks shall be erected at such places where they will not be disturbed during excavation

- Exact excavation as per dimensions indicated in the plan shall be done.
- If backfill is required, excavation shall be done so as to be on top of undisturbed surface. Suitable non-expansive backfill material shall be provided.
- Compaction shall be done by filling 200 mm layers by using vibro-roller to achieve desired compaction. Backfill shall be done up to plinth level less thickness of slab & 50mm gravel bed.
- If there is soft soil i.e. below 100 KPa safe bearing capacity, it should be removed and replaced with suitable backfill materials
- All electrical and plumbing rough-in pipes & conduits shall be installed. Black-outs or pipe sleeves shall be provided, if necessary.
- Top of shuttering shall be aligned at the perimeter and the pipe guide inside the proposed plinth. Water level hose or transit leveler only shall be used for the purpose.
- Then concrete for grade beams and slab as per the design shall be provided.

2.4.2 *Strip Footing*

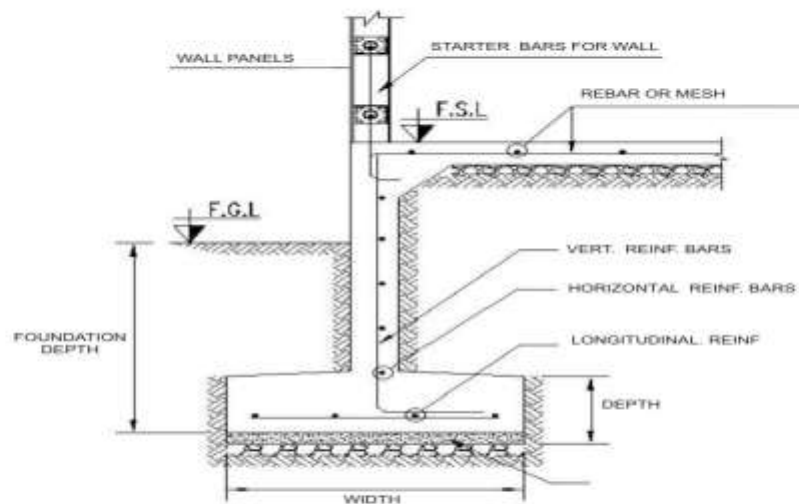


Fig. 4 Typical Strip footing

2.4.3 *Isolated Footing*

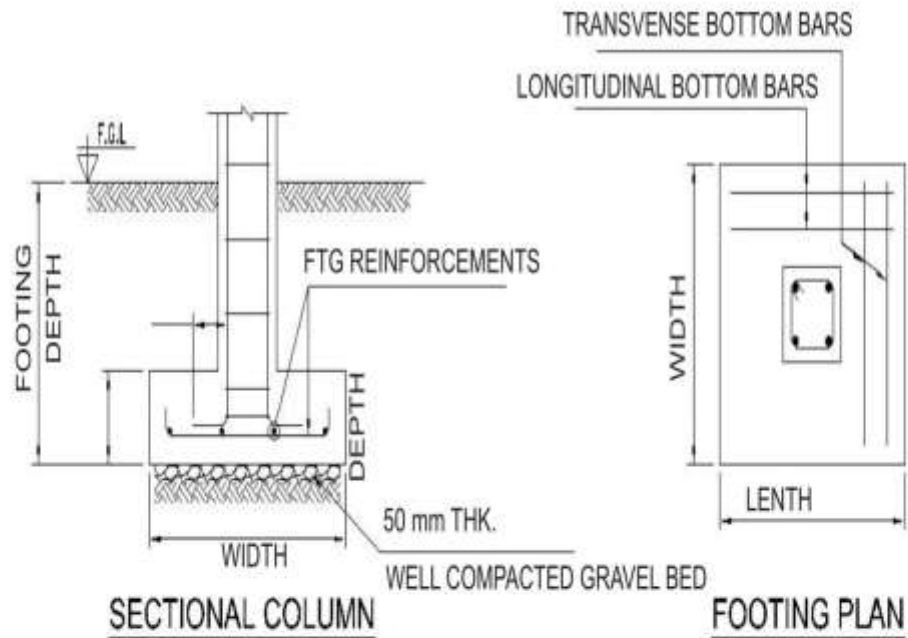


Fig. 5 Typical Isolated Footing & Column

2.4.4 *Raft Footing*

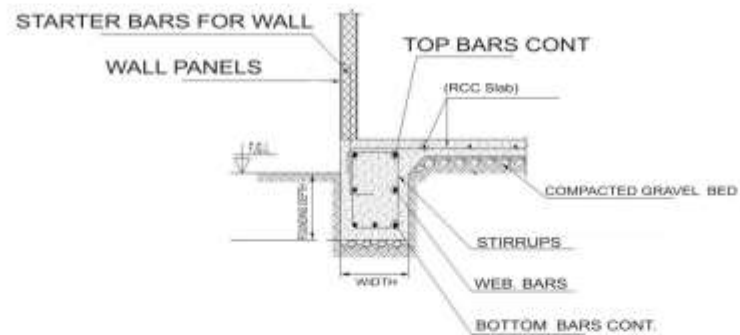


Fig. 6 Typical External Grade Beam

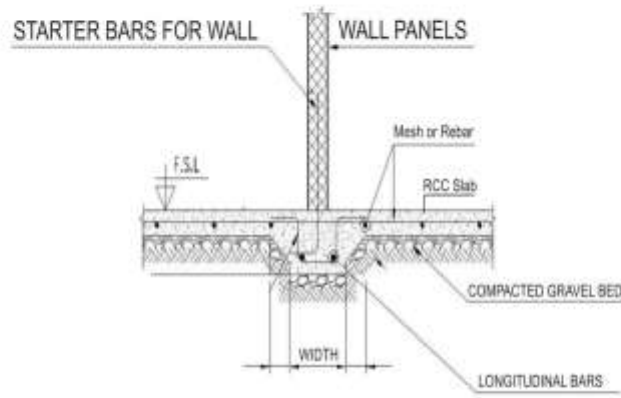


Fig. 7 Typical Internal Grade Beam

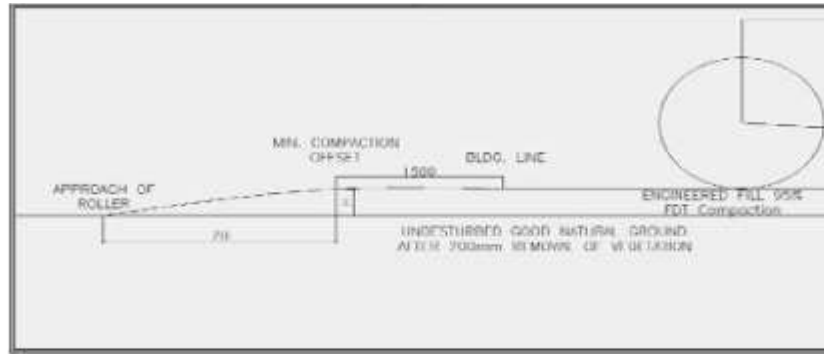


Fig. 8 Backfill, if required

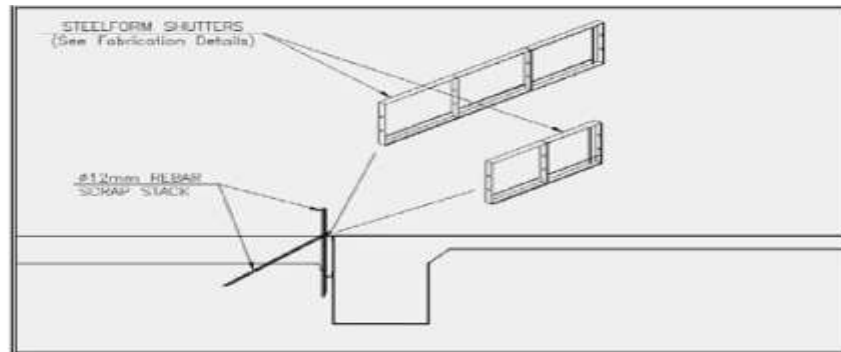
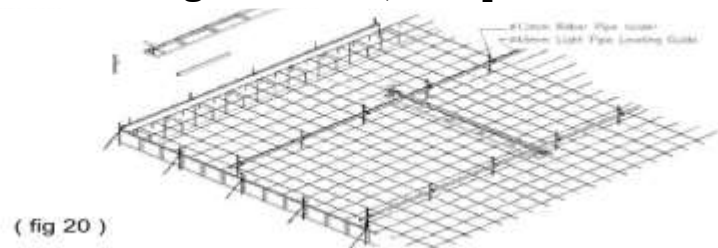
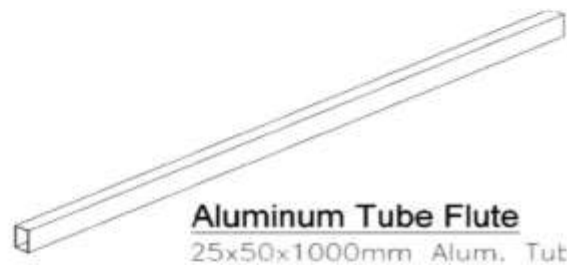
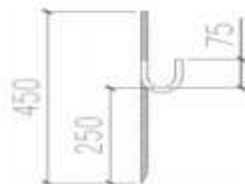


Fig. 9 Backfill, if required



Ø12mm Fabricated Scrap REBAR



Pipe Pin Holder

Fig. 10 Raft Foundation Details

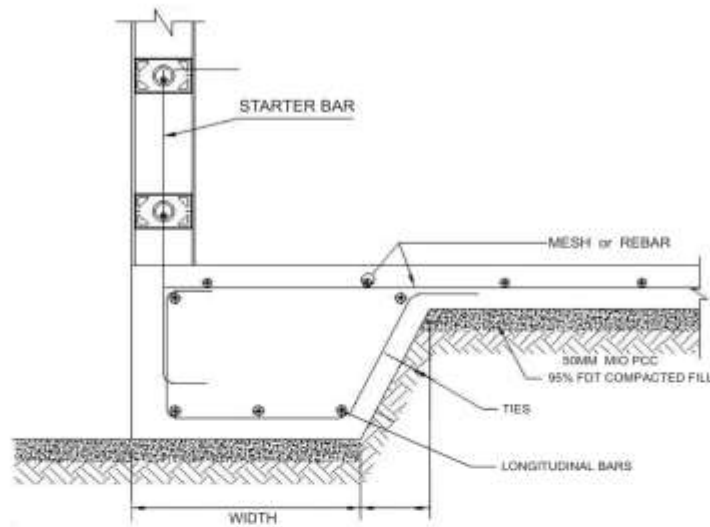


Fig. 11 Typical Raft Footing Edge Beam

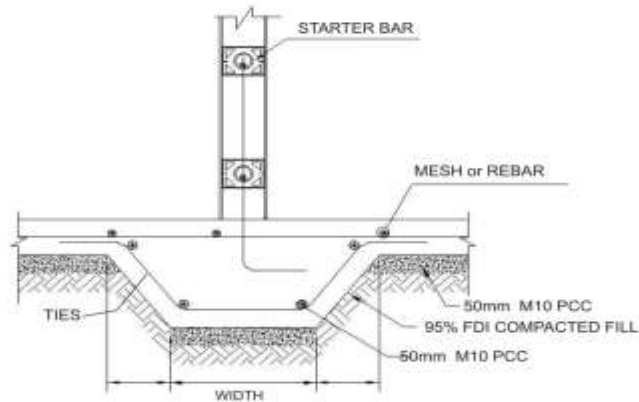


Fig. 12 Typical Raft Footing Internal Beam

2.4.5 Panel Installation

- Flatness of the plinth shall be verified at major corners. If elevation variance is less than 25mm, it should be started from the highest corner elevation. Shims for other panels shall be provided to maintain same wall elevation. If variance is greater than 30 mm, elevation of the plinth shall be corrected or bottom portion of some panels be cut to attain level walls.
- Glue @ 250gm min. is the standard consumption. Reusable bottom angles shall be laid as per alignment of walls where panels are to be installed.
- The first panel shall be placed along the bottom angles directly above the proposed location.
- The panel shall be lifted slightly and then placed along the bottom angles. The panel shall be plumbed at edge and face sides and provide shims, if needed.

- Standard diagonal bracing angle 35x35x2000x3mm shall be provided for alignment stability which should be fixed with 25mm concrete nail on the slab and by FCB screw at side of the wall. Then the alignments shall be rechecked, diagonal bracing adjusted to achieve correct plumpness. (Fig. 13)
- The panel shall be screwed both sides at bottom at 250mm center to center, while glue is still tacky.
- Second panel at other side of the corner shall be installed. Same procedure shall be followed as for the first panel and then go to item no. 2.
- Corner connection details shall be followed as shown in Fig. 14.
- Joinery stud shall be positioned half into the panel end already installed. Glue shall be provided prior to inserting. The same shall be screwed with FCB screw at 250mm center to center, while glue is still tacky. If glue is not available, spacing shall be kept at 200mm center to center.
- Next panel shall be installed following the instructions given from item no. 2 onwards.
- Adjacent next panels shall be continued as per sequence.



Fig. 13 Diagonal bracing

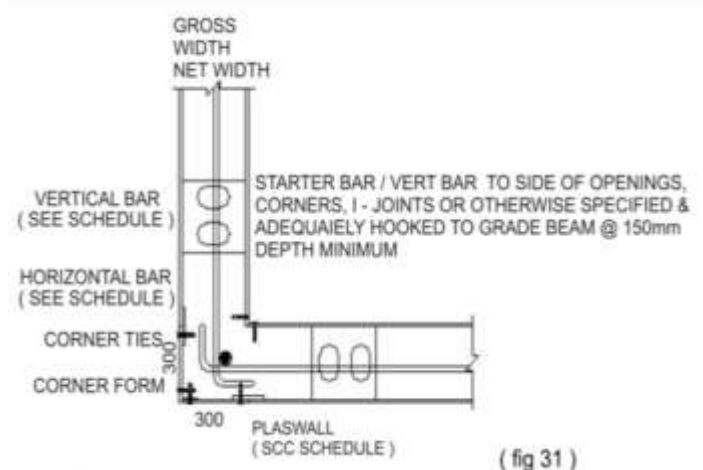


Fig. 14 Corner connection

2.4.6 T-Section

- After installing the primary walls, mark the place where corner will be constructed.
- The joiner stud shall be placed and marked by pencil to have a vertical line reference.
- The joiner stud shall be moved up by 60mm from slab to bottom of joiner stud. The stud hole shall be marked by pencil.

- The marked slots shall be cut by 100mm angle grinder with dry type diamond blade.
- Reinforced dowels shall be prepared, inserted & tied just after screwing the joiner stud corner connection. (Fig 14)
- In case, the holes intersect with panel stud of the primary wall, the portion of primary stud shall be cut to accommodate the marked holes for T-connection. One 12mm vertical bar shall be provided as replacement.
- In case of cross-connection, horizontal bars shall be provided.

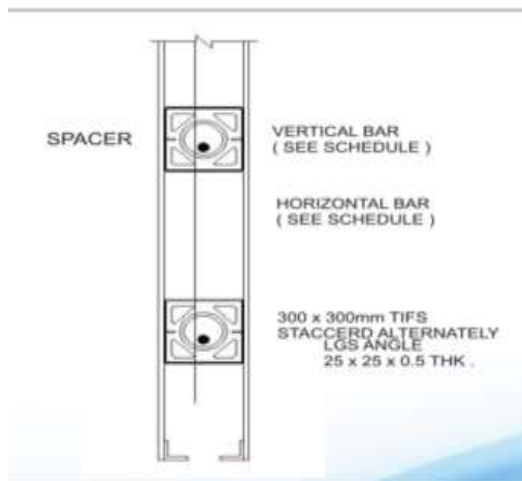


Fig. 15 Nib End Wall Detail



Fig. 16 Door & Window Jambs

2.4.7 *Nib End Wall Detail*

- For nib, end cap shall be provided.
- Glue shall be applied on end cap stud which shall be inserted to correct position and screwed. (Fig. 15)

2.4.8 *Door & Window jambs Installation*

- Light gauge door & window jambs shall be provided for the panels
- Door jambs shall be installed along with the panel. (Fig. 16)
- Window jambs shall be installed (not fixed) as shown in Fig. of Annex 4 to accommodate concrete at window sills. This will eliminate honey-comb and ease pouring of concrete.
- The window sill shall be overflowed by concrete and then push down window frame. The lintel panel shall be screwed to press down the window frame. Spacing of screws shall be the same.

2.4.9 *Embedment of Services*

- After installation of the panels, electrical and plumbing pipes shall be inserted into the panel as per the drawings.

2.4.10 *Placing of Reinforcement*

- Placing of reinforcement shall be of Grade Fe 415 or as per the requirement and shall be as per the structural drawings and IS 456:2000 and IS 1139:1966

2.4.11 *Concreting*

After placing of reinforcement and services in the panel, conventional concrete shall be poured by manually or by Pumping system as per following details:

- For job site, mix of 1: 1.5: 3 ratio by volume shall be used. Otherwise, a sample site mix shall be prepared in accordance with section 9.2 of IS 456:2000.
- Aggregate of max. size 6 to 10mm shall be used.
- Slump should be between 175mm to 200mm.

2.4.11.1 *Pouring of concrete*

- After proper mixing of concrete as per the mix, concrete shall be poured manually into the panel from top of the wall or by cutting slit and attaching chute in the panel. The first pour of concrete should be of 300mm height and after setting, concrete shall be poured up to 800mm as above.
- After setting time of each pour of concrete, keep pouring upto 800mm height and continue till height of the wall.
- Above process shall be followed horizontally for different walls. This will allow setting time of concrete for the previous wall while the next wall is being poured.
- Setting time of concrete shall be min. three hours but during that time other walls shall be poured. Since the project quantum will be big, there will be enough walls available to pour.
- Rubber mallet shall be used for tapping the wall while pouring the concrete to avoid honey comb/segregation.

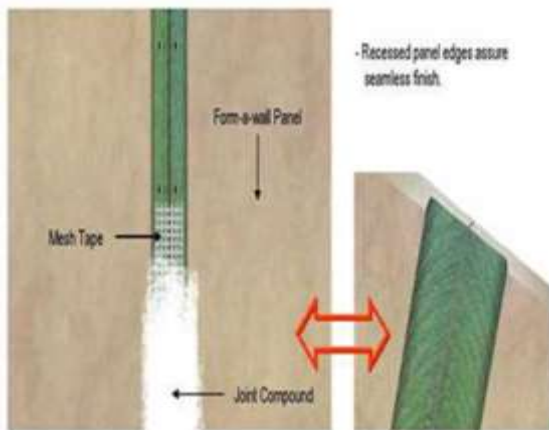


Fig. 17 Joint Treatment Fig. 18 Yellow Putty with Fibre mesh tape

2.4.12 Joint Treatment

- After walls are completely filled and mix dried, joint treatment shall be done using fibre mesh tape and putty.
- One coat of putty shall be applied to close the joint, then second coat shall be applied in order to flush recessed part.
- Mesh tape shall be sandwiched between first & second coats to have a hold over the wall. (See Fig. 17 & 18)

2.4.13 Construction of Slab

- Once construction of panels is completed, slab construction shall be done as per the structural drawings showing wall reinforcement and connection with slab reinforcement.
- Similar process shall be repeated for upper floor.
- After the structure is dried and joint putty applied, finishing process shall be started.

Panel and propping accessories required for manufacture and installation are given in Annex III.

More connection details are given in Annex IV.

2.5 Inspections & Testing

Inspections & testing shall be done at appropriate stages of manufacturing process of all the elements. The inspected panels shall be stored & packed 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.

2.6 Manuals

PAC holder shall provide Construction, Installation and Quality Manuals and showing necessary diagrams, drawings, detailing to the customers and / or their structural designer.

2.7 Skilled/Training Needed for Installation

Skilled labourers like carpenter, masons shall be trained on the system and other unskilled labourers shall be trained in max. 30 days' time by the PAC holder. Training shall be conducted on or off site depending upon the numbers.

2.8 Guarantees/Warranties Provided by the PAC Holder

The FTS Buildtech warrants to the Client and the Architect/client that all materials and equipment furnished under this Contract shall be fit for their intended purpose, unless otherwise specified. All work shall be of good quality, free from faults and defects and in conformance with the Contract Documents. All work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Architect/Client, FTS Buildtech shall furnish satisfactory evidence as to the kind and quality of materials and equipment. Warranties shall become effective on a date established by the FTS and Architect/Client in accordance with the Contract Documents. The FTS Buildtech shall warrant for a period of twelve (12) months that the buildings(s) shall be watertight and leak proof at every point and in every area, except where leaks can be attributed to damage to the building(s) by external forces beyond FTS's control. Structural stability certificate will be provided to the end client.

2.9 Responsibility

- Specific design using Plaswall panels is the responsibility of the designer with the instructions, supervision and guidance of the PAC holder.
- Quality of installation/construction of the system on site is the responsibility of the trade persons engaged by the building owner under the guidance of the manufacturer.
- Quality of maintenance of the building is the responsibility of the building owner under the guidance of the manufacturer.
- 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.

3.1.2 *Inspection of the Panels and Visit to Site*

TAC members and IOs observed the manufacturing process of the panels in detail and the spacers. The process was found to be satisfactory and with minimum training of manpower.

TAC members and IOs also visited the following projects:

- i. 23 G+1 Villas comprising of 1136 panels of 137mm thickness of total area of about 1600 sqm completed at Swami Samarath Nagar, Samantwadi (Mah.)
- ii. 80 G+1 Villas comprising of 3252 panels of 137mm thickness of total area of about 4600 sqm under construction at Yashoda Nagar, Samantwadi (Mah.) The works were generally found to be satisfactory.

3.2 Tests Performed

- 3.2.1**
- (i) Evaluation of Structural Design of G+2 storey 30m x 40m Villa Project at Cupertino, Bangalore using Plaswall Technology by IIT Bombay.
 - (ii) Report on Thermal Transmission Properties of Plaswall (Load bearing walls) by calculation method by Material Lab, Dubai, UAE
 - (iii) Small –Scale Fire Resistance Test on a 110mm thick panel by Firelab, Glenstantia, South Africa
 - (iv) Tests performed on Plaswall Panel for Fire Resistance at the Forest Products Research & Development Institute Fire Testing Laboratory, Philippines as per ASTM E152-58.

3.2.2 Tests performed on samples of spacers i.e. High Impact Moulded Inserts (HIMI) of size 125mm collected by the IO for carrying out the following tests by Central Institute of Plastics Engineering and Technology (CIPET), Ahmedabad:

S.No.	Tests	Test Method	Result Obtained
1.	Density	ASTM D792	1.08 gm/cc
2.	Melt Flow Index	ASTM D1238	15.0 gm/10min
3.	Tensile Strength	ASTM D638	261 Kg/cm ²

4.	Flexural Modulus	ASTM D790	9781 Kg/cm ²
5.	Notch Izod Impact	ASTM D256	J/m

3.2.3 Tests performed on samples of Fibre Cement Board collected by the IO for carrying out the following tests by Deptt. of Earth Sciences, Indian Institute of Technology Bombay:

S.No.	Tests	Test Method	Result Obtained
1.	Apparent Density	IS 14862:2000	1.42 gm/cc
2.	Bending Strength	IS 14862:2000	9.32MPa
3.	Water Permeability	IS 14862:2000	0.16%
4.	Warm Water	IS 14862:2000	0.18
5.	Scale -- Dry	IS 14862:2000	No deposit of water after 24 hours
6.	Heat -- Rain	IS 14862:2000	

3.2.4 Testing of samples of Plaswall Panels of thickness 137mm collected by the IO for carrying out the following tests by Deptt. of Earth Sciences, Indian Institute of Technology Bombay:

S.No.	Tests	Test Method	Result Obtained
1.	Dry Density	IS 15622:2006	1440 kg/m ³
2.	Compressive Strength	IS 15622:2006	16.32 MPa
3.	Water Absorption	IS 15622:2006	5.19%
4.	Thermal Conductivity	IS 15622:2006	0.33 W/mK
5.	Impact Resistance	IS 15622:2006	2.77 MPa
6.	Scratch Resistance	IS 15622:2006	No scratch up to 100N load
7.	Pull Out test	IS 15622:2006	2821 N
8.	Sound Insulation	IS 15622:2006	29 dB for 6hr
9.	Nail Holding capacity	IS 15622:2006	2132 N
10.	Fire Resistance	IS 3809:1979	135 minutes

3.3 Execution of Projects

The manufacturer, as reported, has executed the projects as per the details given below (as reported):

S. No.	Name & location of the Project	Quantity (sqm) approx.	Period of Construction
1.	Construction of Houses at Boisar and a Gallery at Vaisind for Tata Housing, Mumbai	i. Row houses 3 = 675 sqm ii. Sales Gallery = 400 sqm	March, 2011

2.	Construction of Villas at Cupertino, Bangalore for M/s Concorde Group, Bangalore	i.30x40 sq. ft. villa 112 mm = 254 sq m 137mm = 661 sq m ii.30x50 sq. ft. villa 112mm = 264 sq m 137mm= 660 sq m ii.30x60 sq. ft. villa 112mm = 220 sq m 137mm= 428 sq m	April, 2011
3.	Construction of 4 Villas at Goa for M/s Naiknaware Developers, Pune	4 Villas = 1084 sqm	April, 2011
4.	Construction of G+1 Villas at Sawantwadi, Maharashtra for M/s Ranco Reality, Mumbai	23 villas= 1600 sqm, (completed) 80 villas = 4600sqm	October, 2017 Under progress
5.	Construction of Villas & School at Ooty for M/s Ground Reality, Bangalore	i. 4 Villas = 500 sqm ii. School (ongoing) = 200 sqm	August, 2015 onwards

PART 4 STANDARD CONDITIONS

The 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.
- 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 distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.
- 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, TAC 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:

- (a) The presence or absence of patent or similar rights relating to the product;
- (b) The legal right of the Certificate holder to market, install or maintain the product;
- (c) 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.



For and on behalf of
Chairman, TAC & C

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, Lodhi Road,
New Delhi-110 003

Place: New Delhi

Date of issue _____

PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT

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

5.1.1 IS 383:2016 – Specifications for coarse and fine aggregates from natural resources

5.1.2 IS 419:1967 – Specifications for putty

5.1.3 IS 456:2000 – Code of practice for reinforced cement concrete

5.1.4 IS 516:1969– Standard test method for flexural strength of concrete specimens

5.1.5 IS 1139:1966 – Specifications for hot rolled mild steel, medium tensile steel and deformed bars for concrete reinforcement

5.1.6 IS 2185 (Part 1):2003 – Specifications for concrete masonry units—hollow and solid concrete blocks

5.1.7 IS 2380 (Part 14):1977 – Methods of test for wood particle board and other ligno cellulosic materials – screw & nail withdrawal test

5.1.8 IS 3809:1979 – Fire Resistance Test for Structures

5.1.9 IS 3812 (Part 2):2003 – Specifications for fly ash for use as pulverized mixture in cement concrete

5.1.10 IS 8112:2013 – Specifications for 43 grade ordinary Portland cement

5.1.11 IS 13920:2002 – Ductile detailing of reinforced concrete structures

5.1.12 IS 14862:2000 -- Specifications for Fibre Cement Flat Sheets

5.1.13 IS 15622:2006 – Specifications for Pressed Cement Tiles

5.1.14 ASTM C 518-02 – Standard test method for steady state thermal transmission properties by means of heat flow meter apparatus

5.1.15 ASTM C779 – Standard test method for abrasion resistance of horizontal concrete surfaces

5.1.16 ASTM C873 – Standard test method for compression strength of concrete cylinders

5.1.17 ASTM C900 – Standard test method for pullout strength of hardened concrete

5.1.18 ASTM 322:09 – Standard test method for thermal conductivity

5.1.19 ASTM E119 – Standard test method for fire tests of building construction and materials

5.1.20 ASTM E 152-58 – Non-combustibility test for materials and heat emissions from building materials

5.1.21 ASTM E413 – Classification of rating of sound insulation and field transmission class

5.1.22 ASTM E2179 – Standard test method for lab measurement of effectiveness of floor coverings

5.1.23 BS 476 (Part 4):1970 – Fire tests on building materials and structures—Method of test to determine classification of surface spread of flame

5.2 Company Standards of the PAC holder – The branded design & specifications of the raw materials and finished product are as submitted by the manufacturer. The PAC holder has to make available the company standards to the consumers according to which testing have been done.

5.3 References

1. Evaluation of Structural Design of G+2 storey 30m x 40m Villa Project at Cupertino, Bangalore using Plaswall Technology by IIT Bombay.
2. Design of a G+2 storey with Roof Deck Residential Villa Project at Djibouti, Africa by Senior Consultant Engineer
3. BBA Agreement Certificate No. 16/5380 pertaining to Greenspan Permanent Shuttering Systems on which Plaswall Technology is based
4. Report on Thermal Transmission Properties of Plaswall (Load bearing walls) by calculation method by Material Lab, Dubai, UAE
5. Small –Scale Fire Resistance Test on a 110mm thick panel by Firelab, Glenstantia, South Africa
6. Tests performed on Plaswall Panel for Fire Resistance at the Forest Products Research & Development Institute Fire Testing Laboratory, Philippines as per ASTM E152-58.
7. Tests performed on samples of spacers i.e. High Impact Moulded Inserts (HIMI) of size 125mm collected by the IO for carrying out the following tests by Central Institute of Plastics Engineering and Technology (CIPET), Ahmedabad
8. Tests Performed on samples of Fibre Cement Board and Panels by Indian Institute of Technology Bombay, Mumbai

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Lost-in-Place Formwork System-Plaswall Panel System (For Structural Applications)** bearing the mark manufactured by M/s FTS Buildtech Pvt. Ltd. is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No. 1034-S/2018** is awarded to **M/s FTS Buildtech Pvt. Ltd., Mumbai.**

The period of validity of this Certificate is for a period of two years i.e. from 12-03--2018 to 11-03-2020 as show on Page 1 of this PAC.

This Certificate consists of a cover page and pages 1 to 40.



Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA

Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
C-10, 1st Floor, Indraprastha, New Delhi-110 003



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.

Place: New Delhi

Date:

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

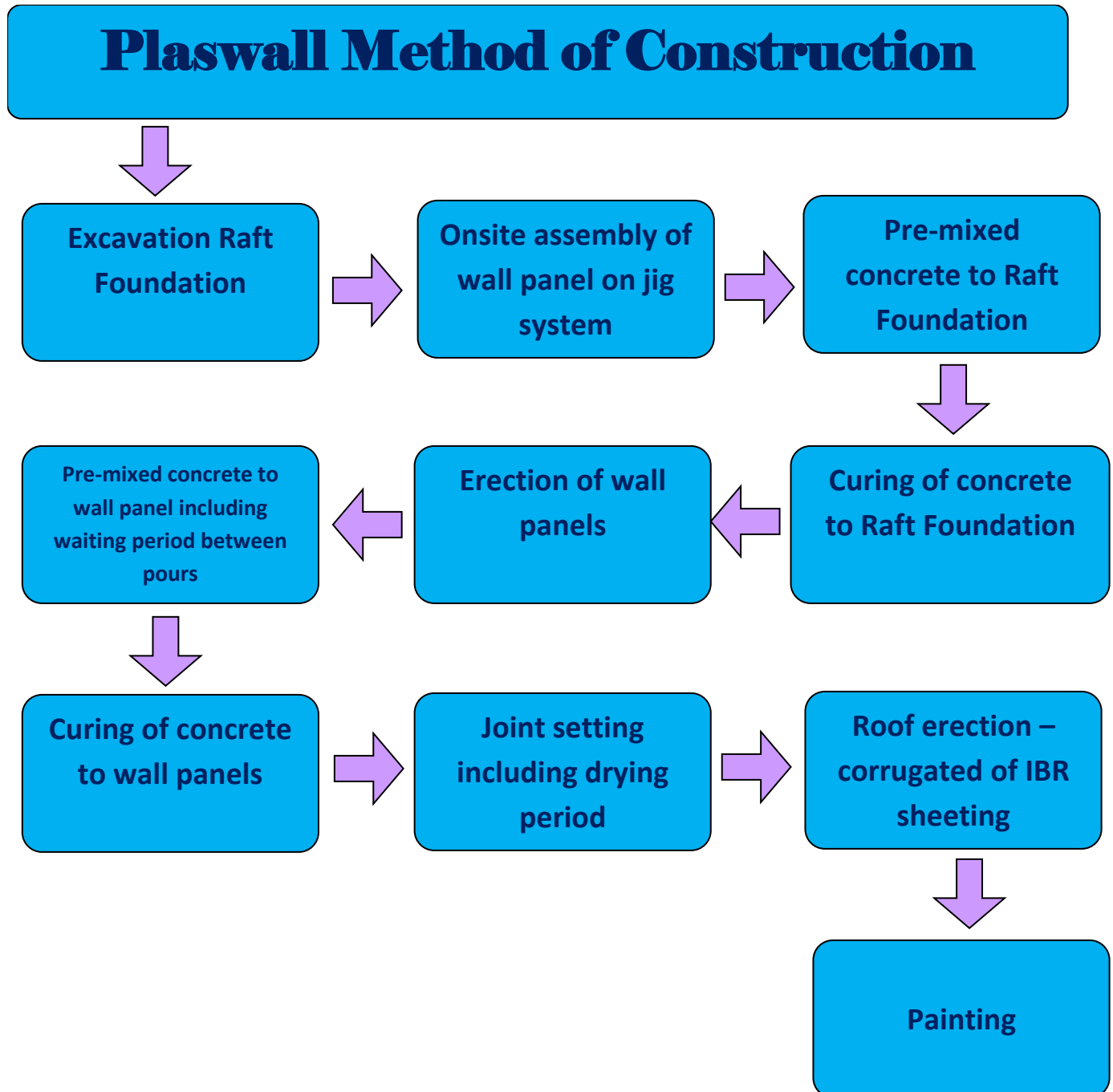
ANNEX I
(Clause 1.4.2)

**QUALITY ASSURANCE PLAN FOR LOST-IN-PLACE FORMWORK SYSTEM –
PLASWALL PANELS**

S. No.	Parameters to be inspected	Requirement Specified	Test Method	Frequency of Testing
I. Raw Materials				
1.	O P Cement 43 Grade	Manufacturer's test report	As per IS 8112: 2013	Every batch/lot
2.	Sand (River & crushed)	As per IS 383:2016	As per IS 383: 2016	Every batch/lot
3.	Fibre Cement Board	Manufacturer's test report	IS 14862:2000	Every batch/lot
4.	Additives and bonding agents	Manufacturer's test report	Manufacturer's specifications	Every batch/lot
5.	PU Adhesive Glue	Manufacturer's test report	Manufacturer's specifications	Every batch/lot
6.	Putty	Manufacturer's test report	As per IS 419:1967	Every batch/lot
II. Plaswall Panels				
1.	Dry Density	1440 kg/m ³	IS 15622:2006	One time or as per requirement
2.	Compressive Strength	16.32 MPa	IS 15622:2006	One time or as per requirement
3.	Water Absorption	5.19%	IS 15622:2006	One time or as per requirement
4.	Thermal Conductivity	0.33 W/mK	IS 15622:2006	One time or as per requirement
5.	Impact Resistance	2.77 MPa	IS 15622:2006	One time or as per requirement
6.	Scratch Resistance	No scratch up to 100N load	IS 15622:2006	One time or as per requirement
7.	Pull Out test	2821 N	IS 15622:2006	One time or as per requirement
8.	Sound Insulation	29 dB for 6hr	IS 15622:2006	One time or as per requirement
9.	Nail Holding capacity	2132 N	IS 15622:2006	One time or as per requirement
10.	Fire Resistance	135 minutes	IS 3809:1979	One time or as per requirement

ANNEX II
(Clause 1.6.3)

*PROCESS FLOW CHART OF LOST-IN-PLACE FORMWORK SYSTEM – PLASWALL
PANELS*



ANNEX III
(Clause 2.4.13)

ACCESSORIES

Panel Accessories

HIMI Spacer :



(fig 2)

SCREW :



(fig 4)

GLUE :



(fig 5)

Template :



Panel Installation Accessories :



Propping Accessories

Standard H-frame sets
Base jacks
U-heads
Cross channel runners
12mm Plywood for services fitting
PVC pipes for sleeves
4" angle grinder w/ abrasive cutting blade

Removal of shoring



(fig 12)

Steel Deck Sample Propping



(fig 11)

Maximum Spacing of Propping

- Maximum props spacing = 1000mm
- Be sure to level the props by strings to avoid excessive floor topping during finishing stage.
- **Never prop the steel deck along the ribs.**

FOR SPAN \leq 4000MM

- After 7 days, retain the center shoring only.
- After 14 days, remove all shoring.
- When pouring the suspended slab at next level, be sure to shore the slab below giving 2 slabs supporting freshly poured concrete except pouring of 1st floor.

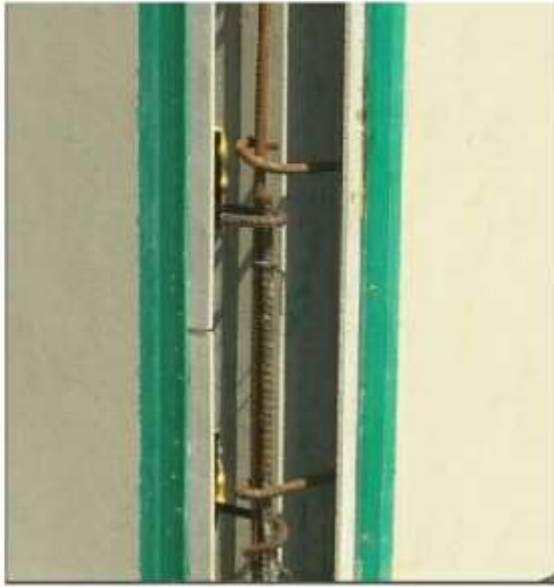
FOR SPAN \leq 6000MM

- After 14 days, retain the center shoring only.
- After 21 days, remove all shoring.
- When pouring the suspended slab at next level, be sure to shore the slab below giving 2 slabs supporting freshly poured concrete except pouring of 1st floor.

ANNEX IV
(Clause 2.4.13)

CONNECTION DETAILS

Deformed Reinforcing Bars

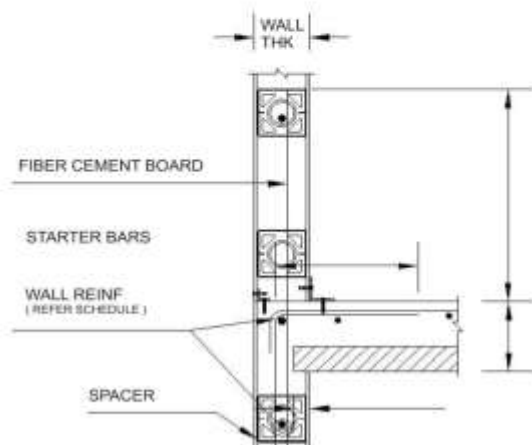


Horizontal & Vertical Reinforcement

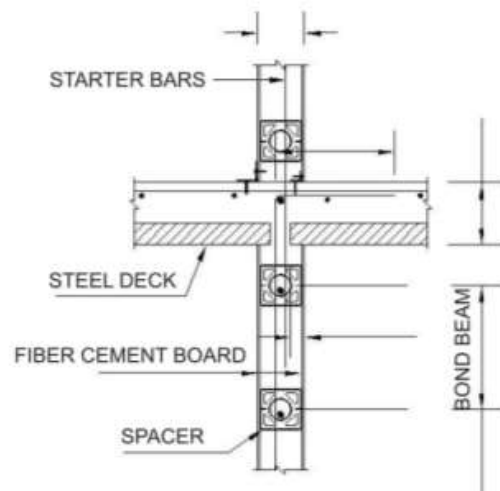


Top View of Plaswall at Corner Junction

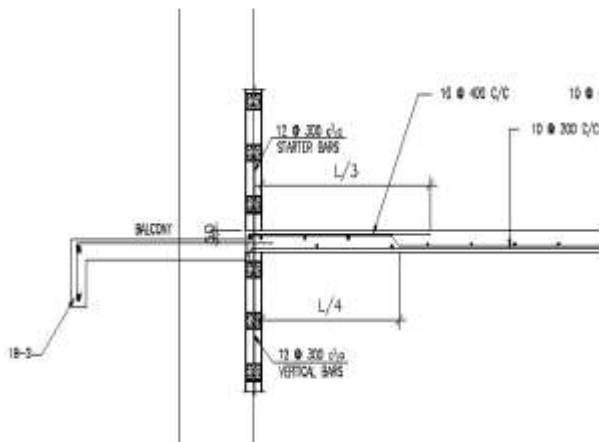
Slab Connection Details



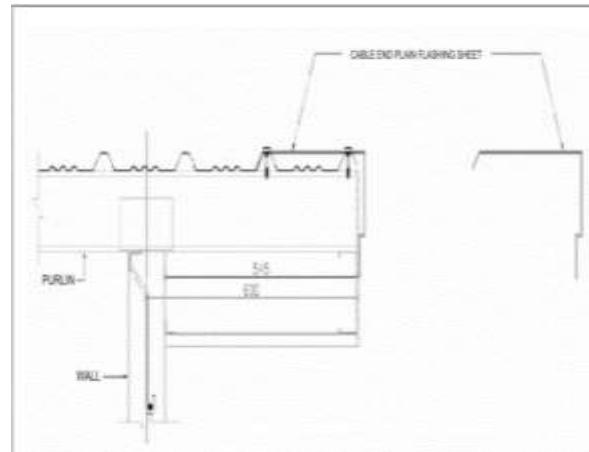
End Wall Slab Detail



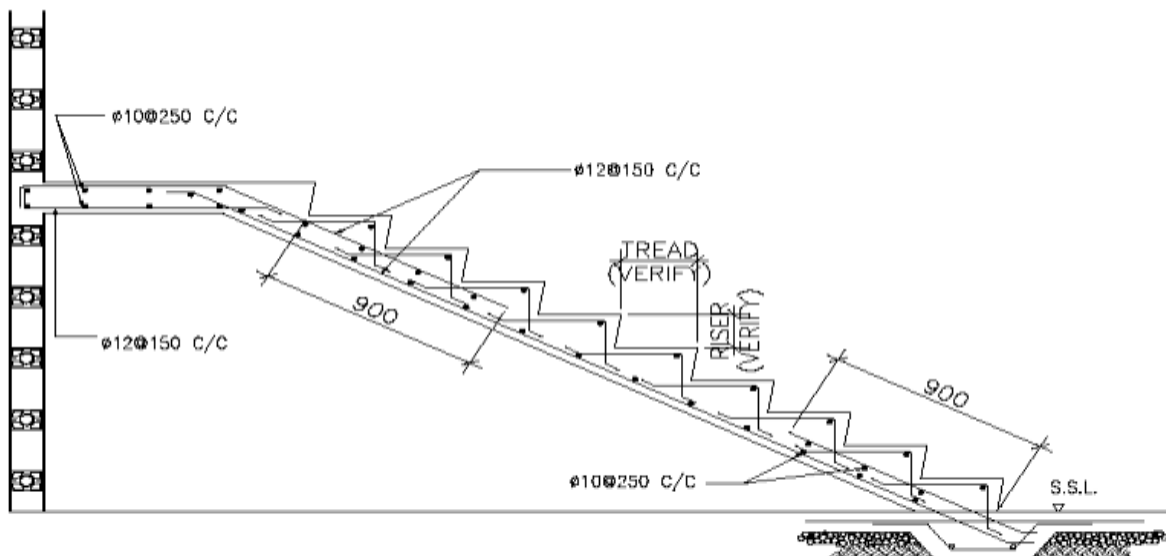
Common Wall Slab Detail



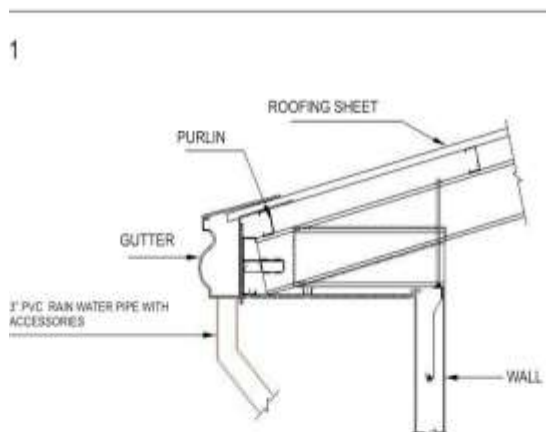
Wall to Slab Connection



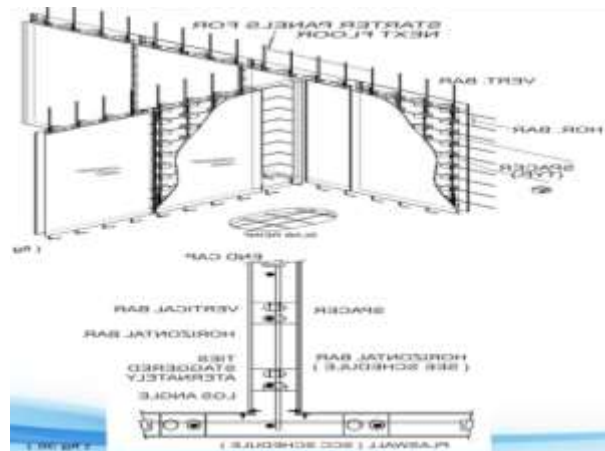
Steel Roof and Plaswall



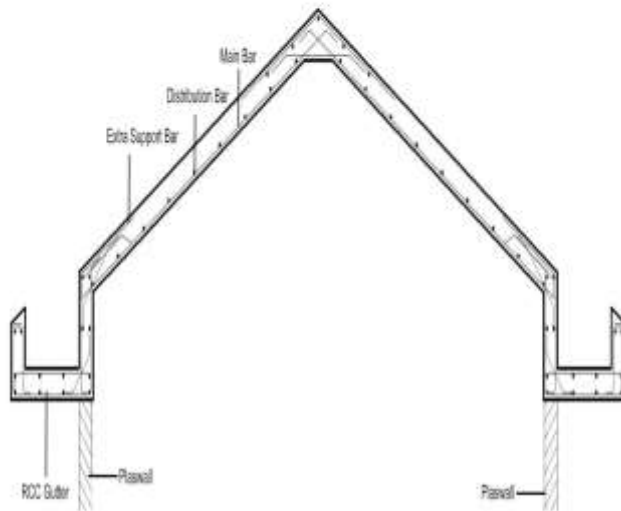
Typical Staircase Detail



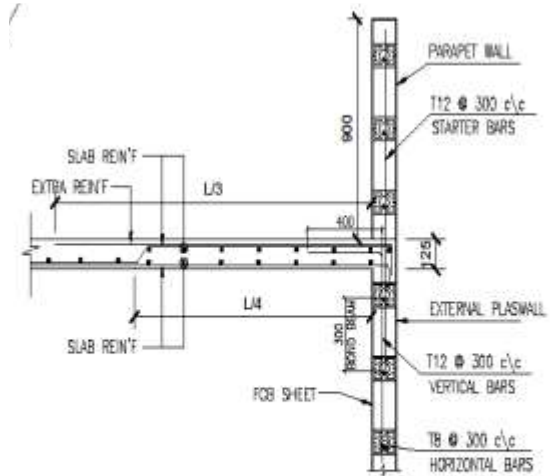
Sloping Truss and Plaswall



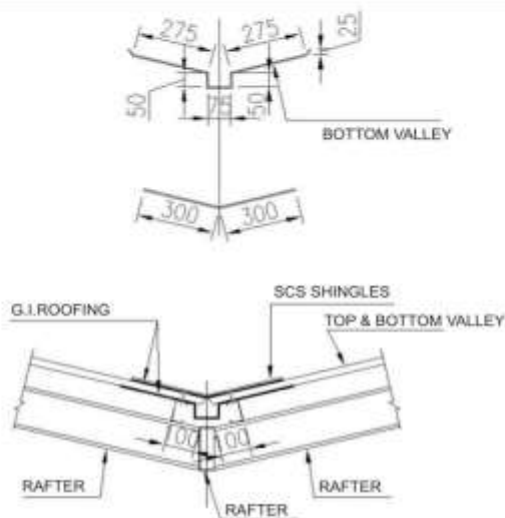
Starter Panels for Next Floor



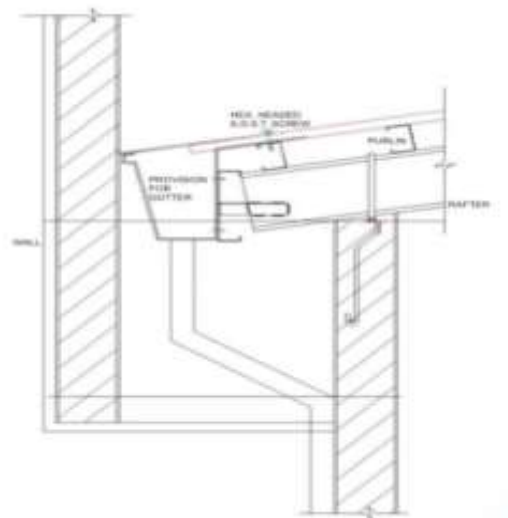
Sloping Slab Detail with Plaswall



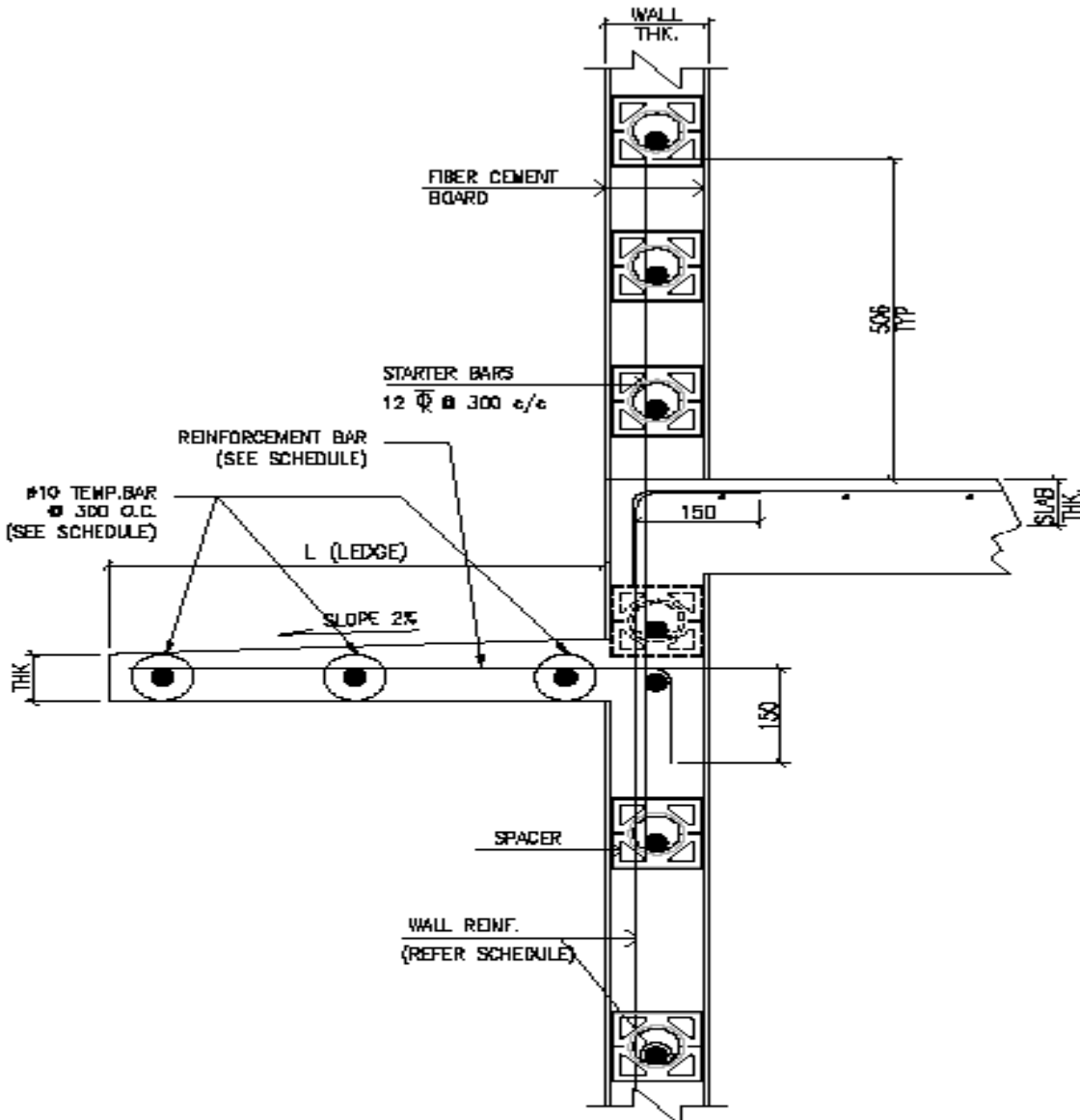
Typical Parapet Detail



Typical Valley Gutter



Typical Inside Gutter

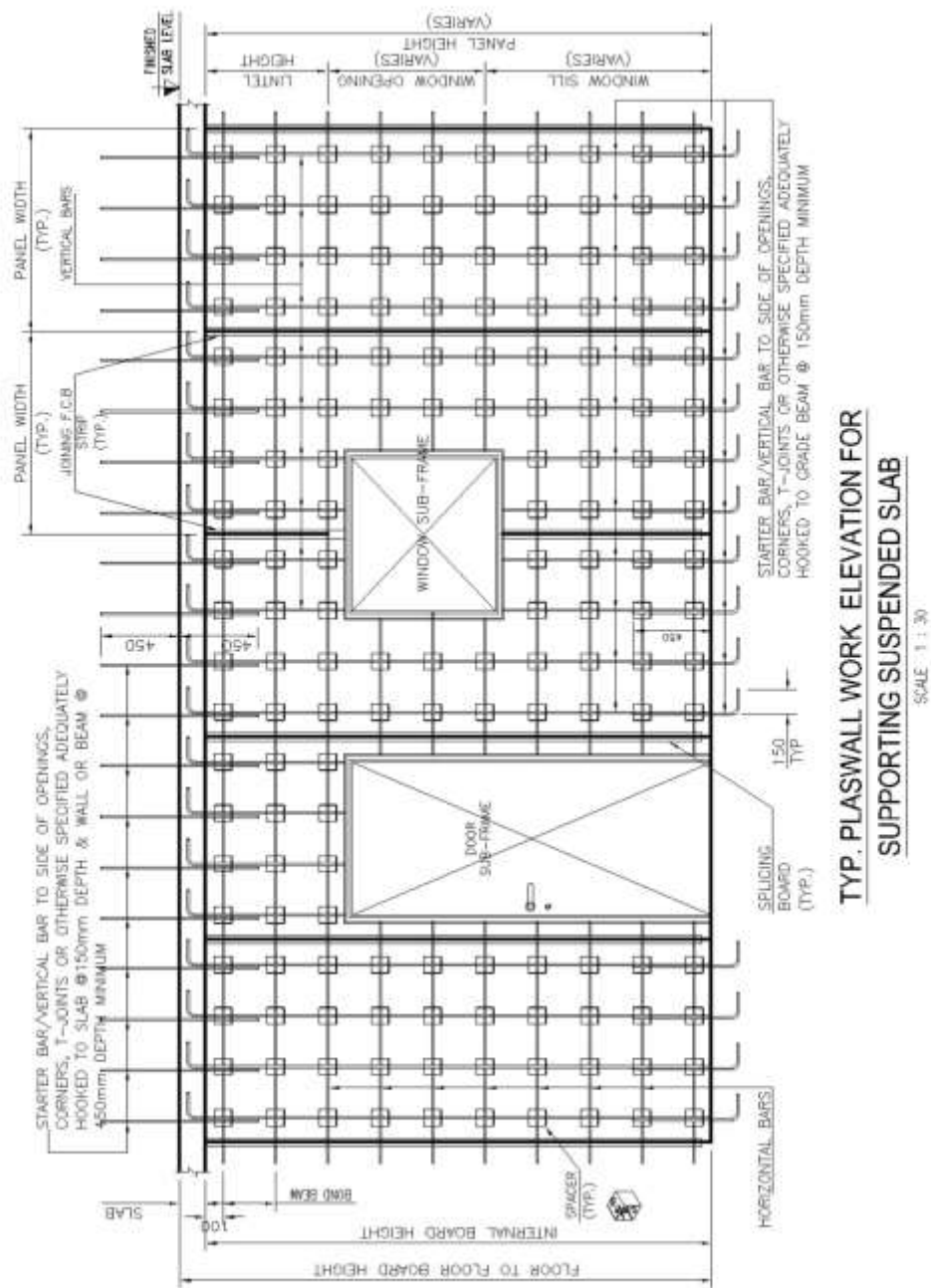


7 LEDGE DET.
S-4 NOT TO SCALE

SCHED. OF LEDGE REINF.

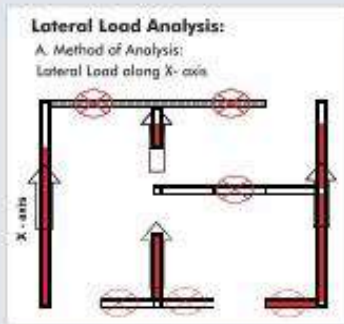
LEDGE LENGTH (L)	LEDGE THK-min. (mm)	TOP BAR REINFORCEMENT	TEMPERATURE BAR
800	75	Φ 10 @ 200mm	Φ 10 @ 300mm

Chajja Details



**TYP. PLASWALL WORK ELEVATION FOR
SUPPORTING SUSPENDED SLAB**

Typical Elevation for supporting suspended Slab including Door & Window



Lateral Load along X- axis.

- Lateral load for shear walls are those parallel to the direction of lateral load being considered. All transverse walls, perpendicular to the direction of lateral load being considered are neglected.
- All openings are considered voids. Only net wall length are considered.

Lateral Load along Z-axis:

- The same as the X-axis analysis only reverse the directions.

Design Method:

- G+2 and below structures, by semi manual analysis. Ground floor walls are analyzed as per above method removing door & window lengths. Lintel and sills are ignored and consider as a factor of additional safety.
- G+3 and above, by software model analysis. Openings are considered as void areas. All wall connections from the slab to the wall, where starter bars are located, moments are released along the local transversal direction.

This method will provide lateral loads supported by in-plane wall members only.

- The above methods will transfer all lateral loads in a considered floor to the walls parallel to the considered direction only.

Construction Adaptability to Design method:

- All walls are connected by single layer starter bars from the floor slab system.
- Floor slab is poured first with starter bars required, then shear walls are installed along the starter bars. This default process provides construction joint between the wall and the floor but with starter bars along the wall to transfer continuity of forces. Meaning, pin connection along transversal of the walls is the correct analysis as per applicable construction process.

Plaswall Design Axial Load Capacity

1. Types of Wall Construction:

- 1 FIXED joint above to floor, PINNED joint below to floor slab.
- 2 PINNED joint above to floor, PINNED joint below to floor slab.



Working Formula:

$$P_{uw} = 0.3 (t - 1.2 e - 2 ea) f_{ck}$$

(32.2.5 IS 456 : 2000)

where;

(32.2.2 IS 456 : 2000)

t = thickness of the Shear Wall minimum Case 2
 e = $0.05t$ discontinuous slab above
 $0.05t$ continuous slab above (Center of Wall)

$$ea = H^2 / 2500t$$

(32.2.4 IS 456 :2000)

H_w = unsupported height of the shrestrained against rotation both ends

H = $.75 H_w$ not restrained against rotation

$1.0 H_w$

f_{ck} = Concrete compressive grade (Mpa)