



Factory Made Fast Track Modular Building System - INSTACON

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 Synergy Thrislington
A1,Phase 1,Industrial Area
Mohali(Chandigarh)-160055**

Performance Appraisal
Certificate No.

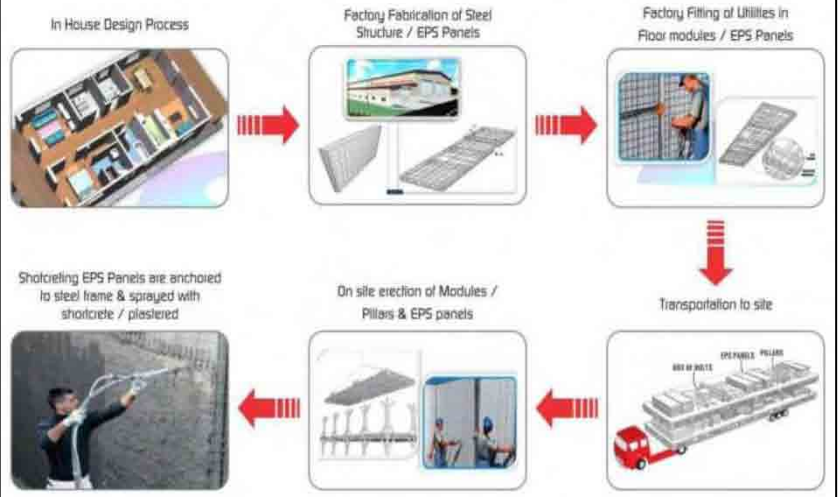
PAC No **1011-S/2013**

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CONSTRUCTION PROCESS



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PERFORMANCE APPRAISAL CERTIFICATE

FOR

FACTORY MADE FAST TRACK MODULAR BUILDING SYSTEM

ISSUED TO

M/s Synergy Thrislington

STATUS OF PAC 1011-S/2013

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 – I CERTIFICATION

I -1 CERTIFICATE HOLDER

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I – 2 DESCRIPTION OF SYSTEM

I – 2.1 Name of the System – FACTORY MADE FAST TRACK MODULAR BUILDING SYSTEM

I – 2.2 Brand Name –INSTACON

I – 2.3 Brief Description –Factory Made Fast Track Modular Building construction system based on steel structure with different walling components is designed according to relevant Indian / International standards to withstand various forces, manufactured and fabricated in a controlled factory environment and shipped to a prepared building site for installation.

About 70% of the work is done in the factory with minimal usage of concrete which enables it to deliver the building within a few days of work at site.

The steel-modules pre-fitted with flooring, ceiling tiles, electrical and plumbing fittings are transported to the site for installation. Once all the components are assembled and erected at site, concreting is done on the factory made 3-D Expanded Polystyrene (EPS) panel walls making it a monolithic structure.

I --3 DESIGN AND DETAILS OF THE SYSTEM

I –3.1 Design

The *Instacon* panel is designed using the Concrewall panels. The system may be used as an alternate solution to a building designed using conventional brickwork masonry wall.

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 Synergy Thrislington through the use of chartered Engineers is responsible for the structural design of the *Instacon* System for each project.

The *Instacon* engineer shall also liaise with the engineer of the developer and shall provide the necessary loading information for the design of the foundation.

The system shall be designed to provide the required performance against the loads to be taken into account in accordance with IS 800:2007 and IS 801:1975 and the data given for various panels. It shall provide besides other requirements the required bearing resistance for earthquake and wind forces as per IS 875 (Part 3):1987 and IS 1893 (Part 1):2002, both individually and in combination, wherever applicable.

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. Design calculations should have proper sketches annotated in English.

Foundation shall be specifically designed in accordance with provision given in IS 1904:1986. Both single and double panels should have starter bars from either foundation or ground floor slab. All foundations should be designed by chartered engineer with appropriate reference.

In addition, any other requirement regarding safety against earthquake need to be ensured by the designer as per prevailing codal requirements.

I -- 3.2 Details of Structure

I – 3.2.1 Main Structure -- The main structure shall be made of steel pillars, steel modules, steel staircase designed by experienced structural engineers for the forces and moments of intended design loads i.e. dead load, imposed loads, wind load, earthquake loads, temperature variation and effects due to shrinkage, creep, handling, lifting, erection etc. as per provisions made in the latest version of IS 875 (Parts 1 to 5):1987, IS 1893(Part 1): 2002 and National Building Code of India 2005.

I – 3.2.2 Foundation -- Foundation shall be either strip or raft designed and constructed as per IS 1904:1986 and other related Indian standards, as applicable.

- I – 3.2.3 Steel Structure --** The structure consists of steel pillars, modules and other components designed for worst loading conditions as per IS 800:2007 and IS 801:1975. Steel pillars shall be made by welding MS plate of 16mm thickness and steel tubes of size 200mm x 200mm and of thickness varying from 3mm to 16mm depending upon the number of floors. The smaller pillar is fixed with sub-assemblies for modules.
All the columns shall be checked for their safety and computations for the same for satisfying requirement of IS 800 and IS 801.
- I – 3.2.4 Steel Staircase –** Steel staircase shall be designed and fabricated using HR steel sheet of thickness 3mm / 4mm with MIG welding process. Staircase is pretreated for surface cleaning using steel cleaning agent and painted with two coats of anti-corrosion primer and fire proof paint.
- I – 3.2.5 Flooring –** The floor is made up of deck sheet and wire mesh of size 100mm x 100mm x 3mm thickness. The deck sheet is fixed on the modules ready after providing with utilities like plumbing and electrical etc. are fixed. Flooring, roofing and ceramic tiles are fixed as per the relevant specifications.
- I – 3.2.6 Walling –** Walling is completed by using factory made EPS based wire mesh welded with 3D panels. The panels are easy to install and are manufactured using insulated polystyrene core covered on both sides by hot GI coated round wire square mesh, duly connected by 33 connectors per sq meter.
- I – 3.2.7 Door and Window –** Any type of door and window frame and panel can be fixed in the structure. For fixing the door frames, manufacturer's instructions and guidelines shall be followed. Metal door frame pressed from 1.2/1.5mm thick galvanized steel sheet with mitered and welded construction may also be fixed. The doors used shall satisfy the performance requirements as per relevant Indian Standards. For doors not covered by any Indian Standards, third party certification may be adopted. Performance characteristics for Dimensions & squareness, General flatness, Impact indentation, Flexure test, Edge loading, Shock absorption, Buckling resistance, Slamming and Misuse as per IS 4020:1998 shall be required before accepting any doors for use.

I – 4

MANUFACTURING

I – 4.1 Manufacturing shall be done in fully mechanized machines.

I – 4.2 Steel Structure

- i) HR coil of required size using slitler shall be converted into C-Channel by rolling process.
- ii) C-channels shall be punched as per the relevant drawings on the punching press for different size of holes.
- iii) C-channels shall be further fabricated into modules (as sub-assemblies for modules) using Mig welding machines.
- iv) These sub-assemblies shall be welded with each other using Mig welding to complete one module. 3mm thick base plate shall be used for boundary of the frame and 3mm thick base plate is used for central and for truss supporting channel.
- v) The top most roof structure of INSTACON is a truss and purlin structure made of MS tube of size 60mm x 40mm as per the drawings.
- vi) Angle of size 50mmx50mmx3mm shall be used for the central truss of MS module and 40mmx40mmx3mm for lifting arrangement of finished modules.
- vii) Modules shall be pre-treated for surface cleaning using steel cleaning agent and painted with two coats of anti-corrosion primer and fire proof paint for longer life.

I – 4.3 Steel Pillars

- i) MS plates of 16mm thickness shall be cut as per the required size and drawings.
- ii) Steel tubes of size 200mm x 200mm and of thickness varying from 3mm to 16mm shall be cut into desired size using cutting machines and gas cutter.
- iii) The steel tubes and finished plates shall then be welded and joined with each other to make pillars. The smaller pillar is fixed with sub-assemblies for modules. Same process is followed for making all the four sizes of the pillars.
- iv) After joining the plates, lee-braces shall be fabricated using HR sheet. The manufacturing process is same as in case of C-channel and joined with the pillar for load bearing capacity and to make the building earthquake resistant.

I – 4.4 Steel Staircase

- i) HR sheet of required thickness 3/4mm shall be cut as per the required size using cutting machine.

- ii) Sheet shall then be bent on bending machine using dies and tools as sub-assemblies.
- iii) These sub-assemblies shall be converted as staircase with MIG welding process.
- iv) Staircase shall be pre-treated for surface cleaning using steel cleaning agent and painted with two coats of anti-corrosion primer and fire proof paint.
- v) The staircase modules shall then be fixed with floor and roof modules using HTT fitting process.

I – 4.5 EPS (Expanded Polystyrene) Panels

- i) Wall panels shall be manufactured using self-extinguishing type EPS of density not less than 15 kg/m³ and galvanized cold drawn wires in the machines. The specifications of EPS panels shall be strictly followed.
- ii) The panels shall be assembled on site and in-situ concrete poured to realize the different elements of the system viz. vertical structural walls, horizontal structural elements, cladding element and internal walls.

I – 4.6 Doors and Windows

- i) Metal door sets, when used, shall be manufactured from prime quality stretched cold formed steel sheet conforming to the relevant Standards. Door frames shall be pressed from 1.2/1.5 mm thick galvanized steel sheet with mitered and welded construction.
- ii) Hinge reinforcements shall be manufactured from 3mm thick steel plate and welded to the frame.
- iii) Door leaf shall be manufactured from 0.8/1.0 mm thick galvanized steel sheet with lock framed edges. It is insulated and bonded with infill of honeycombed paper core/mineral wool, forming a rigid flush-fitting stress-free level leaf.
- iv) Innovative flush double glazed 400mm x 600 mm vision panels shall be constructed with vacuum sealed 6mm as required toughened clear glazing units.
- v) The doors shall be finished in polyester powder coating of 60/80 microns forming a smooth surface finish.
- vi) Standard MS framed windows fitted with glass shall be used.

I – 4.7 Utilities

- i) Once the steel structure module is ready for electrical and

- plumbing work as per the drawings, these utilities shall be planned & executed based on the services/utilities layout design and requirement of the floor area.
- ii) After completion of services/utilities, the module is covered with deck sheet. Wire mesh and MS studs of required size are fixed on the deck sheet before laying of PCC flooring. After decking, PCC of M25 grade shall be laid for a total depth of 76mm and flooring tiles are fixed wherever required depending upon utilization of area. The modules are now ready for shifting to site.

I – 4.8 Transport of Modules and Pillars along with accessories:

All the handling/transportation at site for erection shall be done by use of mechanical equipment such as tower & mobile cranes and trucks etc. Due care shall be taken that there will not be any damage to these modules, pillars and other elements. For this special lifting points shall be provided in these modules so that handling stresses shall be kept to the minimum. Transportation shall be carried out in mainly two stages:

- i) From manufacturing plant to stacking yard.
- ii) From stacking yard to erection site. The transportation shall be carried out by using trucks of desired capacity and length. Erection shall be carried out by cranes of suitable capacity at site.

I -- 5 ASSESSMENTS

I --5.1 Scope of Assessment

I-- 5.1.1 Scope of assessment includes conformance of manufactured panel to the specified requirements for use in building construction as:

- i) Steel Modules
- ii) Steel Pillars
- iii) Staircase
- iv) Concrewall Panel
- v) Floor/ roof deck
- vi) Outer non-load bearing walls

I-- 5.2 Basis of Assessment

Assessment of the suitability of the Factory Made Steel Composite Modular Building System manufactured as steel

module, load bearing wall and floor/ roof slab etc. is based on:

- i) Inspection of production facilities at site during visit of the IOs
- ii) Seismic Performance Evaluation of Model of a G+7 CRC Framed Structure by CSIR- Structural Engineering Research Centre, Chennai
- iii) Quality Assurance System followed by the Certificate holder for quality control of the system.
- iv) Test report on panels by CSIR-Structural Engineering Research Institute, Chennai

I-6 USE OF THE FACTORY MADE MODULAR BUILDING SYSTEM

I-6.1 The system shall be used as framed steel structure

I-6.2 Special Aspects of use:

- i) The building to be constructed using Factory Made Modular 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 Fast Track Factory Made Modular 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 Steel Modules and Concrewall 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 Factory Made Modular Building System and its applications.

- I – 6.3 Scope of Inspection** – Scope of inspection included the verification of production, performance and testing facilities at the factory including competence of technical personnel and status of quality assurance in the factory.
- I – 6.4 Manufacturing & test facilities** – Manufacturing and test facilities available in the factory were found to be suitable to produce and fabricate the steel structure and concewall as per the specifications. Testing equipments listed were also verified and found to be in working condition.
- I – 6.5 Competence of Technical Personnel --** Persons involved in training were found to be well conversant with testing procedures required for the quality control of the product.
- I – 6.6 Experience in actual use** – A 10 storey (2554 sqm) building constructed in 48 hours at Mohali, Punjab was inspected. It showed no distress & was found to be functioning satisfactorily.

I – 7 CONDITIONS OF CERTIFICATION

- I – 7.1 Technical conditions**
- I – 7.1.1 Raw materials and the finished panels and walls shall conform to the requirements of the prescribed specifications.**
- I -- 7.1.2 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. Design calculations should have proper sketches annotated in English.
- I – 7.2 Quality Assurance** – The Certificate Holder shall implement & maintain a quality assurance system in accordance with Scheme of Quality Assurance (SQA) given in the Annexure attached with this Certificate.

I – 7.2.1 Structures using the panels shall be designed as per Clause I-2.4 and executed as per provisions of this PAC.

I – 7.3 Durability -- The Certificate Holder shall provide necessary structural warranty ensuring durability of the system to the user, on demand.

I – 7.4 Handling of User Complaints

I – 7.4.1 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.

I – 7.4.2 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.

I – 8 CERTIFICATION

I – 8.1 On the basis of assessment given in Part III 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– II CERTIFICATE HOLDER’S TECHNICAL SPECIFICATIONS

II –1 GENERAL

II – 1.1 The PAC holder shall manufacture the panels & walls in accordance with the requirements specified in the Factory Made Fast Track Modular Building System.

II–2 SPECIFICATIONS FOR THE SYSTEM AND DESIGN INFORMATION.

II -2.1 Specification – 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.

II – 2.2 Raw Materials

(i) Steel Structure

(a) H R Steel strip: Shall conform to IS 10748:2004

(b) M S Plate: Shall conform to IS 2062:2011

(c) M S Tube: Shall conform to IS 4923:1997

(d) Hexagon Bolts & nuts (M16x30 for pillars, M12x25 for elbow joints, M12x40 for module joints & M8x25 for window frames): Shall conform to IS 1363(Part 1-3):2002

(ii) *Expanded Sintered Polystyrene (EPS)*: Self-extinguishing type EPS 80 in accordance to UNI EN 13163:2003 (IS 4671: 1984) having minimum density 15 kg/m^3

(iii) *Zinc Coated Cold Drawn Steel Wire* – Shall be of 2.5/3.0 mm dia and zinc coating galvanizing shall be of $60 \text{ gm/m}^2 \pm 5 \text{ gm/m}^2$

(a) Mechanical characteristics

Tensile strength (2.5mm dia): 750 N/mm^2

Tensile strength (3.0mm dia): 700 N/mm^2

Yield strength (2.5mm dia): 680 N/mm^2

Yield strength (3.0mm dia): 600 N/mm^2

Welding strength (Pull out weight for single point): 46 kg

Elongation: $> 8\%$

(b) Chemical characteristics

% C : < 0.24

% P : < 0.055

% S : < 0.055

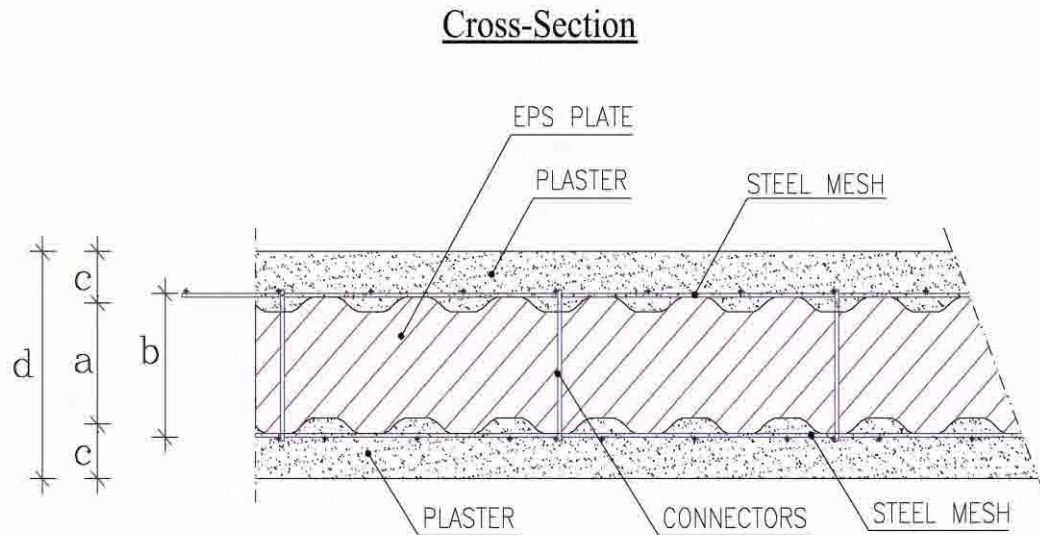
% Ceq : < 0.52

Longitudinal wires: 2.5/3.0 mm dia. every 65 mm

Transverse wires: 2.5 mm dia. every 65 mm

Cross steel wire: 3.0 mm dia. (approx. 68 per sq m)

II–2.3 Production Process and Construction Process of Concrewall Panels



a = EPS nominal thickness	(variable between 40mm to 320mm)
b = distance between the steel meshes	(a + 10 mm)
c = concrete thickness	(average ≥ 25 mm)
d = total thickness	(2 x c + a)

Fig. 1

II – 2.3.1.2 Polystyrene blocks EPS: The most complete hypothesis includes the following phases

- Shape the dried blocks and cut sheets of a specific form and dimension according to the final type of product. The possible scraps shall be grounded and recycled, within certain limits, in the production of EPS blocks on the condition that these are first cleaned and are without any foreign substance, with particular attention to the presence of dust.

II – 2.3.1.3 Assembly:

- Assembly of the Concrewall panel shall be made by electro welding 6 wires (in transversal and perpendicular position with respect to the panel surface) with two meshes, forming a sandwich including the EPS sheet between these, which has been previously inserted.

II – 2.3.2 Construction Process

II –2.3.2.1 Erection

- 1) Erection of steel structures using modules and pillars at site shall be done with the help of cranes. The cranes of capacity 100 to 150 ton min with a boom height of 15 meters are required for a building height of 35 meters. A min space of 15 meters around the building shall be required for normal cranes otherwise tower crane may be used for erection.
- 2) Steel modules on ground floor shall be fixed with foundation on 40mm thick plate already fixed on the RCC pillars and welded after the alignment.
- 3) Steel pillars shall be mounted on the fixed locations and tightened with hex bolts of size M16x30 using tightening tools at specified torque.
- 4) Bracing of pillars shall be fixed with bolt of M 12x25.
- 5) Ground floor roof modules shall be placed on the pillars and tightened using M16x30 bolts.
- 6) The module to module and window frames shall be fixed as per the design and drawings using M12x40 and M8x25 hex bolts respectively.
- 7) EPS panels shall be fixed with steel structure and pillars wherever walls/partitions are required.
- 8) Aluminium form work shall be fixed on both the sides of EPS wall panels.
- 9) Concrete of M25 grade shall be poured to sandwich the EPS panel in the already fitted aluminium form work to construct walls/partition
- 10) Windows/door frames shall be fixed on these walls to support the door/window shutters/glass.
- 11) Internal finishing of the building shall be done as per the relevant specifications.
- 12) Provision for lights, IT/telephone lines connectivity shall be provided in the floor cum roof modules of the building during manufacturing.
- 13) After erection of complete steel structure, the outer walls and inner partitioning shall be done using EPS partition panels and concrete.
- 14) Bathroom wall tiles, fittings and accessories shall be fixed and tested.
- 15) Ducts shall be provided for serviceability of lifts, plumbing and electrical work.

- 16) All the electrical devices to the mains electrical supply shall then be connected to make them operational and functional.
- 17) Electrical earth and lightning protection equipments shall be installed after the installation of complete steel structure at site as per the requirements which shall then be tested

II – 2.3.2.2 *Wall construction*

- All corners and wall joints should be reinforced with right angled wire mesh to the full height of the walls.
- To cut panels to fit for door & window openings, wire should be cut with a wire cutter or angle grinder. Measure and mark the cut lines before starting to cut.
- After the wire mesh has been cut, EPS shall be cut with a hacksaw blade or stiff blade hand saw.
- Added steel mesh reinforcement shall be required around door and window openings to ensure that no plaster cracks form in these areas. Mesh reinforcement strips shall be tied diagonally with wire around openings before plastering.
- Once wall panels are in place and tied together, bracing shall be required to hold them vertical before plastering. This shall be done only on one side of the panels.
- Once the panels are plastered on one side, the wall bracing shall be removed after 24 hours. The panels are now sufficiently stiff so that plastering on other side can be done without bracing.

II – 2.3.2.4 *Roof Module*

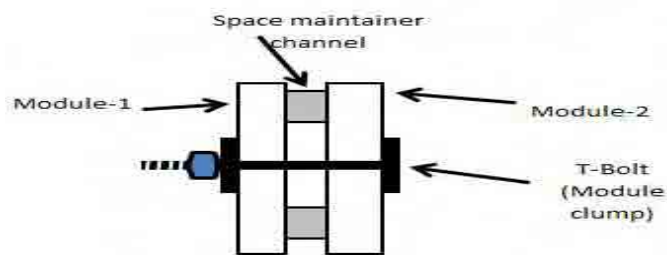
- The slings wire (lifting belt) in the lifting hook shall be used to lift the module with hydra machine. Every module has four lifting hooks at the corners.



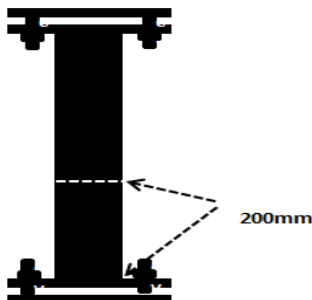
- The module shall be lifted with hydra after taking the proper balance.



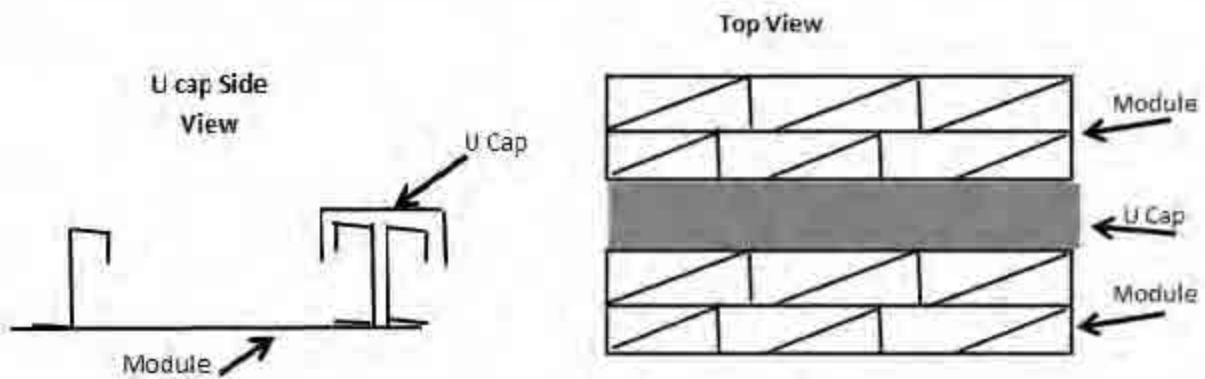
- All the modules shall be mounted on pillars in such a way that the module corners rest on the pillars and cover the guiding caps. All the bolting holes shall be set with the help of MS rod.
- All the bolts shall be screwed (half tight) with pillar and module.
- T clamp shall be tied to join module to module



- After tightening the T bolt, all pillar bolts shall be tightly screwed with 16mm spanner.
- Minimum 2 to 3 lock plates shall be provided in every pillar to maintain the tightness of grouting bolts.



- A line shall be marked at 200mm from bottom on the pillars for levelling.
- U cap shall be provided to join two modules before concreting and flooring to avoid leakage.



Sketches 2 to 7 showing the typical Steel assembly frame details are given at pages 25 to 27 for guidance.

II – 2.3.2.4 *Door and Window fittings*

- Fix a metal angle iron or hollow tube sub frame into the openings before plastering. Fix and plaster these in place and then secure the frames to the sub frame.

II – 2.3.2.5 *Plastering*

- Plastering shall be done by machine. The indicative quantity of each material per cum. should conform to relevant Indian Standards and shall be:
 - (i) Concrete: 350kg
 - (ii) Sand: 1600kg Sand should be without clay or any organic substance and totally washed.
 - (iii) Water – 160litres. The quantity of water may be different according to the natural sand humidity. The parameters that should be constant are: $W/C = 0.52$ and $I/C = 4.50$.
- Any problem of workability should be solved without adding water. The retraction cracks formation may be avoided by adding polypropylene fibers in the mix (1kg/m^3).
- In order to control the final plaster thickness, some guides should be used. These shall be removed as soon as the plaster ‘sets up’ and the spaces are filled and are smoother before the plaster gets dry.

II – 2.3.2.6 *Plumbing and electrical fittings*

- Plumbing and electrical conduits shall be behind the panel wire mesh before plastering.
- The space behind the wire mesh shall be opened up by using a blow torch to partially melt the EPS along the lines of the conduits.
- As the EPS used in the panels is fire retardant, it will melt under the flame but not burn.
- The wire mesh shall be cut with wire clippers to make space for DB boards, switches and plug boxes.

Sketches 8 to 14 showing the typical Structural details, EPS Panel, Joining connection and sectional view are given at pages 28 to 34ssssss for guidance.

II – 2.4 Inspections & Testing

- Shall be done at appropriate stages of manufacturing process and construction process.
- 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.

II – 3 SELECTION & INSTALLATION

II – 3.1 The user/installer is responsible for proper selection and erection at site as per manufacturer's instructions.

II --3.2 Choosing size and thickness—Appropriate size and thickness of the panels shall be chosen to suit the thermal requirements of the user.

II – 3.3 Additional Points for Fabrication and Site Erection

The following additional points as observed by CSIR-SERC during the Seismic evaluation of the model of G+7 framed structure should be kept in mind during the fabrication and site erection of the building so as to ensure the safety:

- 1) The structural adequacy of the buildings are checked for seismic forces as per IS 1893:2002 as indicated in Para III–3.11(a). Any change in terms of structural configuration or loading needs to be reanalyzed and checked for structural adequacy to ensure safety.
- 2) The slenderness ratio of all secondary members should be kept below 250.
- 3) The building should be anchored properly on the ground to have adequate counter weight to resist the uplift of the structure during extreme wind and seismic forces.
- 6) Proper detailing should be given to prevent stagnation of moisture on the members and also to provide cover against corrosion by suitable galvanization or painting.
- 7) The column splicing needs to be checked against wind and seismic loads
- 8) The base plates and the foundation bolts of the columns should be adequately designed and anchored into the base concrete.

- 9) It is strongly recommended that the members and connections and storey level drift of the buildings have to be checked for the structural strength and integrity against wind load combinations. Further, the storey level drift of the buildings have also to be checked for wind load combinations.
- 10) The following specifications and all relevant standard procedures should be strictly observed:
 - (i) Dimensions for Hot Rolled Steel Beam, Column and Angle sections as per IS 808:2004.
 - (ii) Hexagon Bolts & Nuts (Size range M5 to M36) as per IS 1363:2002
 - (iii) Technical supply conditions for Threaded Steel Fasteners as per IS 1367:2002
 - (iv) Specifications for Hot Dip Zinc Coatings on Structural Steel and other allied products as per IS 4759:1996
 - (v) Tolerance for Fabrication of Steel Structures as per IS 7215:1974.

II – 4 MAINTENANCE REQUIREMENTS

A proper maintenance guide shall be given by the PAC holder to the client. When building is to be repainted with fresh coat of paint after scraping existing paint, check for joint sealant, pipe joint, sun shade etc. and carry out required maintenance and apply primer before paint is applied.

II – 5 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.

II--6 GUARANTEES/WARRANTIES PROVIDED BY THE PAC HOLDER- PAC holder shall provide necessary guarantees/ warranties. A brochure giving relevant details and warrantee detail shall be made available to the client.

II – 7 SERVICES PROVIDED BY THE PAC HOLDER TO THE CUSTOMER

In-house testing of panels at regular intervals as per the QCA requirement shall be ensured by M/s Synergy Thrislington.

II – 8 MANUALS

A site Erection Manual and a Manual for Health & Safety shall be provided for each project incorporating the Factory Made Modular Building System.

II – 9 RESPONSIBILITY

- Specific design using Factory Made Modular Building System is the responsibility of the designer with the instructions, supervision and approval of Synergy Thrislington.
- Quality of installation of the system on site is the responsibility of the trade persons engaged by the agency
- Quality of maintenance of the building is the responsibility of the building owner.
- Providing necessary facilities and space for movement of cranes and vehicles is the responsibility of the building developer.

Part—III BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

III –1 BASIS OF ASSESSMENT

III – 1.1 The technical assessment was done as per provisions of the Standards listed in Part V of this Certificate

III – 2 FACTORY INSPECTIONS

Inspection of manufacturing process was done. Firm has got necessary manufacturing machineries as per the process description given for manufacturing the panels.

III – 3 TESTS PERFORMED FOR ASSESSMENT

III – 3.1 By CSIR-SERC, Chennai – The following tests have been performed by CSIR-SERC, Chennai as per the specifications given by the manufacturer:

1. *Seismic Performance Evaluation of Model of a G+7 CRC Framed Structure for a ground motion compatible to Zone-V spectrum.*

The main features of the evaluation report are:

a) This report presents the details of the seismic performance experimental studies conducted on the assembled 1:5 scaled model of the G+7 cold rolled steel framed structure on the 4m x 4m shake table of CSIR-SERC at ASTAR Laboratory. The dead and imposed loads are simulated by equivalent

loads through rigidly connected RCC slabs amounting to 1500kg per floor for the intermediate floors and 680kg for the top most floors. For the purpose of seismic experimental studies, the foundation of the model of the frame structure is considered as fixed. The pattern of earthquake spectrum has also been appropriately scaled corresponding to the soft soil spectrum as per IS 1893:2002 code. Free vibration tests have been conducted before and after placement of the loads. This has been followed by progressively increasing earthquake motions quantified by peak ground accelerations (PGA) corresponding to Zones II, III, IV and V as specified for maximum considered earthquake as per IS 1893:2002 for soft soil conditions. Based on the experimental studies, it is found that the overall performance of the scaled model of the framed structure is satisfactory. However, the following points should be noted and taken care of:

- Generally the overall and global behavior of the structure under scaled down seismic building is found to be satisfactory. However, the local behavior may not be fully captured through experimental study. This limitation in an experimental programme, which shall not simulate distortions, lack of fit, marginal out-of-plumb and dimensional tolerances in the prototype structure has to be borne in mind.
- If a building satisfactorily performs under seismic motions corresponding to soft soil conditions, it shall be deemed to have performed well for medium and hard soil conditions.
- In course of the seismic experiment, occasional noise and sound, reflecting high frequency response due to friction, rubbing and occasional loosening and fracture of fasteners have been experienced even though the overall global behavior is satisfactory.
- The results of the experiments are valid under conditions of rotational and translational fixity of the foundation. The uncertainties and vagaries arising out of soil flexibility and settlement may adversely affect the performance of the structure. This has to be suitably taken care of in the prototype design.
- The experiments are based on the design spectrum suggested by IS 1893 (Part 1):2002. The spectrum has been suitably elongated and modified to take care of the reduced model size. In case of real earthquake

being different in terms of frequency content and PGA levels, this may alter the response of the structure different from what is extrapolated from the experiment.

- In the scaled model, all the connections are made of bolts and welded nuts. Hence, in the prototype building, same type of connection with appropriate scaling should be adopted. Any modifications on this aspect need to be analyzed and checked for structural adequacy.
- The problems arising out of corrosion, wind loadings and other phenomenon are not covered in this experimental study and have to be suitably taken care of in the prototype design.

b) Seismic response spectrum analysis of G+7 and G+14 prototype framed structures has been conducted corresponding to Zone V as per IS 1893:2002 codal provisions.

The deflections and the stresses obtained based on the seismic response spectrum analysis for the G+7 and G+14 framed structures are found to be within the permissible limits. However, the following points should be noted and taken care of:

- The structure is modeled by assuming rigid joints and hence the displacement at top the G+14 storey frame is 57 mm and G+7 storey frame is 30 mm, which are much less compared to the real frame behavior with semi-rigid connections.

2. Evaluation on the behavior of a reinforced EPS Panel under Flexural and Axial Compression loads on 100mm and 150mm thick panels

The main features of the evaluation report are:

i) Static Flexural Tests

The 100mm thick RC panels can be used as floor panels for spans less than or equal to 2.70m at live load intensities of 2 kN/m². The 150mm thick RC panels can be used for slightly longer spans greater than or 2.70m under a service live load of 4 kN/m². Based on the test data reinforced concrete EPS panels for varying spans and loadings can be designed.

It is observed from the experiments that EPS floor panels with 3D wire frame reinforcements and RC ribs shall

achieve require flexural capacity. The ductility of the tested panels was very high and till failure stage, the damaged concrete was held in position by the welded wire fabric and 3D wire frame work. The welds in the 3D wire frame started failing sequentially only at large deformations. Besides, the self of the panel being less would ensure that the earthquake loads attracted is less, leading to an efficient structural system.

ii) *Axial Compression Tests*

It was observed that the transverse deflection recorded at the centre of the panel corresponding to each load stage as well as the ultimate load is very low. This indicates that no buckling of the panels has occurred.

The concrete strains measured at various points along the centre line of the panels were consistent. This indicates that the central region of the panels was under uniform compression.

The panels can also be used as load bearing wall panels.

However, the wall panels need to be suitably connected together for efficient load transfer in buildings.

Design steel reinforcements, required for resisting bending moments, shear force and axial force is lumped and provided in the RC ribs. Mesh reinforcements, generally meant for shrinkage and temperature stresses are different in the flexure and axial load test specimens as compared to suggested wall/roof panels, so as to achieve economy in cost.

III – 3.2 By Fire Research Laboratory, CBRI, Roorkee

1. Fire Resistance Test on Double Leaf Single Swing G.I. Composite Fire Door

The data of evaluation reveals that the double leaf single swing G.I. composite fire door specimen has been found to be able to withstand standard fire exposure of 120 min. only with respect to stability and integrity only.

III – 3.3 By Foreign Institutes – The following tests have been performed by various foreign institutes as per the specifications given by the manufacturer:

1. By Giordano Institute, Italy -- Thermal Insulation Tests:

- Single Panel Concrewall PCS08 – Thermal transmittance
 $U_p = 0.557 \text{ W/m}^2\text{K}$

2. *By CSI (MI), Italy – Acoustic Tests*
 - Single Panel Concrewall PCS08 -- Traditional plaster $R_w=37$ dB
 - Single Panel Concrewall PCS08 – acoustic plaster $R_w=37$ dB
3. *By CSI (MI), Italy – Fire Resistance Test:*
 - Single Panel Concrewall PCS08 – EI 92-E 240
4. *By LAPI (PO), Italy – Resistance to Impact with as soft body*
 - Single Panel Concrewall PCS08 – 50kg with impacts of 900 & 1200J – No cracks
5. *By LAPI (PO) – Water Penetration Test*
 - Single Panel Concrewall PCS08 – After three hours no penetration

III – 4 USAGE OF THE SYSTEM

The manufacturer has constructed one INSTACON -- 10 Storey (2554 Sqm) building at Mohali, Punjab in 48 hours from Nov 29, 2012 to Dec 01, 2012

III – 5 Drawings



Fig. 2 Floor Base Assembly 1

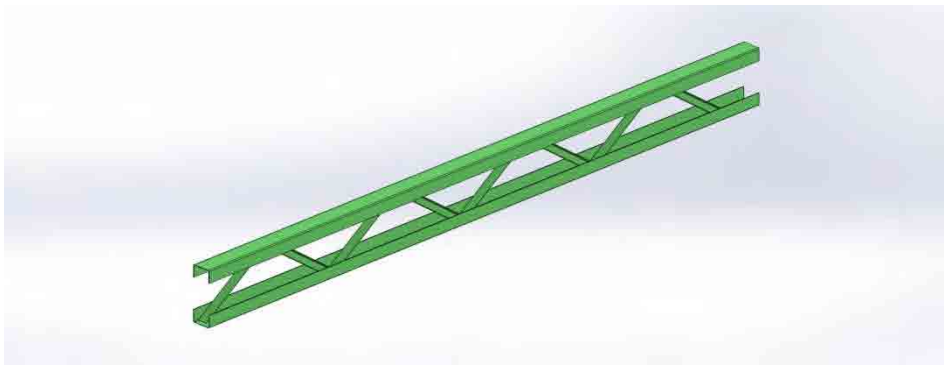


Fig. 3 Floor Base Assembly 2

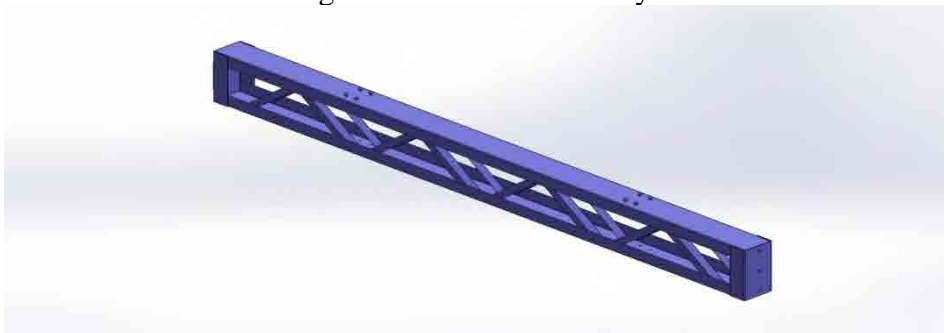


Fig. 4 Floor Base Assembly 3



Fig. 5 C -Channel

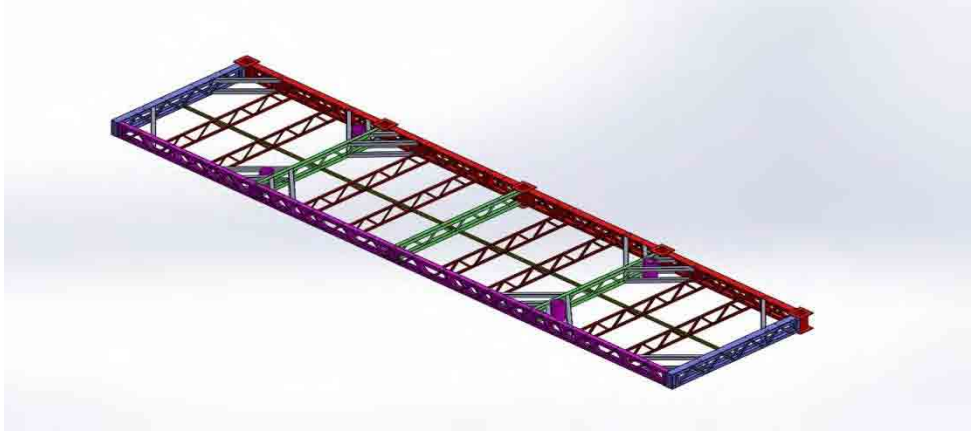


Fig. 6 STEEL Module sub assembly 1

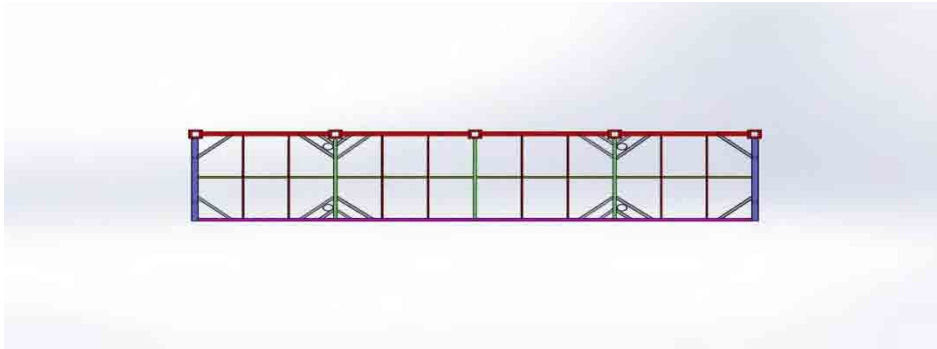


Fig. 7 STEEL Module sub assembly

TYPICAL EPS PANEL DETAIL

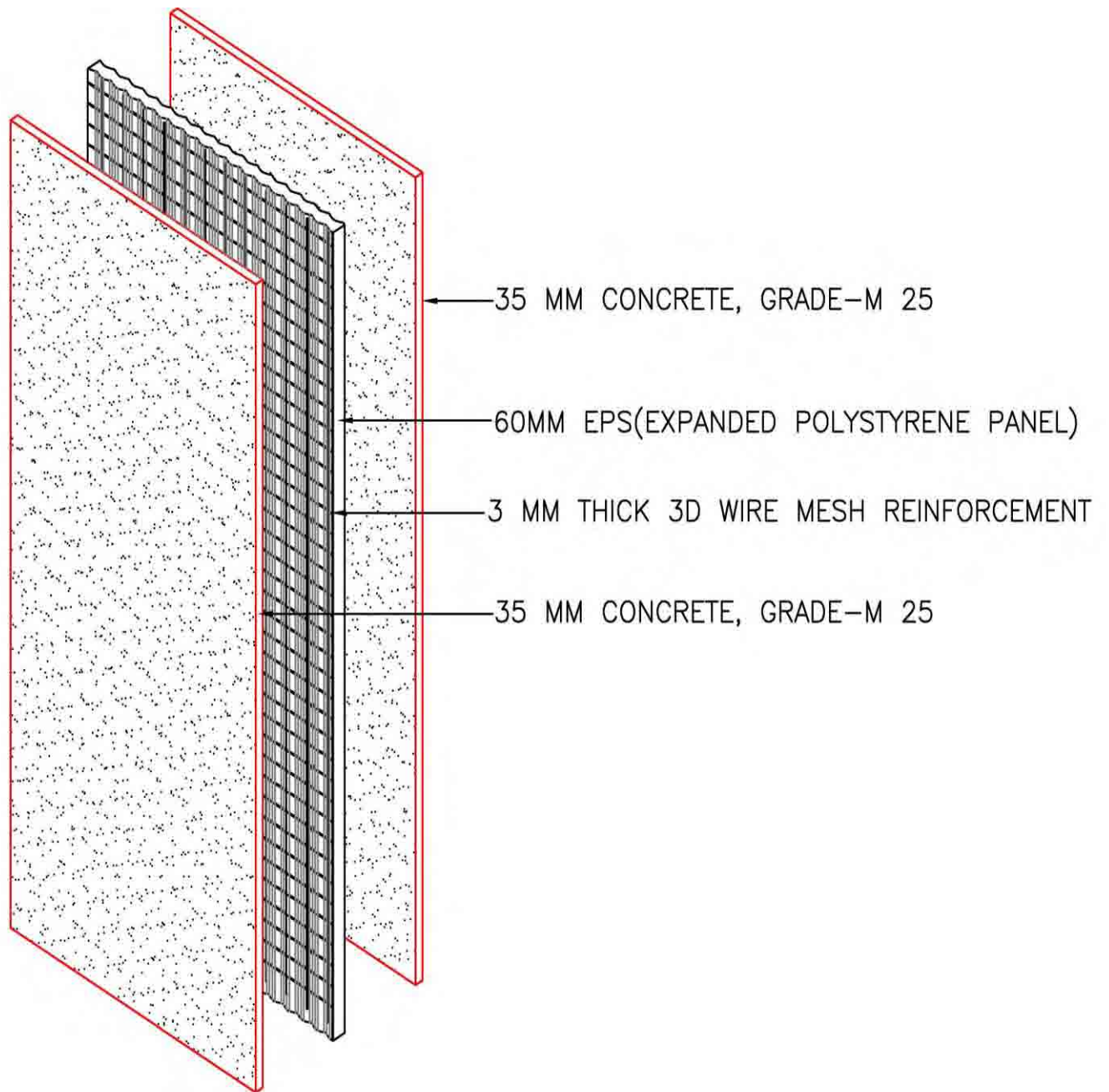


Fig. 8

TYPICAL JOINING CONNECTION

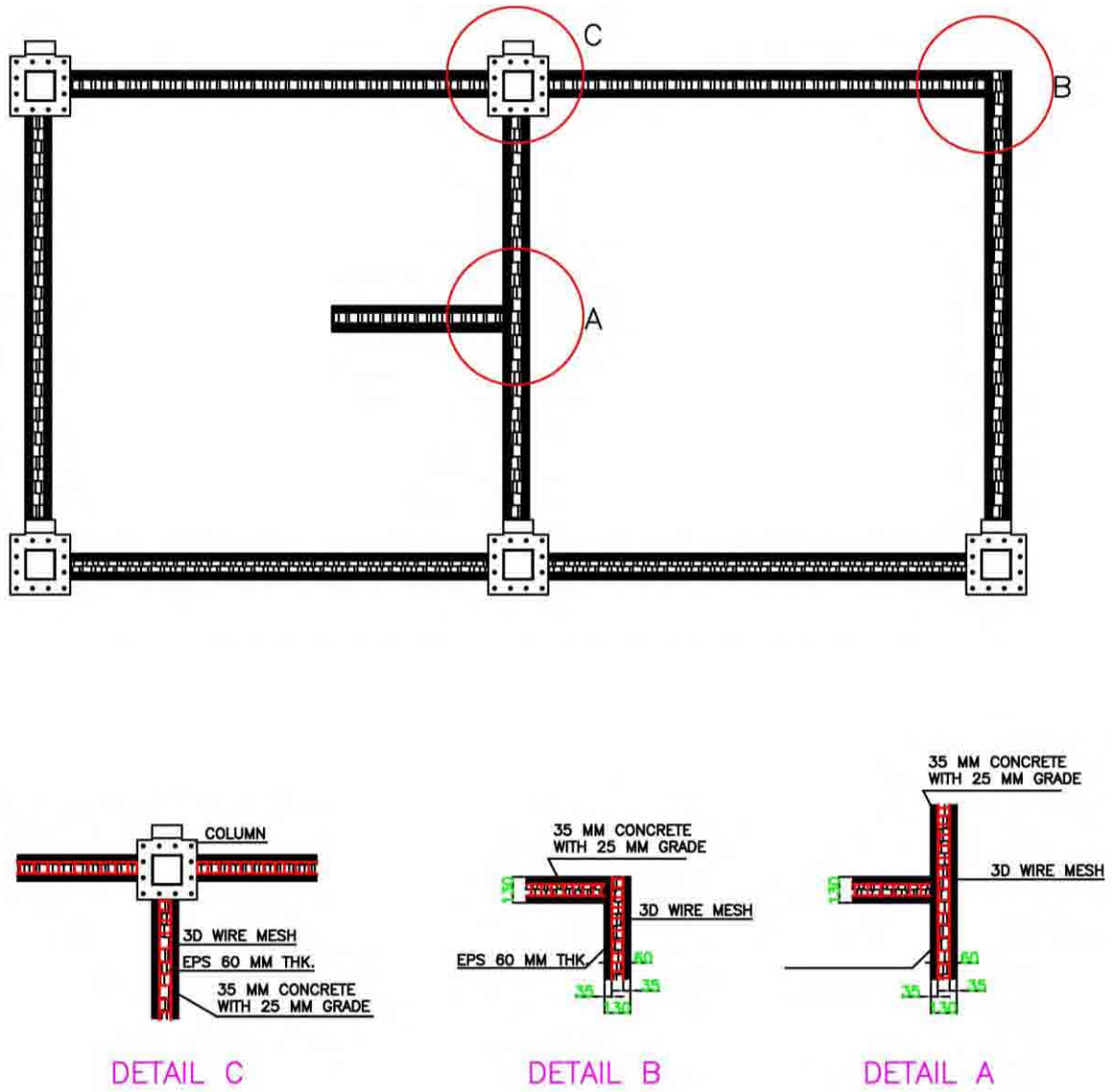


Fig. 9

TYPICAL SECTIONAL VIEW

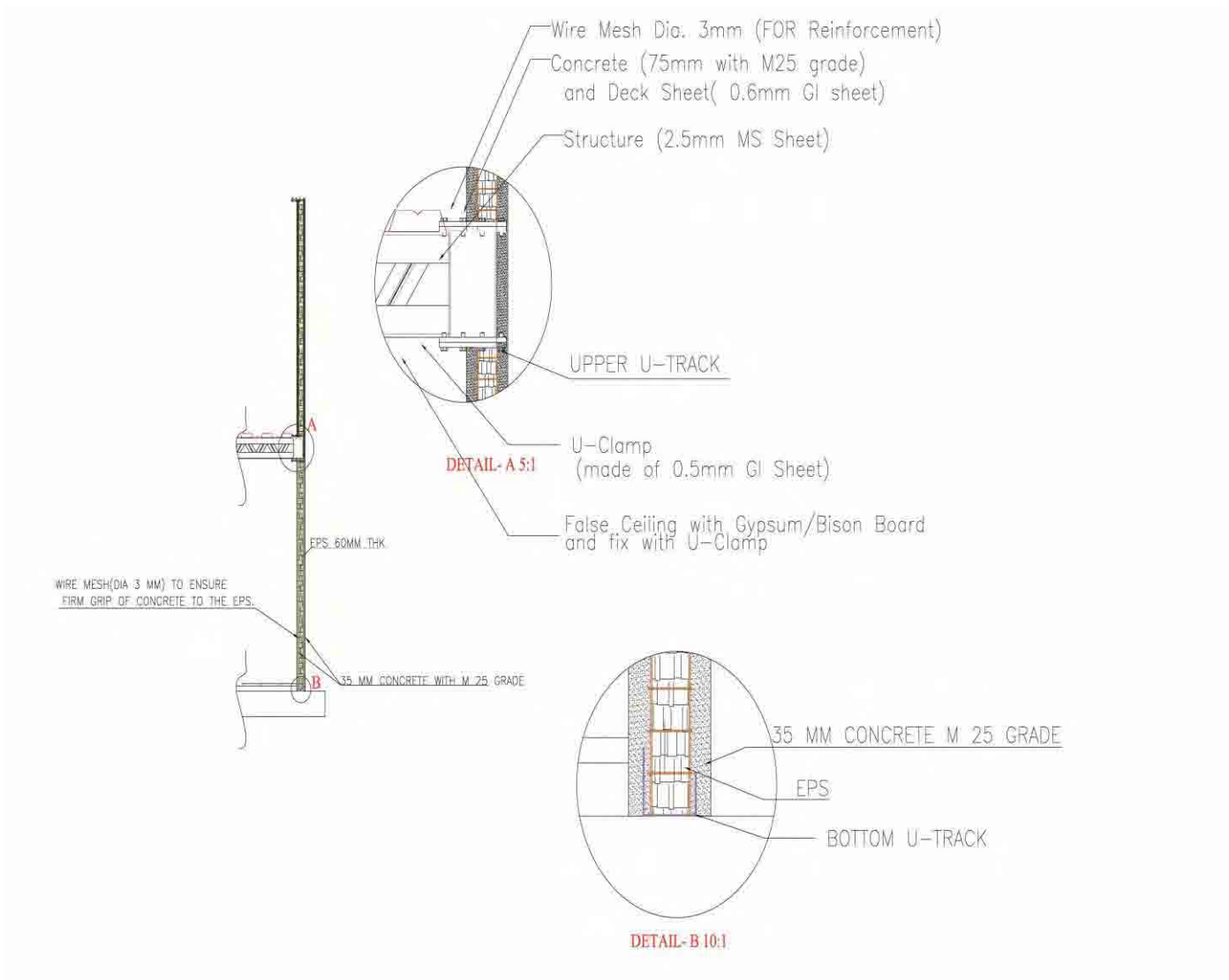


Fig. 10

TYPICAL STRUCTURE DETAIL

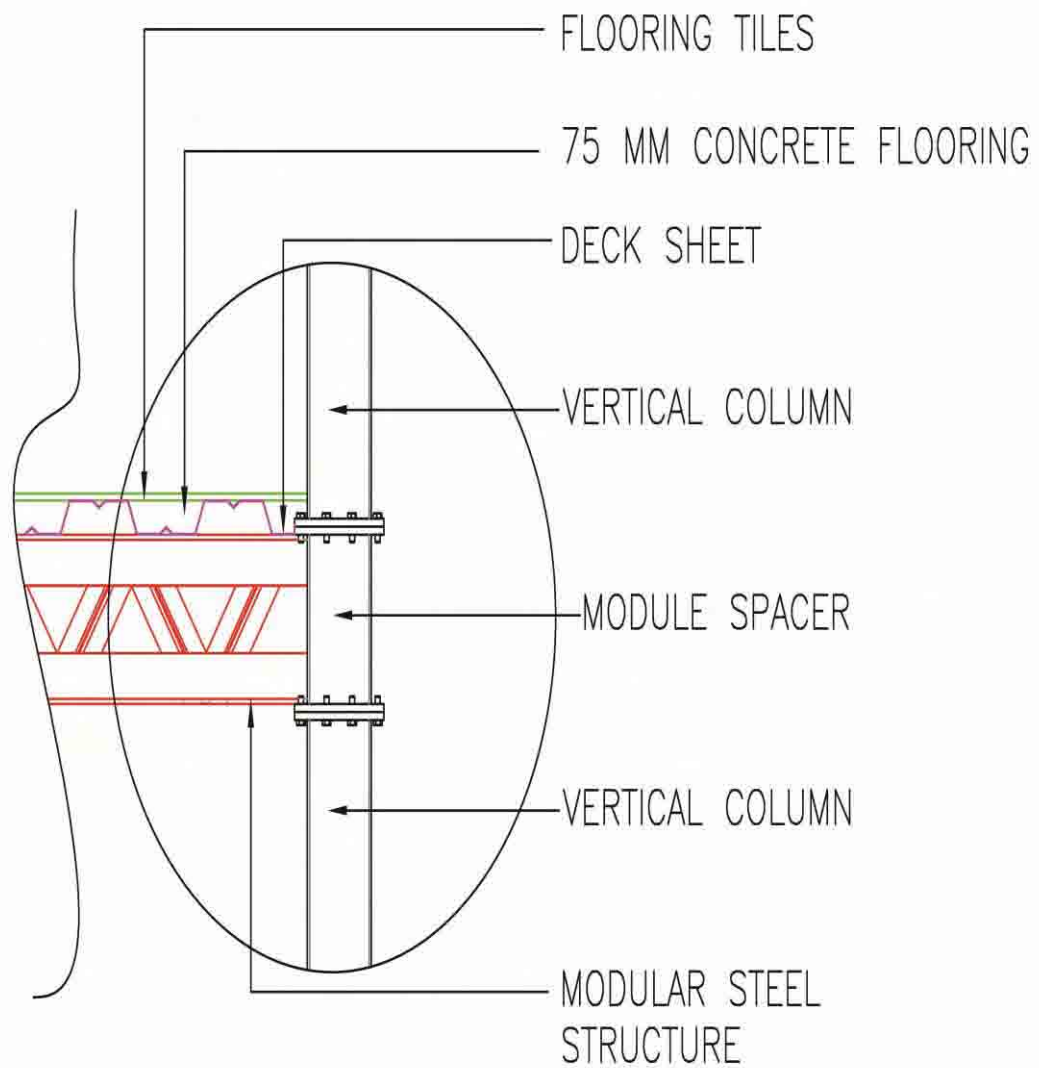


Fig. 11

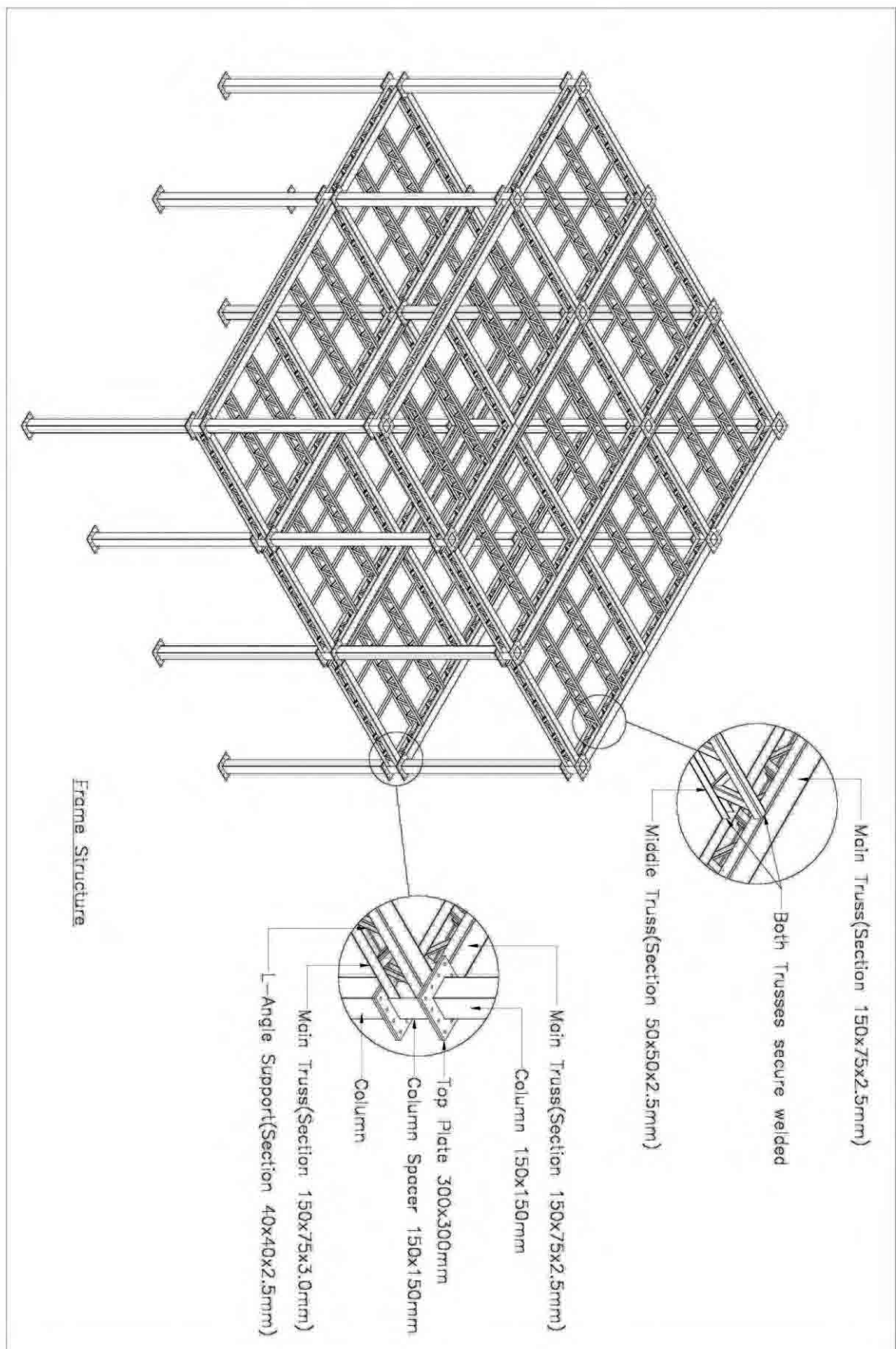


Fig. 12

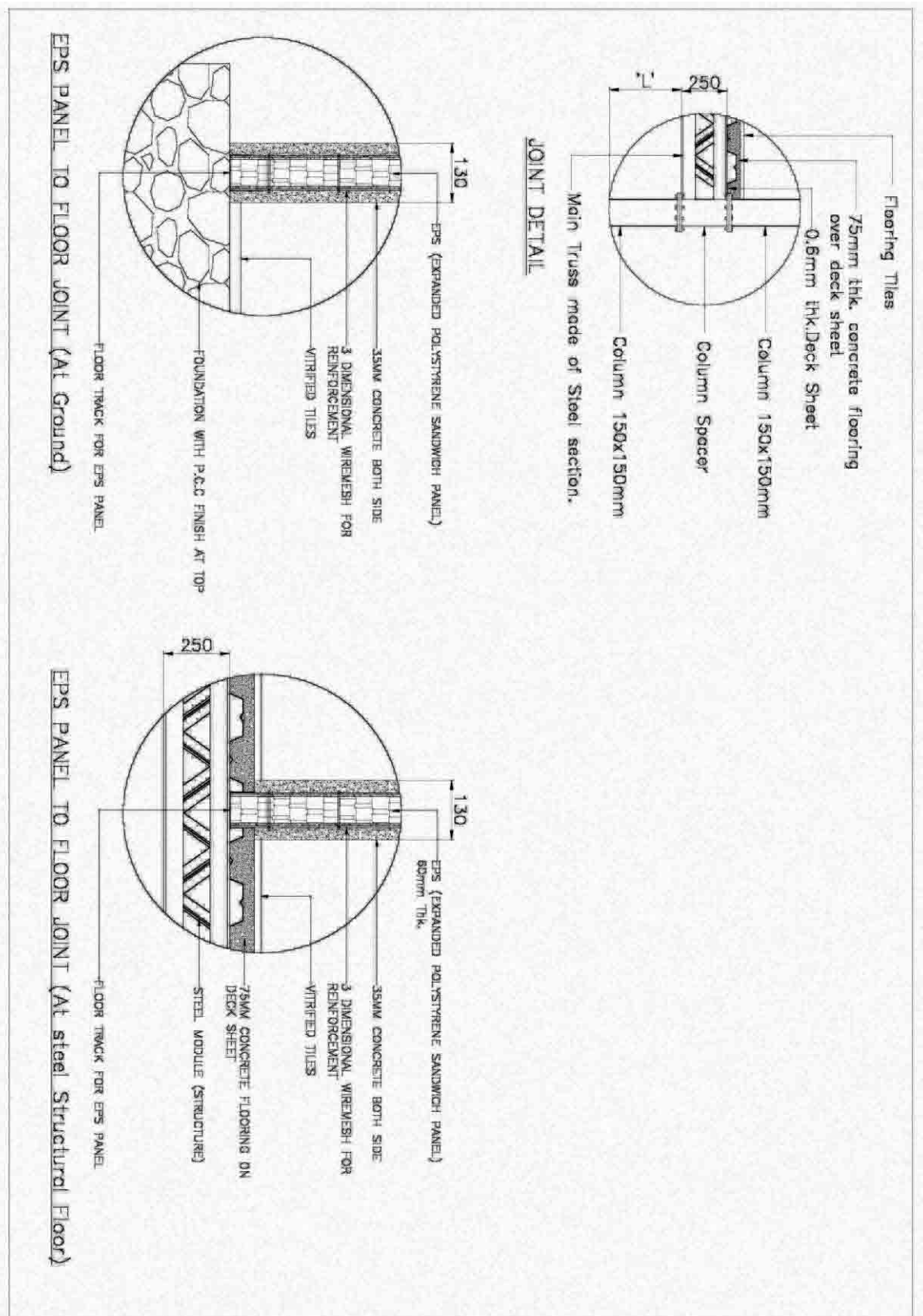


Fig. 13

PART-IV STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

- IV-1** The certificate holder shall continue to have the product reviewed by BMBA.
- IV-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.
- IV-3** The quality of the product shall be maintained by the certificate holder. Complete testing facilities shall be installed for in-process control.
- IV-4** The product user should install, use and maintain the product in accordance with the provisions in this Certificate.
- IV-5** This certificate does not cover uses of the product outside the scope of this appraisal.
- IV-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.
- IV-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)
- IV-8** The certificate holder agrees to inform BMBA of their clients with details of construction on six monthly basis.
- IV-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.
- IV-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.
- IV-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.

IV-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.

IV-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.

IV-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.

IV-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.

IV-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.

IV-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.



Place: New Delhi

Date of issue 20-12-13

Chairman, TAC & Agarwal

Member Secretary, BMBA

for and on behalf of

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

PART – V LIST OF STANDARDS & CODES USED IN ASSESSMENT

Part - V.1 Standards - These Standards are referred for carrying out particular tests only and do not specify the requirement for the whole product as such.

Part –V.1.1 IS 456:2000 – Code of Practice for Plain and Reinforced Concrete

Part –V.1.2 IS 800:2007 – Code of Practice for General Construction in Steel for Hot Rolled Sections

Part –V.1.3 IS 801:1975 – Code of Practice for Use of Cold Formed Light Gauge Steel Structures in General Construction

Part –V.1.4 IS 808:2004– Dimensions for Hot Rolled Steel Beam, Column and Angle Sections

Part –V.1.5 IS 875 (Parts 1 to 5):1987 – Code of Practice for Design Load of Buildings and Structures

Part –V.1.6 IS 1363:2002 -- Hexagon Head Bolts, Nuts and Screws of Product

Part –V.1.7 IS 1367:2002 – Technical Supply Conditions for Threaded Steel Fasteners

Part –V.1.8 IS 1893(Part 1):2002 – Criteria for Earthquake Resistant Design of Structures

Part –V.1.9 IS 2062:1992 – Hot Rolled Medium and High Tensile Structural Steel

Part –V.1.10 IS 4326:1993 – Code of Practice for Earthquake Resistant Design and Construction of Buildings

Part –V.1.11 IS 4759:1996 – Hot Dip Zinc Coating on Structural Steel Products

Part –V.1.12 IS 7215:1974 – Tolerances for Fabrication of Steel Structures

Part – V.1.13 IS 10748:2004 – Specifications for Hot Rolled Steel Strip for welded tubes and pipes

Part –V.1.13 NBC:2005 -- National Building Code of India

Part – V.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.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Factory Made Fast Track Modular Building System** bearing the mark manufactured by M/s Synergy Thrislington is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.1011-S/2013** is awarded to **M/s Synergy Thrislington, Mohali (Pb)**

The period of validity of this Certificate is as shown on Page 1 of this PAC. This Certificate consists of pages 1 to 42.

U. Agrawal



Embossing
Seal
of
BMBA

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: **20.12.13**

PART -- VI 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

ANNEXURE**BUILDING MATERIALS & TECHNOLOGY PROMOTION COUNCIL****QUALITY ASSURANCE PLAN FOR FACTORY MADE FAST TRACK MODULAR BUILDING SYSTEM**

S. No.	Stage/ Description	Product Features	Measurement Means	Frequency of Testing
A. E Welded Mesh / Concrewall Panel				
1.	Acceptance of the raw materials i) Steel Mesh ii) Polystyrene (EPS) Amount of material, Visual inspection, Specifications verification and Dimensional controls	Quantity, Appearance & completeness/ Brand, Compliance of material and Dimensions as per manufacturer Specifications	Visual, Vernier Caliper and Tape measure	Every Lot
2.	Straightening and cutting wire Coil steel wire straightening and cutting in the right size of the longitudinal and transversal wires	Dimensions and Condition of material as per manufacturer Specifications	Visual and Tape measure	Every Length
3.	Electro welding Steel wires welding to obtain a mesh	Dimensions and Orthogonally as per manufacturer Specifications	Tape measure	Every dimension of the panels
4.	Shaping polystyrene Cutting the polystyrene panels from the blocks in right dimensions	Dimensions as per manufacturer Specifications	Tape measure and Vernier caliper	Every dimension of the panels
5.	Welding/Assembling panels Assembling electro welded mesh and polystyrene panels	Dimensions and Orthogonally as per manufacturer Specifications	Tape measure and Vernier caliper	Every dimension of the panels
B. Other Materials/ Products				
S. No.	Parameters to be inspected	Requirement Specified	Test Method	Frequency of Testing
1.	Cement – PPC, OPC 43 & 53 Grade i) Compressive strength ii) Setting time	As specified	IS 1489(Part 1):1991 IS 8112:1989 IS 12269:1987	For Every Batch -- As per Manufacturer Plan QP-01
2.	Fly Ash Grade I – Fineness, Lime reactivity, Compressive strength, Drying shrinkage and Soundness	As specified	IS 3812 (Part 1):2003	As specified in Manufacturer Plan QP-02
3.	Coarse Aggregate (Metal) – Grading, Fineness Modulus, Specific gravity, Water absorption, Moisture content, Flakiness index, Elongation, Deleterious substance,	As specified	IS 383:1970	As specified in Manufacturer QA Plan QP-03

	Soundness, Aggregate impact & crushing value and Abrasion value			
4.	Fine Aggregate (Sand) -- Grading, Specific gravity, Water absorption, Moisture content, Deleterious substance, Soundness	As specified	IS 383:1970	As specified in Manufacturer QA Plan QP-04
5.	Water	As specified	IS 456:2000	As specified in Manufacturer QA Plans QP-05 & 06
6.	Concrete	As specified	IS 456:2000	As specified in Manufacturer QA Plans QP-07
7.	Reinforcement -- Mild steel Grade I, Fe 415 & Fe 500 Grade	As specified	IS 1786: 2008	As specified in Manufacturer QA Plans QP-08
8.	Structural elements – Columns, Beams and Slabs	As specified	IS 800:2007 IS 801:1975 IS 2062:1992	As specified in Manufacturer QA Plans QP-09
9.	ISMB/ISMC/ Chequered plates/ MS angles	As specified	IS 808:2004	As specified in Manufacturer QA Plans QP-10
10.	Door and Window i) Frames—Metallic (GI/MS/Al) ii) Shutters – Plywood/Flush/Poly norm	As specified	IS 3614:1992 IS 4020:1998	As specified in Manufacturer QA Plans QP-11 & QP12
11.	Tiles – Vitrified/Ceramic/Glazed	As specified	IS 13630:2006	As specified in Manufacturer QA Plans QP-13
12.	Paver Blocks/ Chequered Tiles/Marble mosaic	As specified	As per MTC and Company Standardss	As specified in Manufacturer QA Plans QP-14
C. Raw Materials				
1.	Zinc Coated Drawn Steel Wire Mesh	Steel mesh 2.0 mm @ 100mm/cc Tensile strength shall be 600 – 715 MPa, Welding Strength – Pull out rate for single point 46 kgs	As per MTC and Company Standard	Every Lot
2.	Expanded Sintered Polystyrene(ESP	Density shall be 18-20 kg/mm ³ , Length shall be 2.8 – 3.25 m, Width shall be 0.825 – 1.10 m ant thickness shall be 100 mm	As per MTC and Company Standard	Every Lot