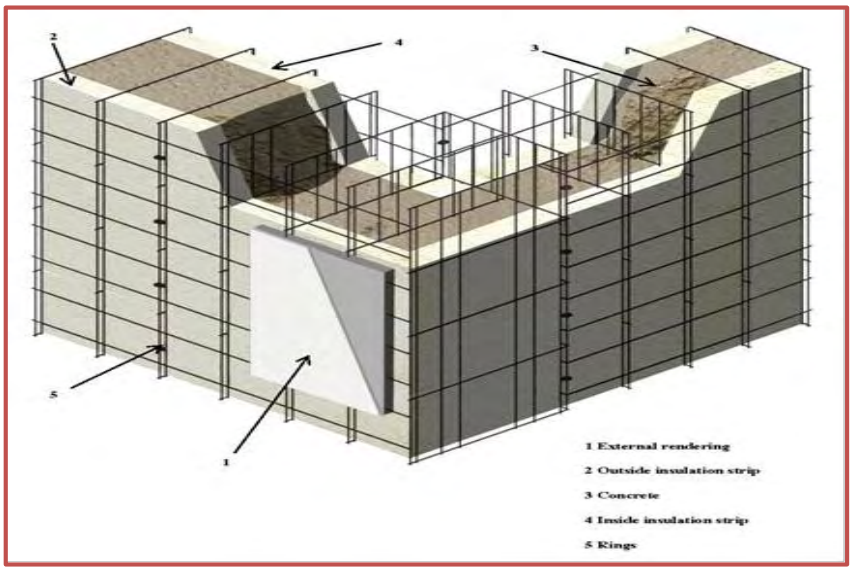
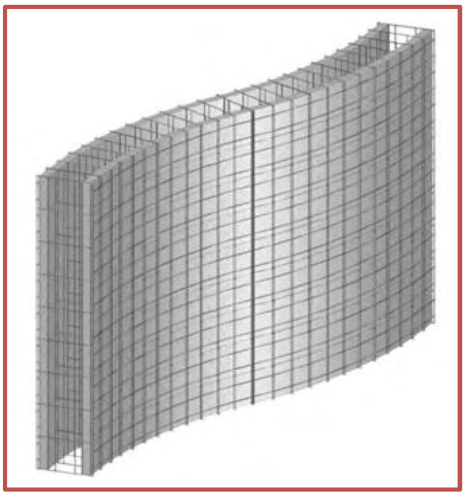
BMTPC
PACS
PERFORMANCE APPRAISAL CERTIFICATION

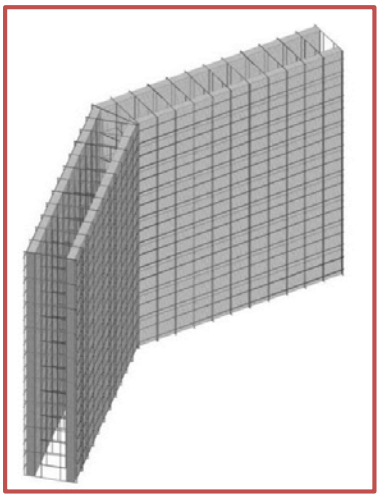
Sismo Building Technology

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:	Performance Appraisal Certificate No.
M/s M. K. S. Infosolutions Pvt. Ltd. **Plot No. 141, Sector 7,** **IMT Manesar,** **Gurgaon – 122050 (Haryana)**	PAC No **1025-S/2016** Issue No. **01** Date of Issue: **08.04.2016**







bmtpc

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation
Government of India
Core 5A, First Floor, India Habitat Centre,
Lodhi Road, New Delhi – 110 003

Tel: +91-11-2463 8096, 2463 8097; Fax: +91-11-2464 2849
E-mail: bmtpc@del2.vsnl.net.in Web Site: http://www.bmtpc.org

PERFORMANCE APPRAISAL CERTIFICATE

FOR

SISMO BUILDING TECHNOLOGY

ISSUED TO

M/s M K S Infosolutions Pvt. Ltd

STATUS OF PAC NO. 1025-S/2016

S.No	Issue No.	Date of Issue	Date of renewal	Amendment		Valid up to (Date)	Remarks	Signature of authorized signatory
				No.	Date			
1.	2.	3.	4.	5.	6.	7.	8.	9.
1	01	08-04-2016	08-04-2018	--	--	07-04-2018	--	

CONTENTS

PART 1 CERTIFICATION

1.1 Certificate Holder

Office : M. K. S. Infosolutions Pvt. Ltd.
A-65, East of Kailash,
New Delhi – 110065

Factory

: M/s M. K. S. Infosolutions Pvt. Ltd.
Plot No. 141, Sector 7
IMT Manesar, Gurgaon – 122050
(Haryana)
Tel: 0124-2290256, 011-41001640
Email: info@sismoindia.com

1.2 Description of system

1.2.1 Name of the System – Sismo Building Technology

1.2.2 Brand Name – Sismo

1.2.3 Brief Description – Sismo Building Technology is an insulating shuttering kit for whole building based on a three-dimensional lattice made of galvanized steel wire. The lattice is filled with materials of different nature to serve as formwork. The basic structure of the Sismo building module is steel wire lattice. At the exterior sides of the lattice, infill panels are inserted, which transform the lattice into a closed structure that can be filled with concrete. The type of infill panels used depends on the purpose of the wall: load bearing or not, insulated or otherwise, etc. The steel wire also acts as armature and anchoring for the finished material and it holds reinforcement bars in place during concrete filling.

This technology was initially developed in Belgium and the firm has a collaboration with n. v. Desmo-Home "Sismo" Ltd. Belgium.

Description of the components is as follows:

- 3D lattice (2.2 mm Ø galvanized steel wire)
- Infill panels (EPS, rock wool, mineral board)
- Structural filler (concrete)
- Finishing (plastering, natural stone, paneling etc.)

Typical detail of a wall is shown in Fig.1.

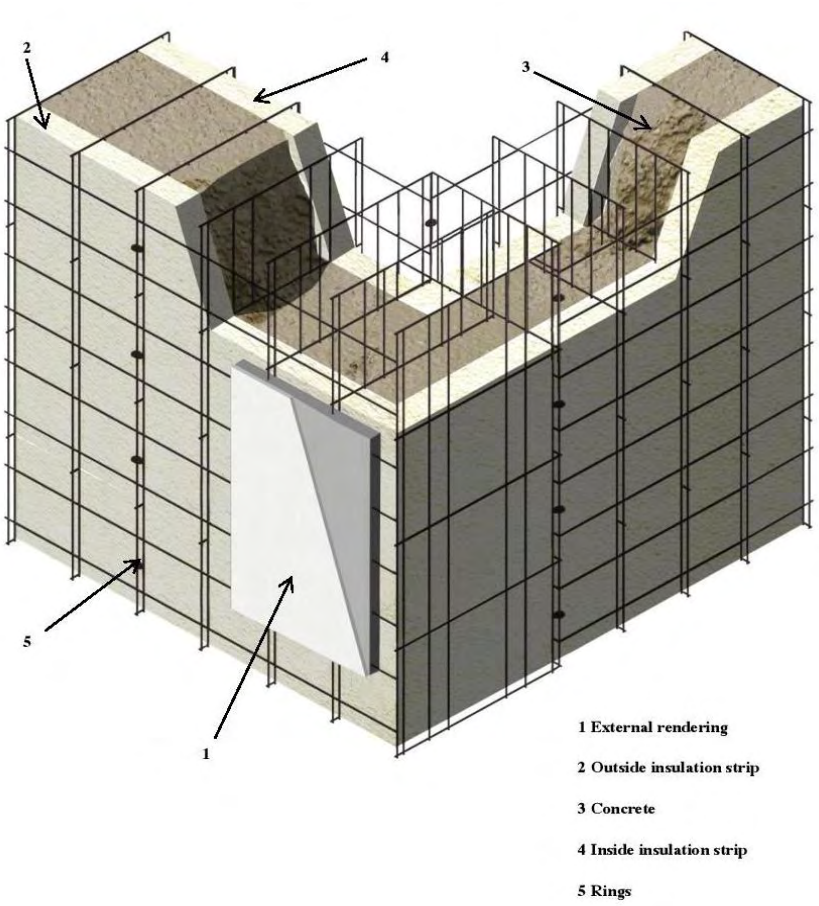


Fig. 1 Sismo Wall

1.3 Modules

1.3.1 *Type of Modules*

Depending on the internal and external material, the walls may be divided into following types:

(i) Inside & outside insulation (EPS) strips symmetrical and asymmetrical
(ii) Inside board and outside insulation (EPS) strips
(iii) Inside & outside board strips
(iv) Inside & outside insulation strips
(v) 2 Sismo walls decoupled and insulated for an optimized acoustic performance. This type is typically used as separating wall between apartment and houses.
(vi) Module with insulation strips as core material

Sismo floors and roofs may be plain, one and two-way slabs; as per requirement.

Detail of these modules is shown in Figs. 2 to 5.

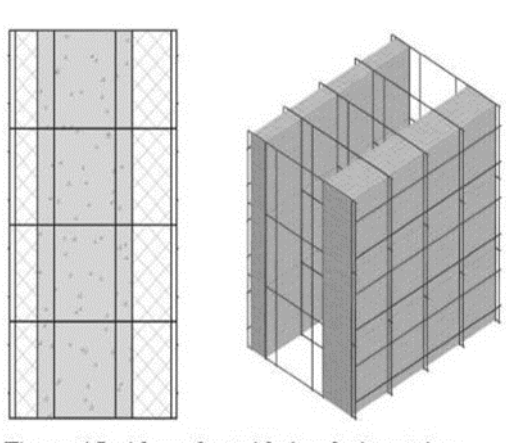


Fig. 2 Inside & outside insulation strips

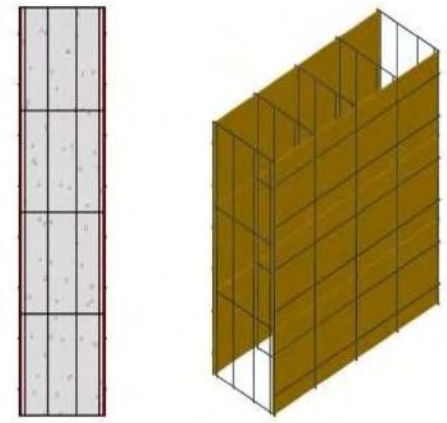


Fig. 3 Inside board & outside insulation strips

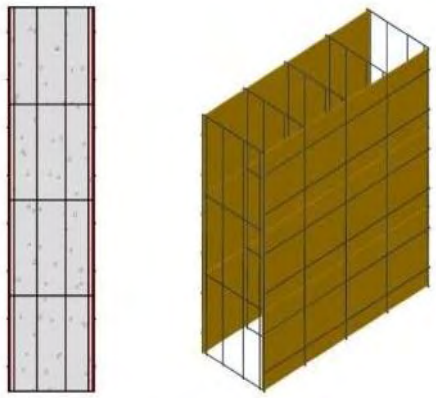


Fig. 4 Inside & outside board strips

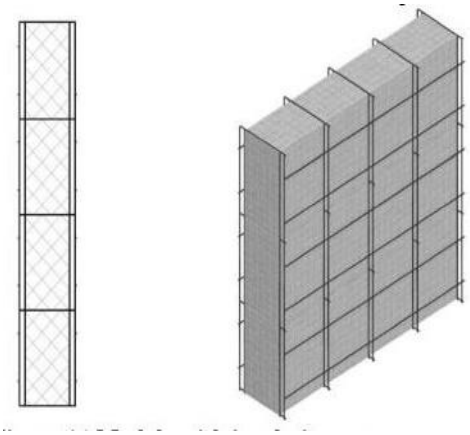


Fig. 5 Module with insulation as core

1.3.2 *Designation of Modules*

The format used for designation of modules is as follows:

- Walls: $SX_1\_X_2X_3\_X_4X_3\_X_5$
- Floors FX_6

Where

X_1 = thickness of steel lattice in cm = 6, 8, 10, 15, 20, 25, 30, 35, 40, 45 or 50

X_2 = thickness of internal insulation in cm = 4

X_3 = type of shuttering material i.e. EPS or FCB

X_4 = thickness of external insulation in cm = 4

X_5 = SW (single wire) or 2SW in absence of 1 cm protruding wire on inside and both sides of the panels respectively as shown in Figs 6 & 7.

X_6 = thickness of the floor measured from the 1 cm protruding wire up to top of the interjoist from 15 to 40 cm as shown in dimension X in Fig. 8.

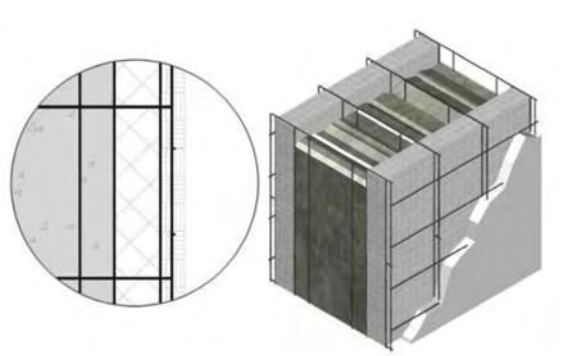


Fig. 6 With protruding lattice (double wire), ± 20 mm rendering

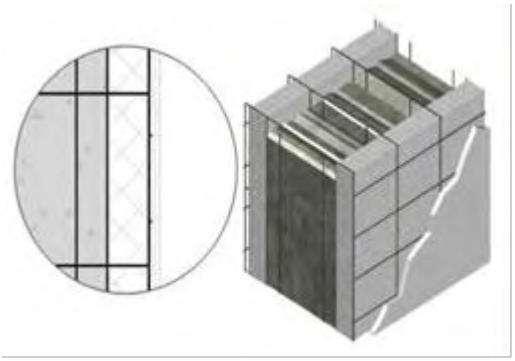


Fig. 7 Without protruding lattice (single wire), ± 10 mm rendering

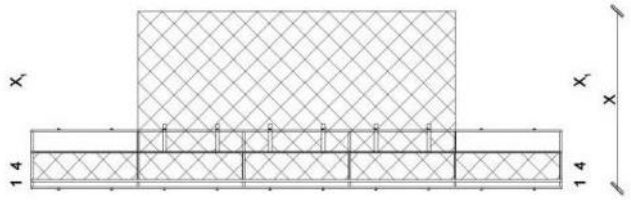


Fig. 8 Floor module with EPS interjoist to create a girder-slab floor

1.4 Description of the Components

1.4.1 *Steel Lattice*

The steel wire frame, formwork for the walls, shall be available in panels of different dimensions as follows:

- Height: in multiples of 15 cm, with a max. of 12 m
- Length: in multiples of 10 cm, with a max. of 1.2 m
- Thickness: Max. 50 cm, depending on the type of wall /roof required

Detail of steel lattice is shown in Figs. 9 to 11.

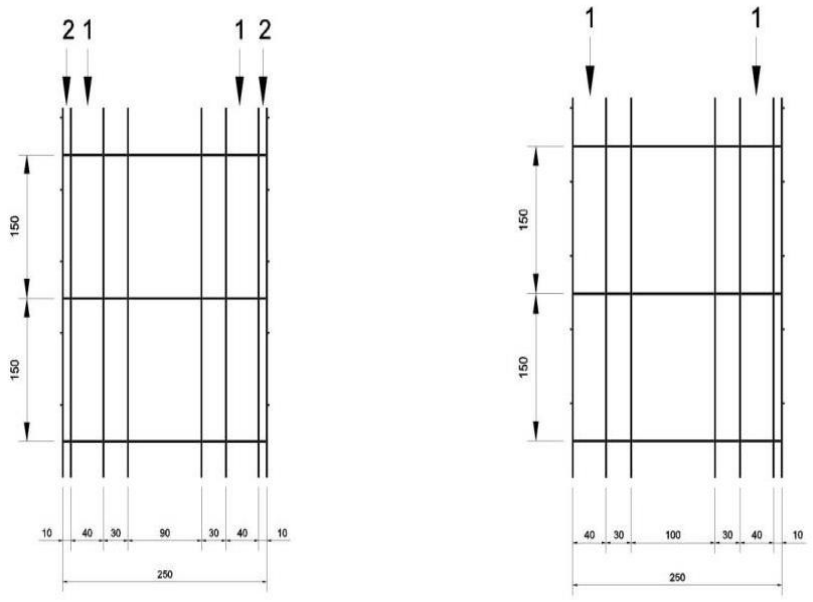


Fig. 9 Vertical cross-section of steel wire lattice. Figure on right one side without 1 cm protruding lattice (single wire frame on one side). 1 indicates position of insulation strips and 2 the position of sheet strips

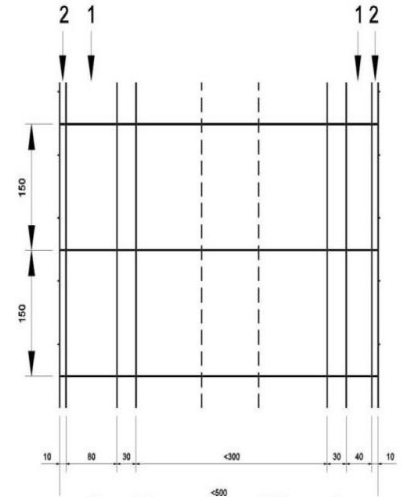


Fig. 10 Cross-serction up to 50 cm

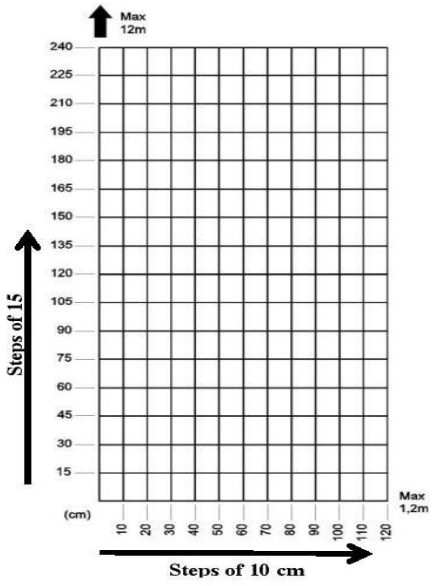


Fig. 11 Modular dimension of module

1.4.1.1 F*unctions of steel lattice*

The steel wire lattice has the following basic functions:

(i) To resist hydraulic pressure of fresh concrete during pouring and first hours of hardening

(ii) To keep reinforcement bars in place during pouring of concrete

(iii) To ensure adhesion (and reinforcement) of finishing when using mineral based renders

1.4.2 *Insulation strips and Interjoists*

The insulation strips have following functions:

- Maintain fresh concrete during the provisional phase of pouring
- Thermal insulation in final phase
- Support of interior and exterior finishing

The strips have fixed dimensions and shall be fixed with tongue and groove: 15mm x 20 mm for EPS strips of thickness 3.8 cm to 11.8 cm and 10 mm x 15 mm (h x w) for other strips of thickness 3.8 cm as shown in Fig. 12.

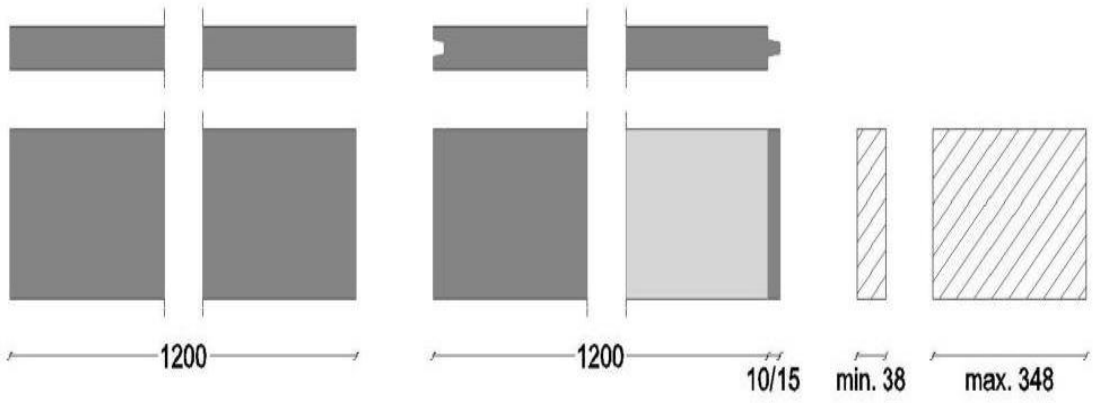


Fig. 12 Insulation strips with or without tongue and groove

The interjoists have following functions:

- Creation of ribs in order to have a one or two-way girder-slab floor
- Thermal insulation in final phase

The interjoists shall have fixed dimensions (length 120 cm & width 45 cm) but may be cut in length in multiples of 10 cm and width in multiples of 15 cm. These shall be available in various thicknesses from 10 cm to 35 cm. These shall have a 'waffle' structure (10 cm x 7.5 cm) and the groove has depth of 3 cm and a width of 1 cm. Their shape ensures a good grip on the metal frame of the floor modules.

The details of one-way girder-slab floor are as follows:

- The center to center distance between the ribs is in multiples of 15 cm
- The width of the ribs is 15 cm or in multiples thereof.

The details of two-way girder-slab floor are as follows:

- The center to center distance between the ribs is in multiples of 15 cm on one side and 10cm on the other side
- The width of the ribs is 15 cm or in multiples thereof on one side and 10cm on the other side.

The details of these slabs are shown in Figs. 13 to 17.

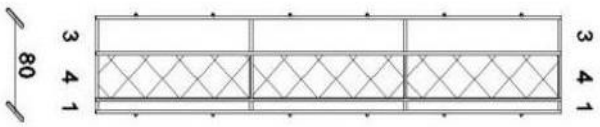


Fig. 13 Module for a deck slab

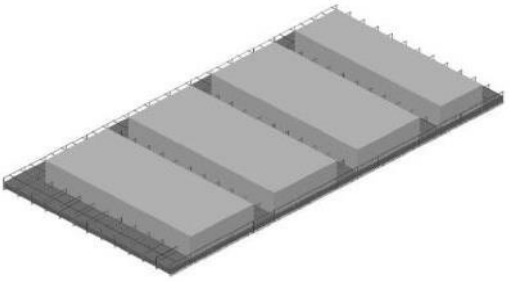


Fig. 14 EPS block for floor module

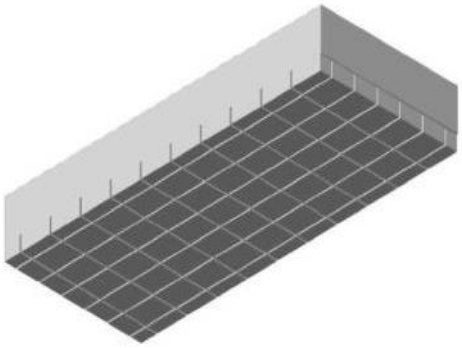


Fig. 15 One-way girder-slab floor

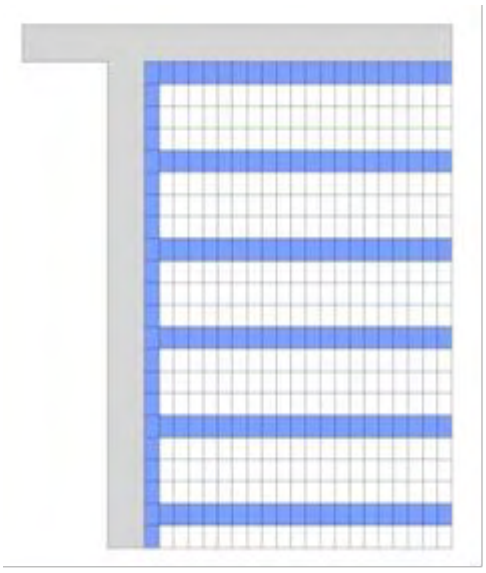


Fig. 16 One-way girder-slab floor

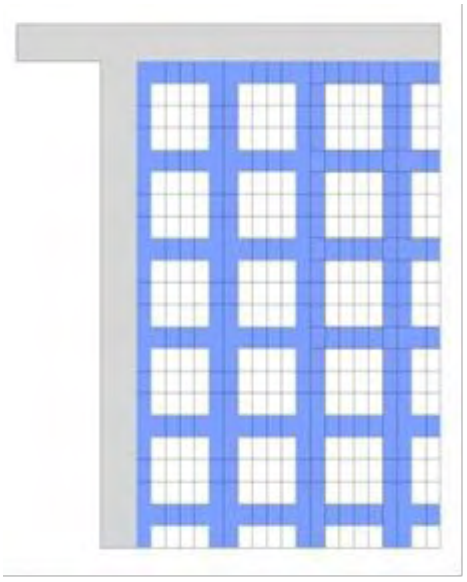


Fig. 17 Two-way girder-slab floor

1.5 Modulation and Manipulation of the Lattice

1.5.1 *Modulation of Lattice*

(i) External and internal walls shall be drawn in elevation and in section using the modular dimensions (15 cm high & 10 cm wide) of the lattice as a unit

(ii) The corners of rectangular units shall correspond to the corners of the lattice. Curves, pitches and starting points shall be determined as required. The top and sides of the openings shall be closed with infill panels.

(iii) The level of the upper side of the unfinished floor slabs shall correspond to that of a vertical 15 cm modular unit, so that the walls shall be continued in 15 cm units.

(iv) In the ground plan, lattices shall be directly placed next to one another. The planning module of 10 cm shall always be used. If this can't be followed, attention must be paid to the assembly of the lattices in that place.

(v) Every effort shall be made to ensure that the lattices are assembled in such a way that their length is always in multiple of 15 cm and height in multiples of 10 cm.

Detail of the modulation is shown in Fig. 18.

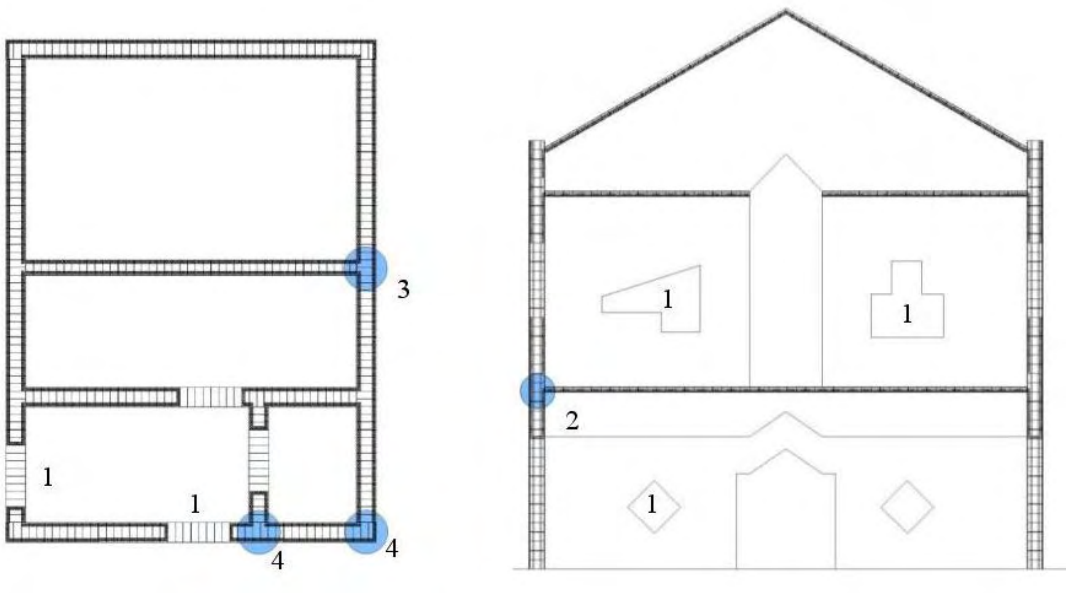


Fig. 18 Modulation

1.5.2 *Modulation Techniques*

1.5.2.1 *Openings:* Openings shall be determined in terms of modular units. The corners of the rectangular openings shall correspond to the corners of the lattice, as shown in Fig. 19. Slanting and arched

openings are possible. Curves, pitches and starting points shall be determined as required.

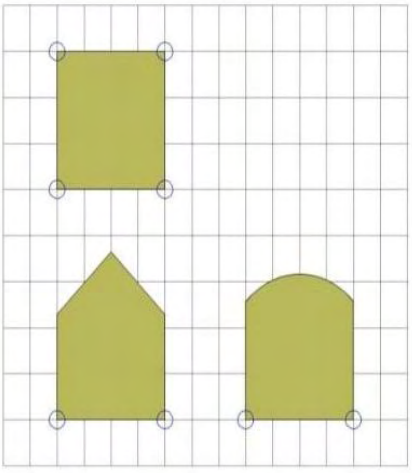


Fig. 19 Corners of rectangular openings

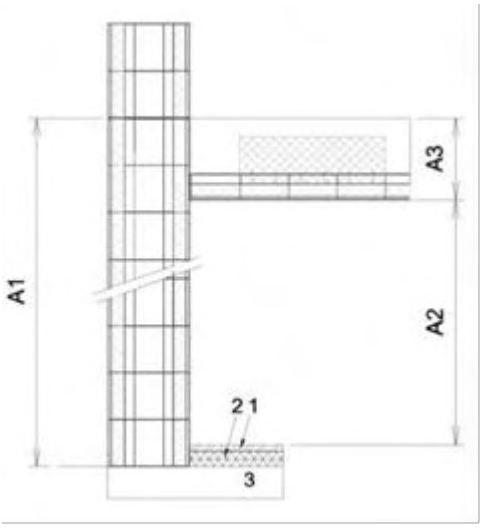


Fig. 20 Level of unfinished floor

1.5.2.2 L*evel of floor slabs:* Level of the upper side of unfinished floor slabs shall correspond to that of a vertical 15 cm module so that the walls may be continued in 15 cm modules. The thickness of the structural floor slab is variable as shown in Fig. 20.

1.5.2.3 Junctions*:* The lattices of outside walls should be allowed to continue past the connecting internal walls. Where lattices meet, one side of the lattice, not being continued, should connect up to 10 cm module of the lattice that is being continued as shown in Fig. 21.

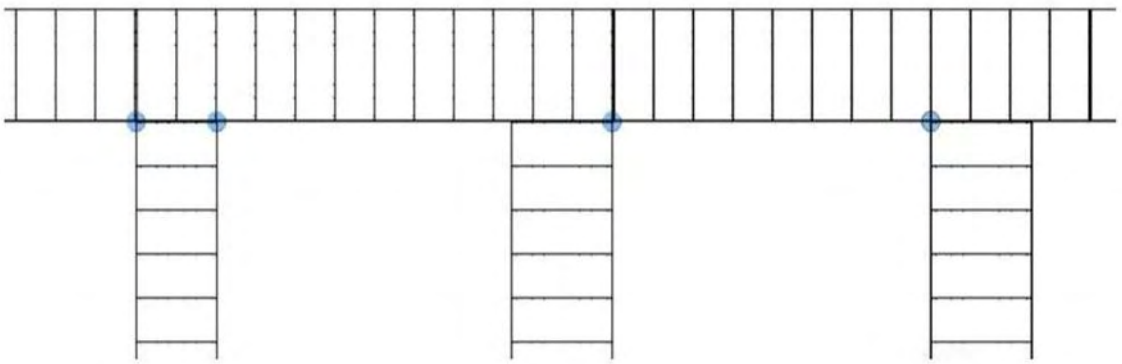
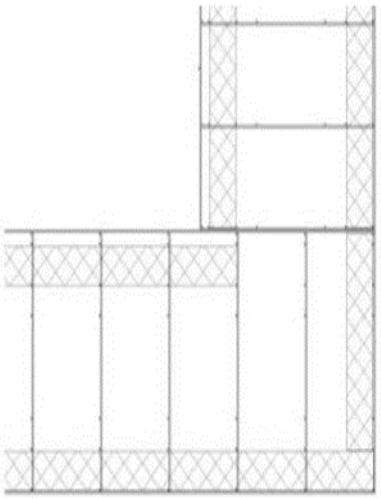


Fig. 21 Junctions, one side of lattice shall connect to the continuing wall

1.5.2.4 *Corners and T-junctions:* Corners and T-junctions shall be formed by placing the lattices against one another so that the lattice continues past the other as shown in Fig. 22.



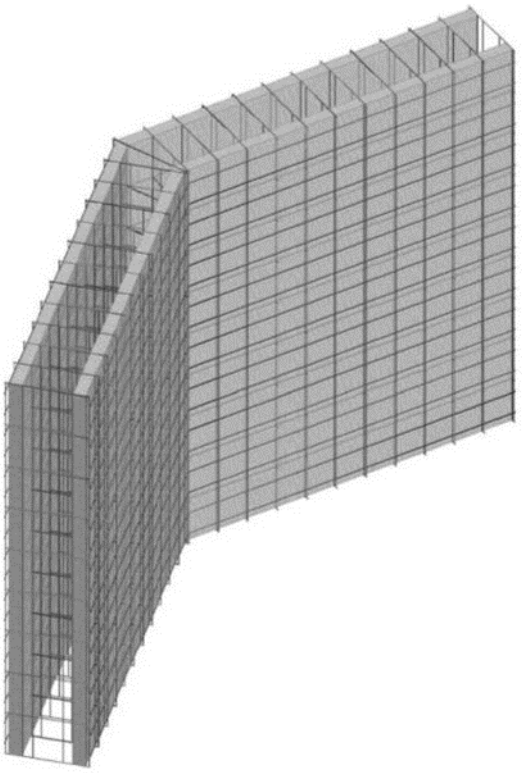
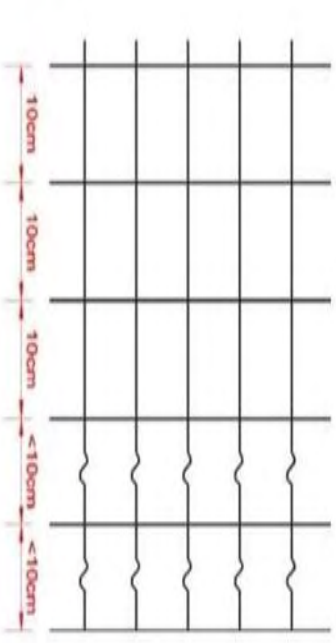


Fig. 22 Junction. One lattice continues past the other **Fig. 23 Bending the lattice**



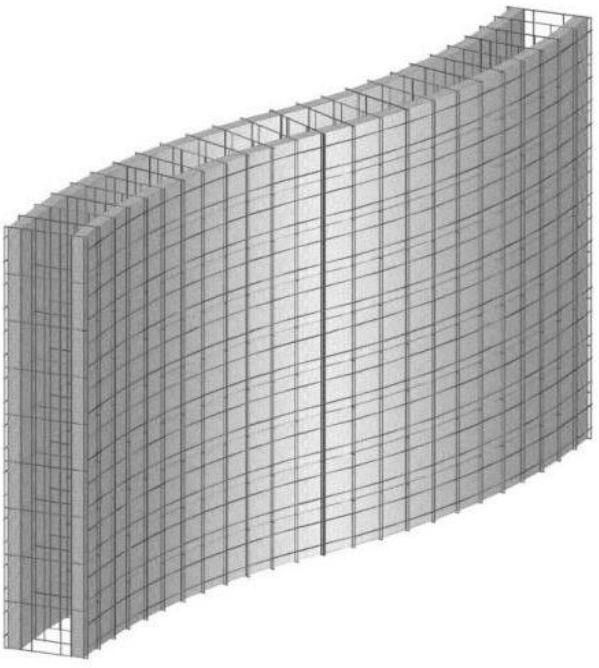


Fig. 24 Shortening the lattice **Fig. 25 Setting curves with the lattice**

1.5.3 *Manipulation of the Lattice*

As the lattice is made of steel wire, it can be molded to any shape. Such modifications shall be made during the production process.

1.5.3.1 *Bending the lattice:* The lattice can be bent continuously from 0º to 90º as shown in Fig. 23.

1.5.3.2 *Shortening the lattice*: When required, the lattice may be shortened by inserting trucks in the steel wire as shown in Fig. 24.

1.5.3.3 *Setting curves with the lattice:* The minimum external radius that the lattice can assume depends on the overall thickness of the lattice, as shown in Fig. 25 and as the following guide:

- For thickness of 5 cm to 20 cm, R > 100 cm
- For thickness of 20 cm to 30 cm, R > 130 cm
- For thickness of 30 cm to 50 cm, R > 150 cm

1.6 Production Process and Machinery

1.6.1 *Production Process*

The production of the modules is carried out in the Sismo Production Station (SPS). The main stages of production include:

- Unwinding of steel wire rolls
- Cutting and straightening of steel wire
- Assembly and welding of two-dimensional lattices
- Assembly and welding of three-dimensional lattices
- Cutting of insulation strips and interjoists
- Insertion of the insulation strips into three-dimensional lattice at the lateral intervals intended for this purpose.

The fixing of the panels and placing of interjoists on respective walls and floors is done at site. Panels are installed after hardening of concrete.

The production is carried out according to an internal factory production control plan. Production flow chart is given in Annex I.

Conformity checks are done on incoming materials and at regular stages throughout the production sequence to ensure the fitness of the components as per Quality Assurance Plan attached at Annex II.

1.6.1.1 *Accessories*

The accessories required for erection of the walls in construction site shall be as follows:

- *Struts*: to support the panels during installation and pouring of concrete (max. distance of 2 m between two panels) as shown in Fig. 26.
- *Strut for stanchion:* to support stanchion for guard rail and used to align and support the top of panels at floor level during installation and pouring of concrete as shown in Figs 27 & 28.
- *Hollow profiles*: to support the panels during installation and pouring of concrete (max. distance of 2 m between two panels) as shown as red in Fig. 29.
- *U*-profiles: to connect the hollow profiles with horizontal steel wire supporting the panels during pouring of concrete as shown in Figs. 26 to 32.
- *Stapler & Rings*: to connect the panels (7 rings per linear meter, on each side of the wall, back and front) as shown in Figs 1 & 33 respectively.
- *Lop ties and Tie twister:* to secure the reinforcement bars to the metal frame as shown in Fig 34.
- *Cutter*: to cut the steel wire at the openings (doors, ceilings etc.) after hardening of the concrete as shown in Fig. 35.
- *Boards*: (3cm/12 cm) for proper alignment of the walls as shown in Fig 27.
- *Props and Shuttering boards (e*.g. CFB): as support for floors to spread the concentrated loads of the vertical props. The number of vertical props may be reducing by using load spread beams as shown in Figs 36 & 37.

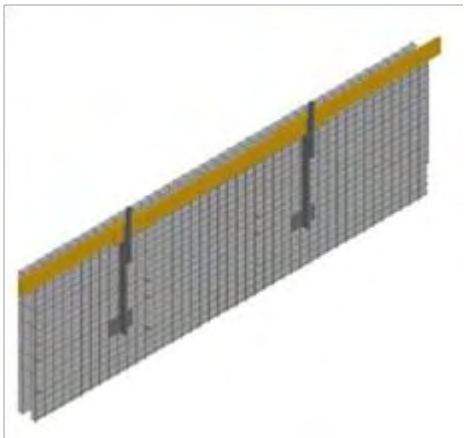
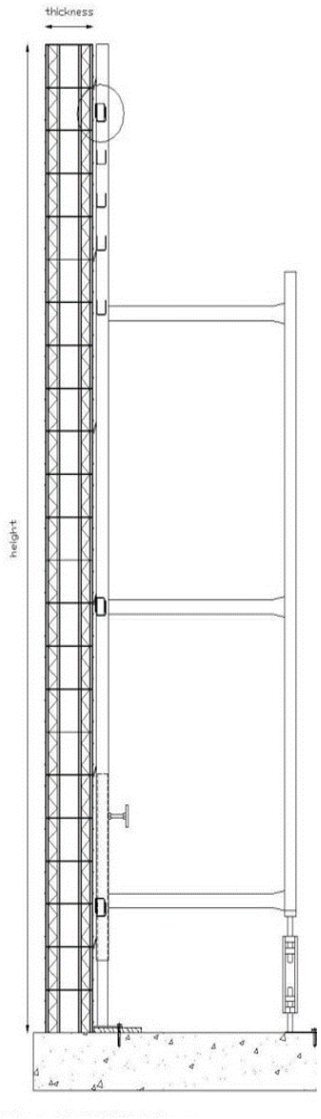


Fig. 28 Struts for stanchions used for alignment of panels Fig. 29 U-profiles



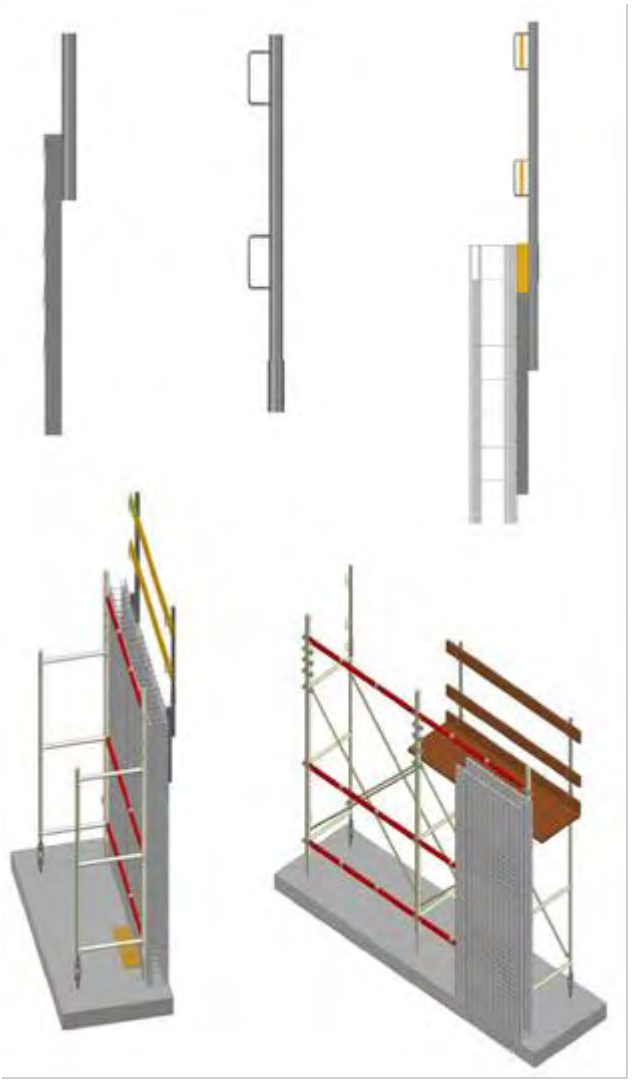
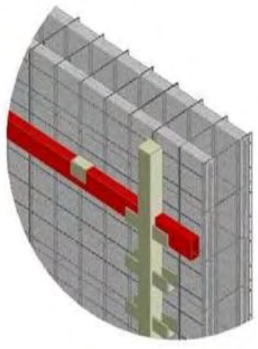


Fig. 26 Strut Fig. 27 Stanchion and strut for stanchion to create guardrail, board to align panels



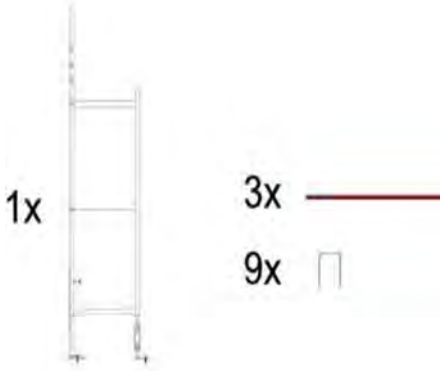


Fig. 31 U -profile **Fig. 32 Hollow profiles** **Fig. 30 1 set of struts: 1 strut, 3 hollow profiles & 9 U-profiles**

Fig. 33 Stapler & staples

Fig. 34 Loop tie & Tie twister

Fig. 35 Wire cutter

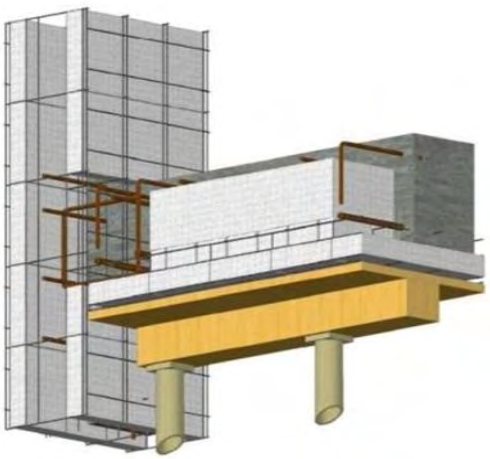


Fig. 36 & Fig. 37 Floor props supporting beams and shuttering boards

1.6.2 *Production Machinery and Equipment*

The components of fully mechanized SISMO Production Station (SPS-7) are given below:

1) *3D machine:* The machine is made of two parts attached to each other -- welded part with wire-holder and feeding part. The 3D machine transforms the 2D-wire mesh into a 3D lattice.

2) *2D machine:* The machine serves for cross welding of wire mesh.

Mesh width	max. 800 mm
Mesh length without multiple transports:	max. 2000 mm
Cross wire diameter	2.2 mm
Line wire diameter	2.2 mm

3) *1D-machines:* The machines straighten rolled up steel-wire and cut it at the right length.

Steel wire:	max. 2.2 mm
Length cut steel-wire:	12000 mm

4) *Transporter*

5) *Sample kit* including stapler and scaffolding structure.

1.7 Design Philosophy

1.7.1 *Strategy*

The design strategy is to exploit concrete to the ultimate and standard solutions for reinforcement shall be used, wherever required. 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. In seismic prone areas requiring seismic resistant construction, relevant provisions of IS 1893 (Part 1):2002, IS 4326:1993 and IS 13920:1993 shall apply.

1.7.2 *Basic principles of designing plain concrete*

Design of the walls, panels, floor slabs etc. are done using Sismo software (Siscad).

i. The optimal result is obtained when walls shall be designed as braced construction elements whose horizontal loads are supported by other bracing elements belonging to the same construction e.g. shear walls.

ii. Walls subjected to bending or axial load & bending and for the rest subjected to wind load parallel or perpendicular to the plane of the wall shall be designed without steel reinforcement, provided following condition is met:
$m_d + m_{t,i} \leq m_u$
where
m_d = the design value for the limit state of collapse, of the max. bending moment per unit length, due to the loads liable to act on the structure
$m_{t.i}$ = the design value for the limit state of collapse, of the accidental restraint moment
m_u= the ultimate bending moment per unit length occurring with the design value of the axial load applied to the center of gravity of the cross section

iii. *Wall-to–floor tie reinforcement:* When $m_{t,i}$ is too high to meet the above condition and it may be proved that a position equilibrium is possible for the limit state of serviceability, reinforcement shall not be required if accepted as per IS 456:2000. This equilibrium exists if the rotational capacity of the wall near to the wall-floor connection shall be sufficient to follow the rotation of the floor slab. If this equilibrium doesn't exist, wall to floor tie reinforcement shall be required.

iv. *Wall-to–wall tie reinforcement:* In bearing walls of houses and buildings where no special loads are to be considered, there shall be a continuous horizontal tie-reinforcement on every floor level. If not otherwise specified by IS 456:2000, the tie-reinforcement shall be omitted when the difference between the upper floor level and the terrain doesn't exceed 6.5 meter.

v. *Edge reinforcement in walls:* Vertical reinforcement shall be provided at the edges of bearing walls for houses and buildings where no special loads are to be considered. Reinforcement shall be provided around all doors and window openings. If not otherwise specified by IS 456:2000, edge reinforcement in walls shall be omitted when the difference between the upper floor level and the terrain doesn't exceed 12.5 meter.

vi. Splitting reinforcement at beams: Splitting reinforcement shall be required when the design value of bearing stress due to the concentrated load exceeds the design value of the concrete strength.

1.8 Assessments

1.8.1 Scope of Assessment

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

1.8.2 Basis of Assessment

Assessment of the suitability of the Sismo Building Technology is based on:

i) Inspection of production facilities during visit of the TAC members and IOs to the factory at Manesar
ii) European Assessment Technical Regulation
iii) Orientation tests concerning fire resistance of 'Loaded concrete floor element' and 'Vertical load bearing wall element" of three different sizes by a Lab in Belgium in 1984 & 1985.
iv) Test on reinforcement in November 2008 by Universitiet, Gent, Belgium
v) Sismo technology: Plain concrete in high rise buildings by Sismo Engineering, Belgium
vi) Guideline for European Technical Approval of 'Non-load bearing permanent shuttering systems based on hollow

blocks or panels of insulating materials' by EOTA, Brussels, Belgium

vii) Earthquake Analysis – Sismo Building Technology, Catholic University, Leuven, Belgium

viii) Measurement of the 'Sound reduction test R of a building' in May 2013 by Blasco bvbo, Belgium

ix) Determination of the strength of resistance in two types of steel wire grids in November 1991 by Research Centre of Belgium Welding Institute

x) Experimental Research in 92-93 & 93-94 by Sismo Engineering & CE Deptt., University of Leunen, Belgium

xi) Quality Assurance System followed by the Certificate holder for quality control of the system.

1.9 Use of the Sismo Building Technology

The technology shall be used for construction of structures consisting of load bearing walls, foundations, cellars, floors and roof etc. for residential, commercial and industrial purposes.

1.10 Scope of Inspection

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

1. 11 Conditions of Certification

1.11.1 Technical conditions

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

1.11.1.2 The production capability and quality of the panels and walls vis-à-vis requirements specified and competence of the technical persons for design and proper erection of the panels and walls at site shall need verification for each plant/ establishment engaged in the production of the modules.

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

1.11.2 Quality Assurance

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

1.11.2.1 Structures using the panels and walls shall be designed as per Clause 1.7 and executed as per provisions of this PAC.

1.11.3 Durability

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

1.11.4 Handling of User Complaints

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

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

1.12 Certification

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

PART 2 CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

2.1 General

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

2.2 Specifications for the System

2.2.1 Specifications

Specification for the raw materials and finished product shall be as per performance criteria when tested in accordance with the

company standard & relevant Indian Standards listed in this Certificate.

2.2.2 Raw Materials

(i) Hot galvanized steel wire shall conform to the specifications as given below:

- Zinc coating shall not be less than 60 g/m^2
- The dia. of the wires and rings shall be 2.2 mm ± 0.03 mm.
- Tensile strength: 680 N/mm^2 min.
- Chemical composition: C = 0.020 % min., Mn = 0.150 % min, Si = 0.250% max., P = 0.030 % max., S = 0.030 % max.

(ii) *Rings:* Rings shall be used to hold the panels together during installation phase.

(iii) *Insulation strips and panels:*

- *Expanded polystyrene (EPS):* shall conform to IS 4671:1984 and shall have density not less than 15 kg/m^3.
- *Fibre cement board (FCB) 5 mm thick:* shall conform to IS 14862:2000.

(iii) *Cast-in-place concrete:* The ingredients, grade of concrete & slump for walls, floors and roofs shall be used as per IS 456:2000..

2.2.3 Inspections & Testing

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

2.3 Implementation

2.3.1 *Handling, transportation and storage of panels*

- The handling of panels on site shall be done with gloves and protective glasses as they have sharp points.
- Loading and unloading of modules shall be done either manually or by machine.
- The modules shall be transported and stored sideways, standing or in a horizontal position. When stored and transported in horizontal position, extra care should be taken to limit stress because bottom panels of a pile horizontal staked modules have a higher risk of deformation.

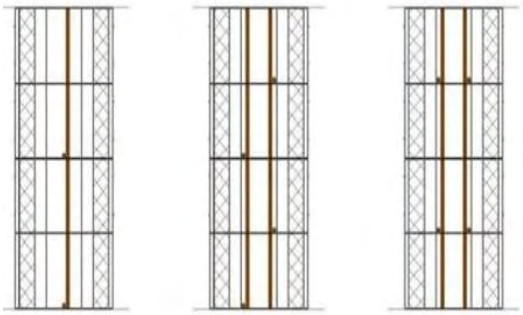
2.3.2 *Erection of Panels*

- The panels shall be placed on the foundation or on the floors. They shall be held together by rings (see Fig.1) longitudinally placed every 15 cm on both sides of the wall.
- In the initial phase, the panels shall be supported on one of their sides by struts (see Fig. 26) specially developed for this purpose. They shall provide lateral support to the panels till hardening of the concrete. The maximum distance between lateral supports should not exceed 2 m. It should be possible to transform the struts to scaffolding to allow access at the top of the casing to monitor pouring of the concrete.
- The free end of the panels (in case of openings, windows, doors or ceilings) shall be closed in the same manner as the common parts to ensure holding of fresh concrete.
- The verticality of the walls shall be checked before and during casting.
- The floor modules shall be temporarily, till hardening of the concrete, be supported by shuttering panels, beams and props (Figs. 36 & 37). When props are only calculated for supporting the weight of fresh concrete, circulation and curing platform shall be used.

2.3.3 *Placing of reinforcement*

- The modulated dimensions of the lattice shall be 10 cm horizontally and 15 cm vertically (see Figs 38 to 43) and in multiples thereof. The securing of the bars through the lattice, shall ensure a correct positioning of the reinforcement after pouring of concrete.

- Stirrups, straight, L and U shaped bars shall be placed during mounting of the modules. The lattice should not be combined with welded reinforcement mesh.
- The placing of vertical bars shall be done through the top of panels and shall progress together with the mounting of the panels.
- Horizontal bars for ties, lintels etc. shall be inserted sideways and progresses together with the mounting of the walls. It is sometimes required to remove the insulating strips used as formwork at the edge of the panels to be able to insert the horizontal reinforcement bars and then slide them back into position.
- Length of U-shaped horizontal bars used shall be 1 m for straight length and 30 cm for bend portion, wherever required.



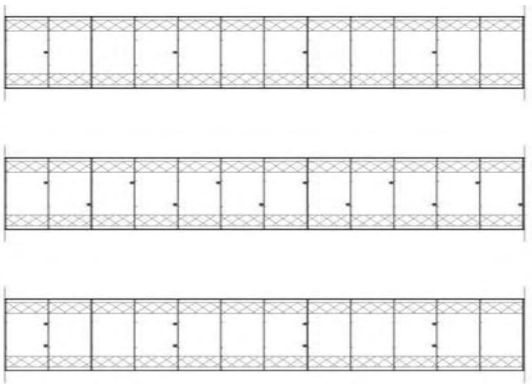
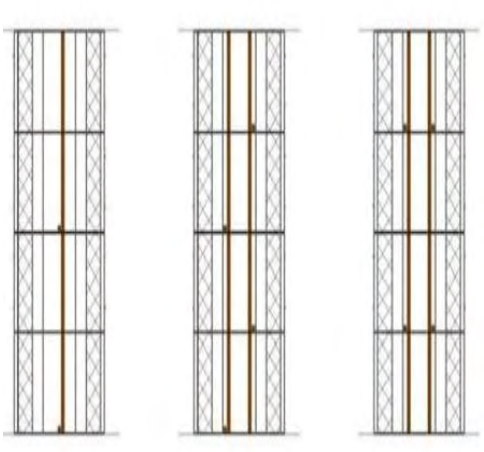


Fig. 38 Horizontal reinforcement bars **Fig. 39 Vertical reinforcement bars**



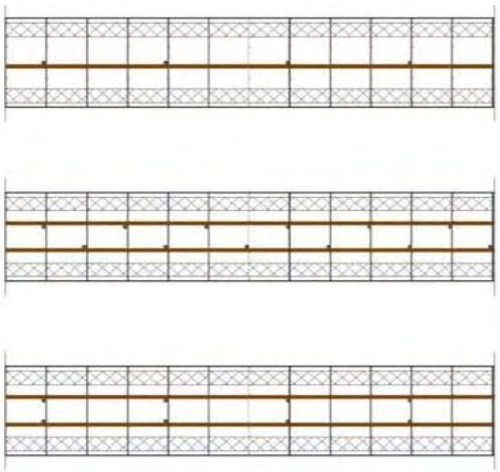


Fig. 40 Horizontal reinforcement bars **Fig. 41 Vertical reinforcement bars**

Positioning of reinforcement bars

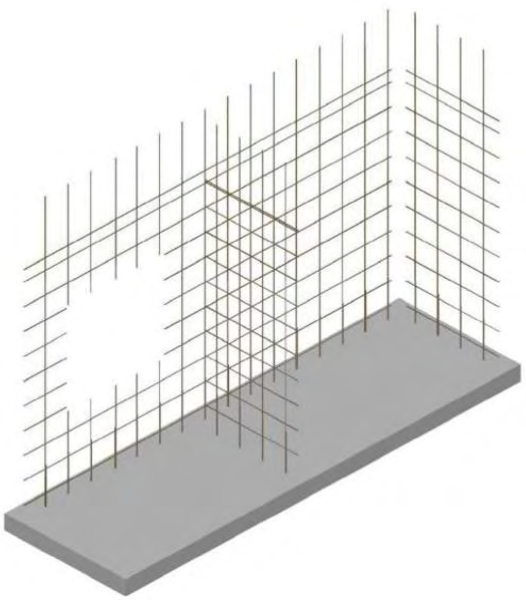


Fig. 42

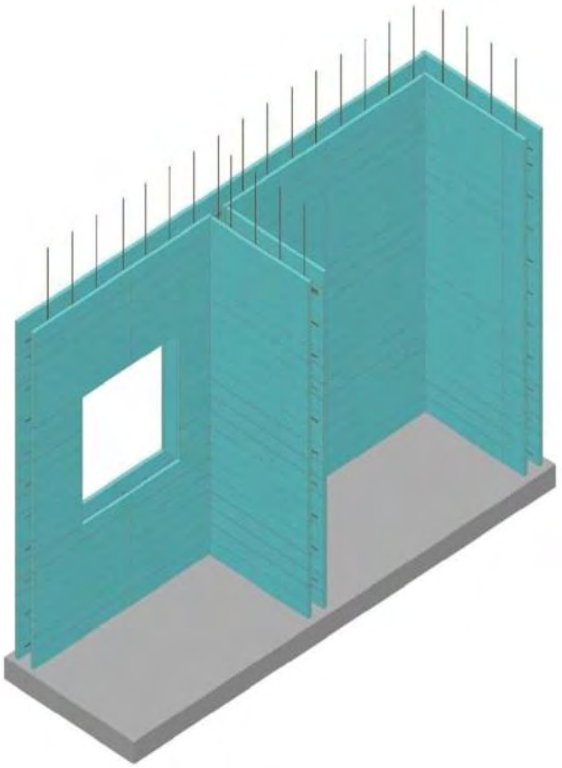


Fig. 43

Positioning of reinforcement bars

The detail of placing of reinforcement bars for Corner-connection, T-connection, Beam, Wall-Floor connection, Starter bars and Floor are given below:

i.*Corner –connection* (see Figs. 44 to 46)

- U-shaped horizontal reinforced bars
- U-shaped horizontal reinforced bars in the second wall
- Common vertical reinforced bars

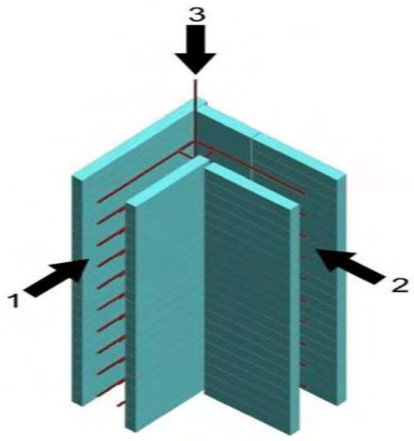


Fig. 44

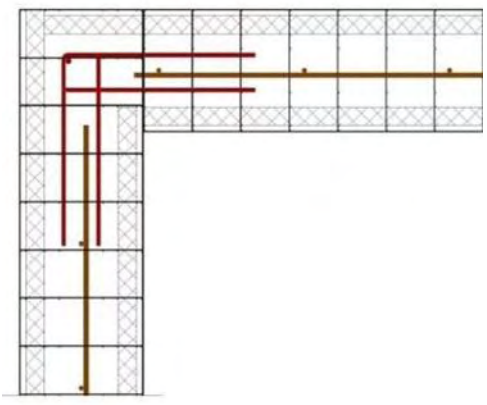


Fig. 45

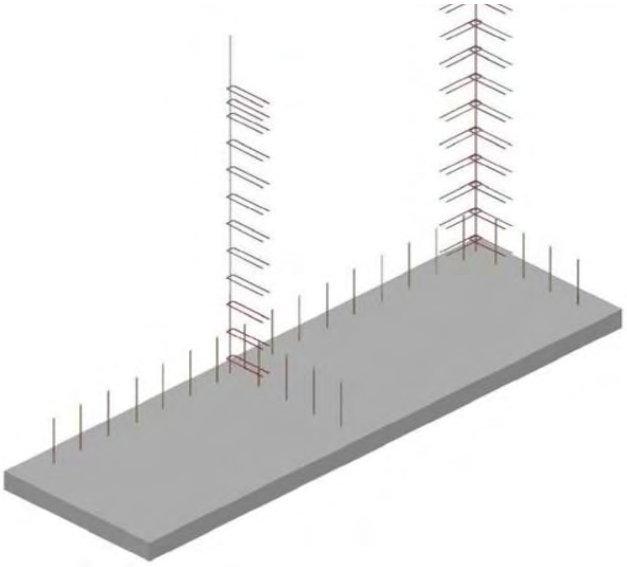


Fig. 46
Wall connection – Corner-connection

ii. T-connection (see Figs. 47 to 52)

- U-shaped horizontal reinforced bars in the wall to join
- Installation of the wall in T-connection
- Horizontal reinforced bars of a wall
- Common vertical reinforced bars

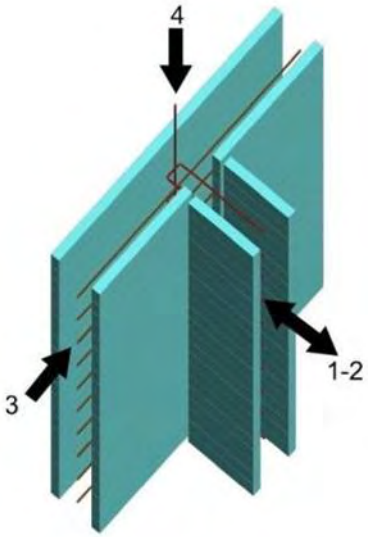


Fig. 47

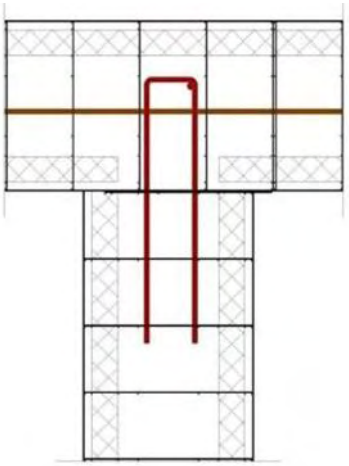


Fig. 48

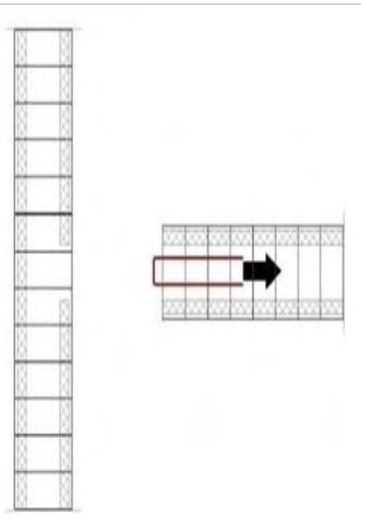


Fig. 49 (Step 1)

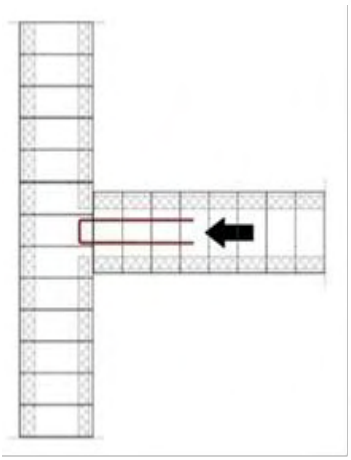


Fig. 50 (Step 2)

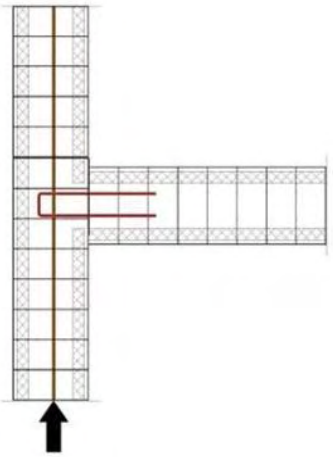


Fig. 51 (Step 3)

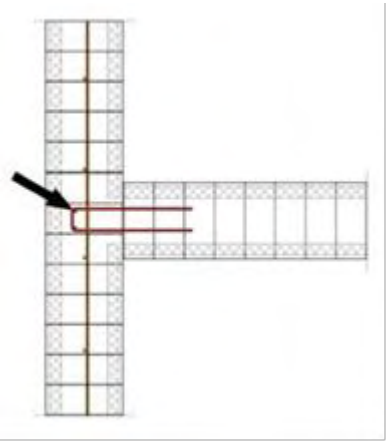


Fig. 52 (Step 4)

Wall connection – T-connection

iii. Beam (see Figs. 53 to 56)
- Vertical stirrups
- Horizontal reinforced bars

iv. Wall-floor connection (see Figs. 57 to 60)
v. Starter bars (see Figs. 61 to 62)
vi. Floor (see Figs. 63 to 66)

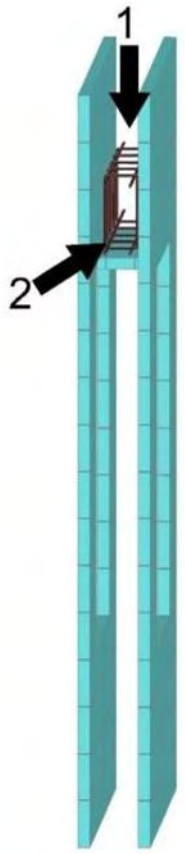


Fig. 53

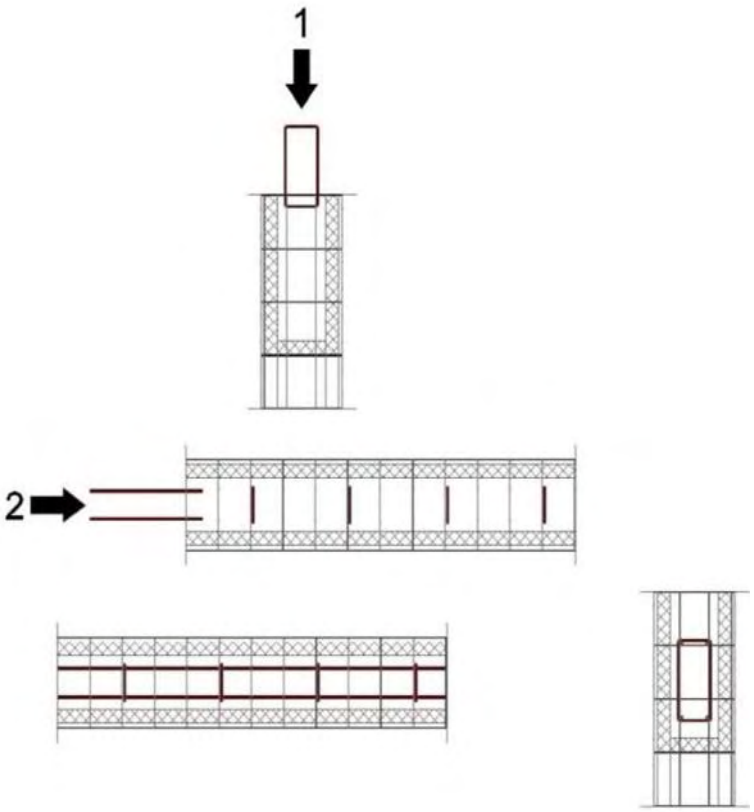


Fig. 54

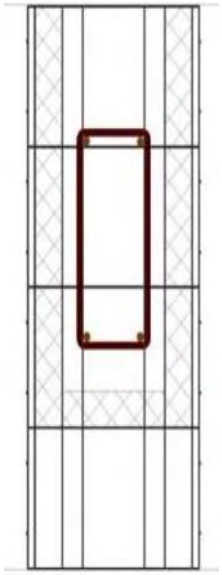


Fig. 55

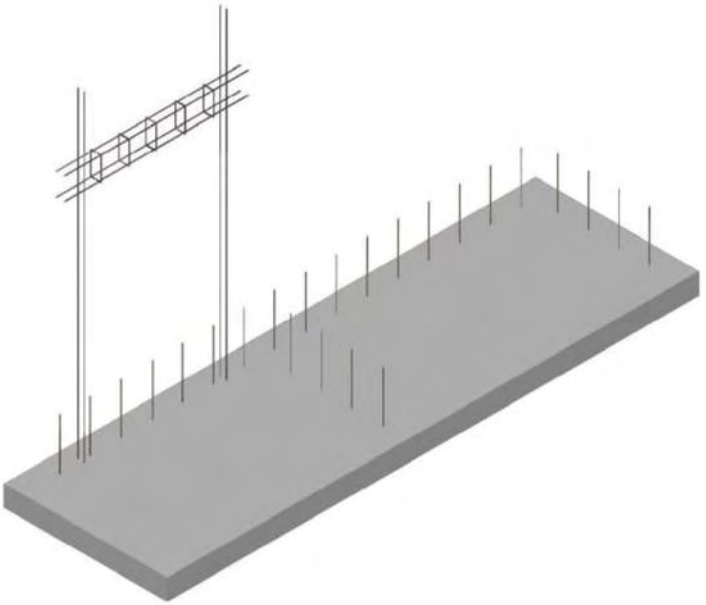


Fig. 56

Lintel/Beam

Fig. 57

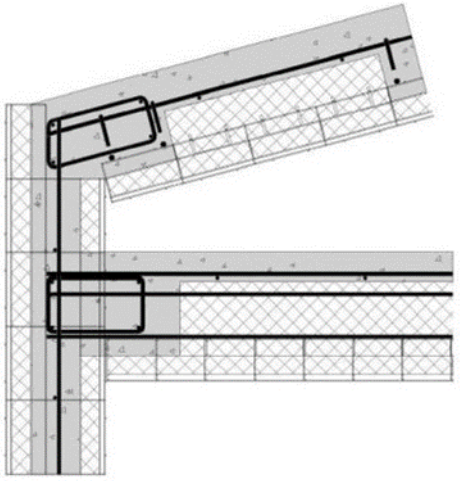


Fig. 58

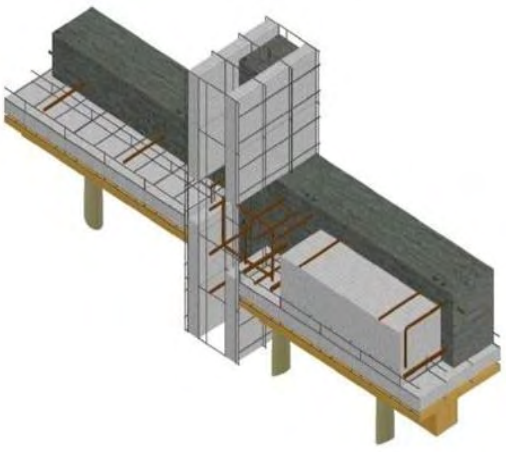


Fig. 59

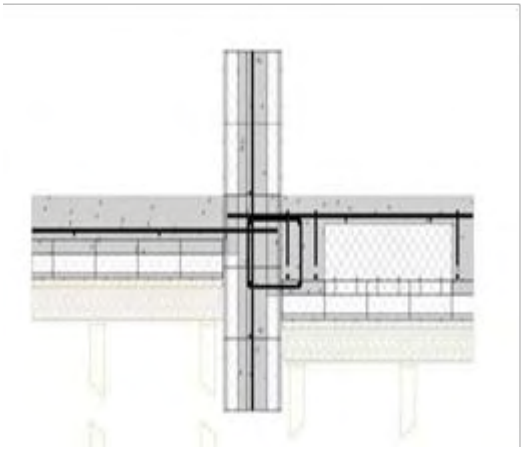


Fig. 60

Wall-floor connection

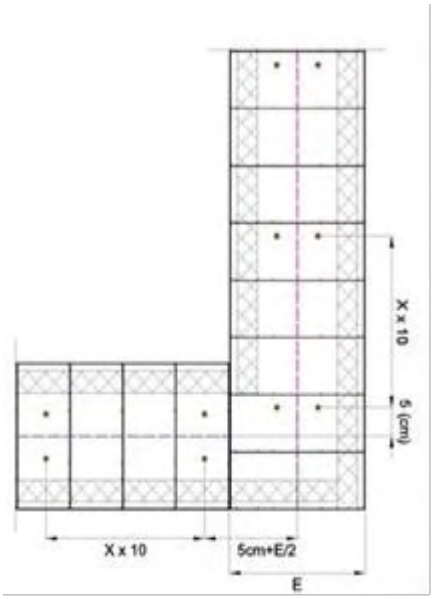


Fig. 61

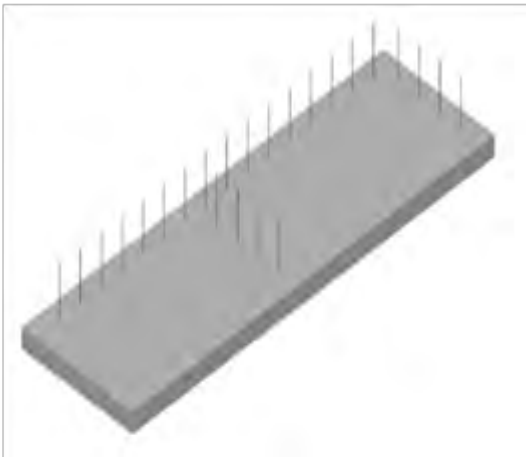


Fig. 62

Starter bars

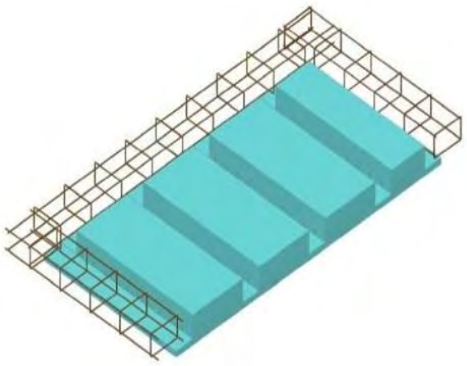


Fig. 63

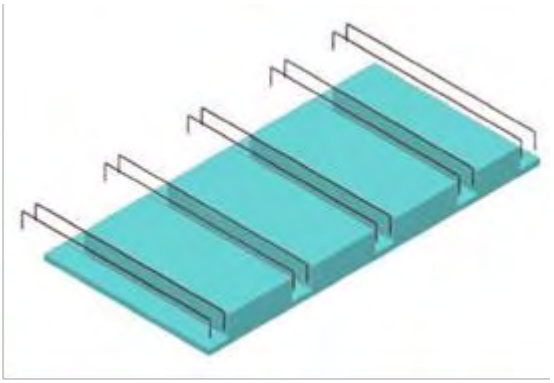


Fig. 64

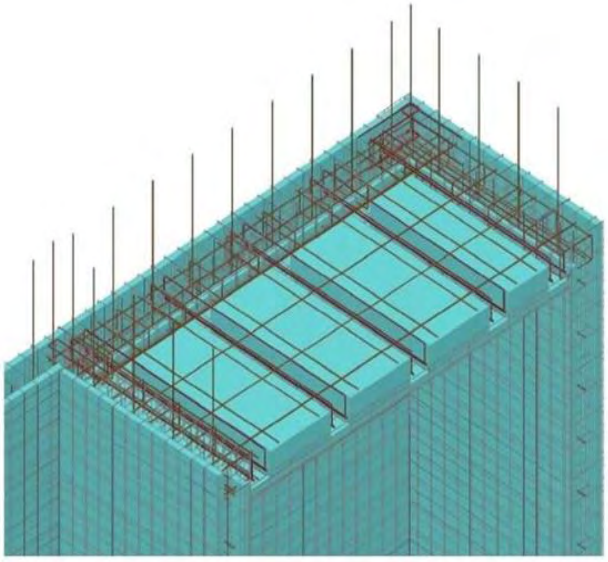


Fig. 65

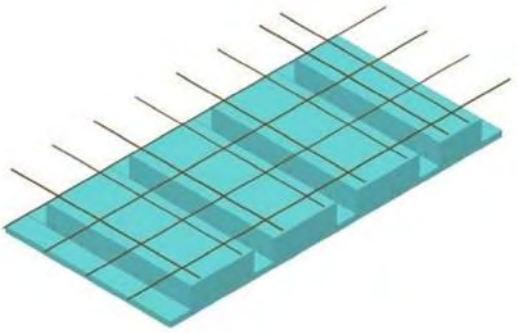


Fig. 66

Floor

2.3.4 *Pouring of concrete*

The pouring of concrete shall be done with a pump device or a tipper. The following requirements shall be adhered to:

- The speed of concrete filling shall be limited to 100 cm per hour. Concrete is filled in layers up to 50 cm and shall be filled up to a maximum height of 6 m in a day.
- If filling is done with a pump device, suitable measures should be taken to cut the dynamic pressure of concrete. A flexible rubber sleeve is secured with retaining rings to the pipe of the pump device in order to limit the pressure of concrete by compressing the hose manually.

In order to ensure the geometrical and mechanical properties of the finished wall, the following checks are carried out during concrete filling:

- Control and possible correction of verticality of the wall before hardening of concrete
- Visual verification of penetration of cement of the cement laitance in joints between the strips so that all gaps are completely filled. Cores shall be taken through the insulation at critical positions, such as below windows and at corners, to establish integrity of concrete.

Roofs with pitch below and over 30º shall be constructed with open and closed lattices respectively.
Insulating strips shall be cleaned with a water jet or brushed after pouring of concrete to remove light leakage of laitance.

2.3.5 *Finishing*

2.3.5.1 *Rendering*

As there are significant regional differences due to availability of local materials and climatic conditions, the recommendations of the manufacturer of the material should generally be followed and good trade practice regarding installation and sealing should be observed. Renders should contact the local supplier to ascertain the product best suited for finishing of the modules.

2.3.5.2 *Other types of finishing*

As long as the recommendations of the manufacturer of the finishing material are followed and good trade practice regarding installation and sealing should is observed, the widest variety of finishing techniques can be adopted, such as natural stone cladding, shingle, cladding panel, masonry, curtain walling, plastering, plasterboards, tiling, wood paneling etc (see Figs. 67 to 70).

Fig. 67 Finishing board with bead point method

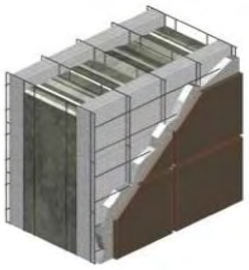


Fig. 68 Tiles on a cement base

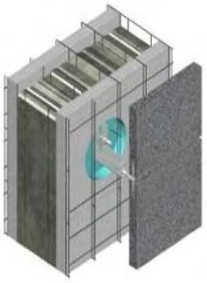


Fig. 69 Mechanical anchors for natural stone or cladding

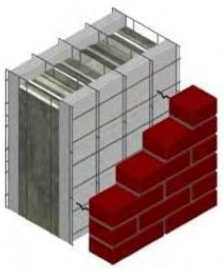


Fig.70 Brick façade with wall ties

2.3.6 *Imbedding of ducts*

- In self-extinguishing polystyrene panel conduits path shall be made (see Fig. 71).
- When thin hard panels are used for shuttering, conduits may either be surface mounted or inserted before the concrete is poured.
- Alternatively, polystyrene strips may be inserted allowing the conduits to be installed at a later stage.

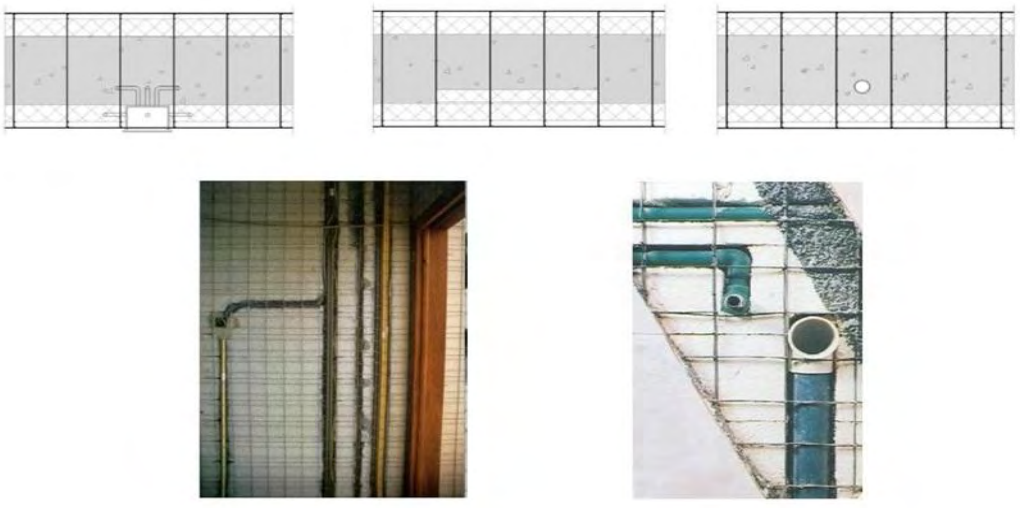


Fig. 71 Ducts embedded into concrete and/or insulation strips, either pouring concrete or afterwards in the insulation (cut or malt)

2.3.7 *Fixing of objects*

- It is possible to fix objects up to 80 kg per fixing device in the insulation strips.
- For other cases, the fixing devices should be inserted in the concrete (see Fig. 72).

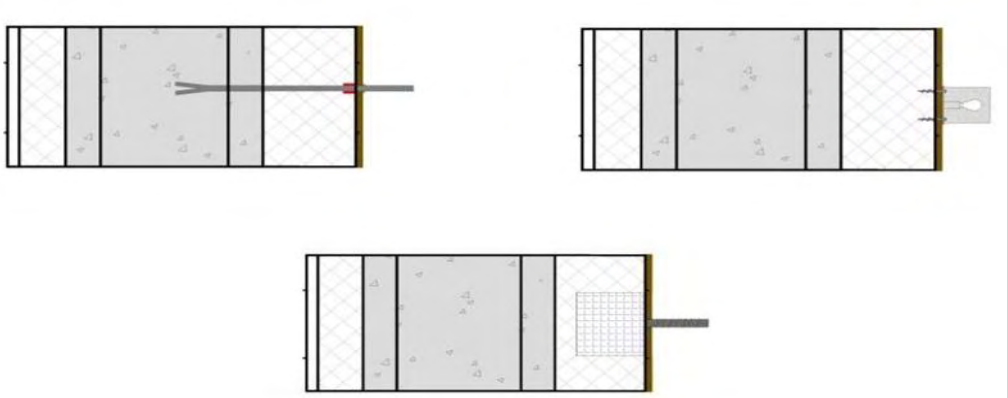
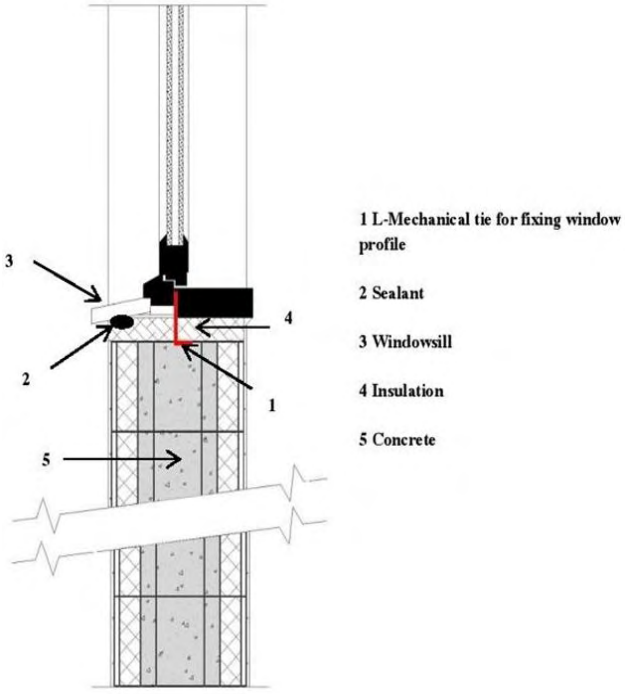


Fig. 72 Anchoring of objects in concrete or insulation of objects

2.3.8 *Other Details*

For window connections, floor connections roller shutting and underground finishing etc., refer Figs. 73 to 82.



1 L-Mechanical tie for fixing window profile

2 Sealant

3 Windowsill

4 Insulation

5 Concrete

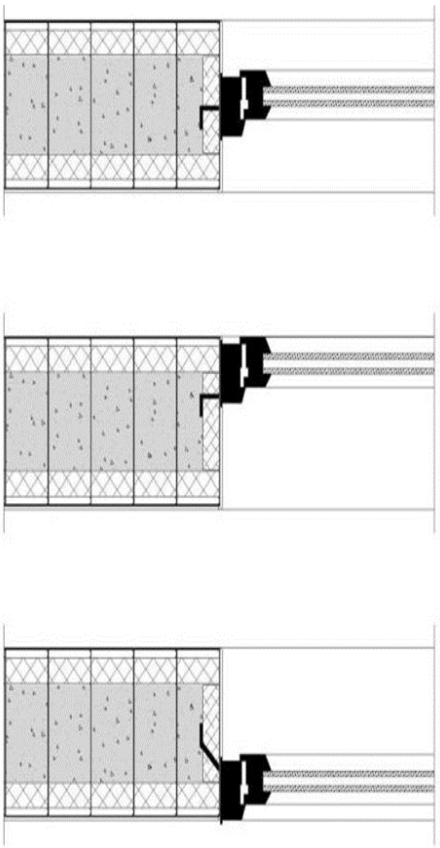


Fig. 73 Vertical section Fig. 74 Horizontal section – center, front & back position of window

Window connections

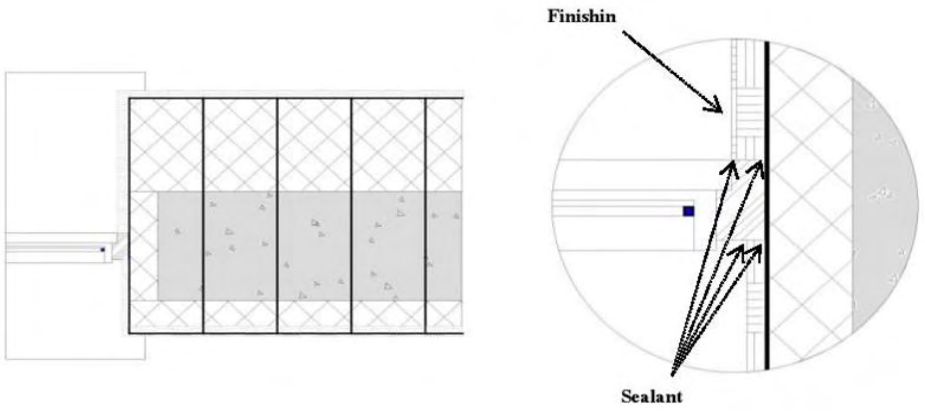


Fig. 75 Window connection

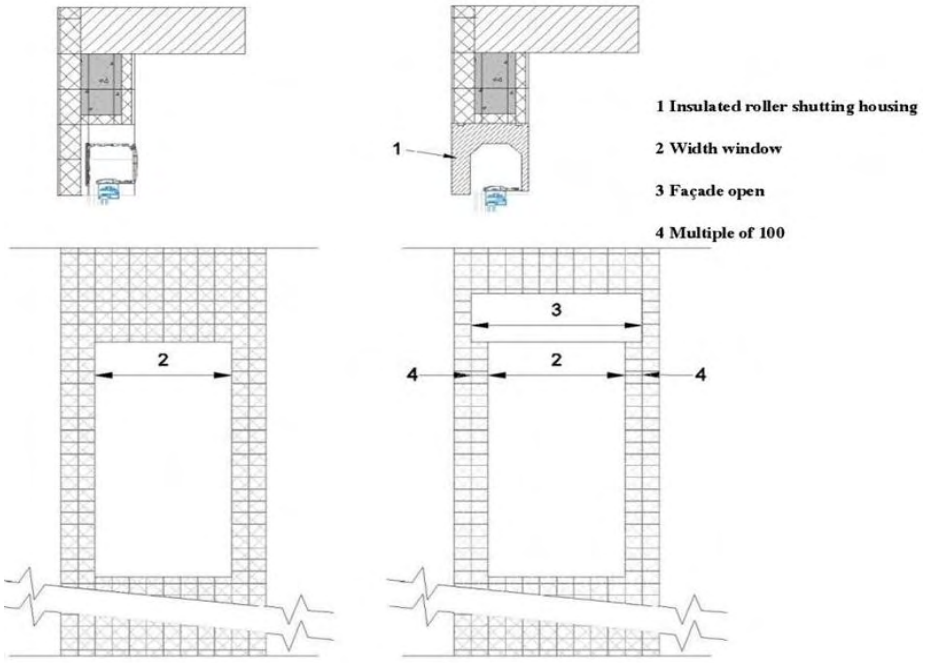


Fig. 76 Façade closed or open with integrated insulated roller shutter housing

Floor connections

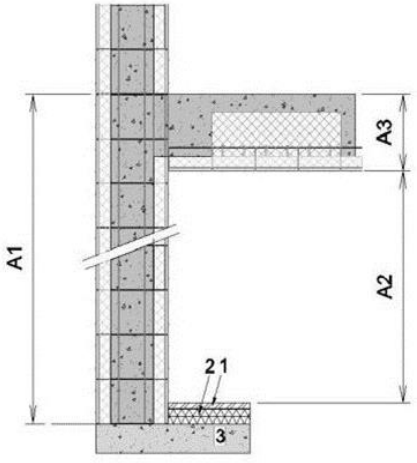


Fig. 77 With floor module

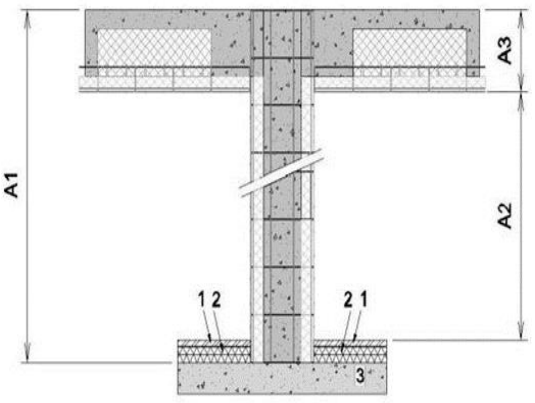


Fig. 78

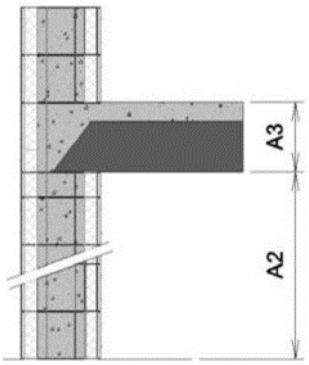


Fig. 79

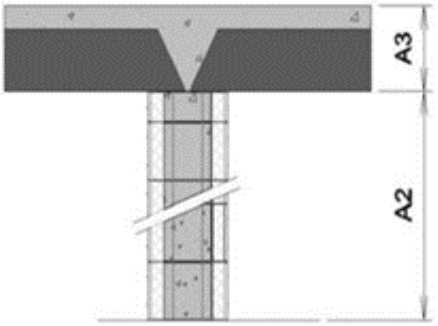


Fig. 80

With self-bearing element and compressed layer

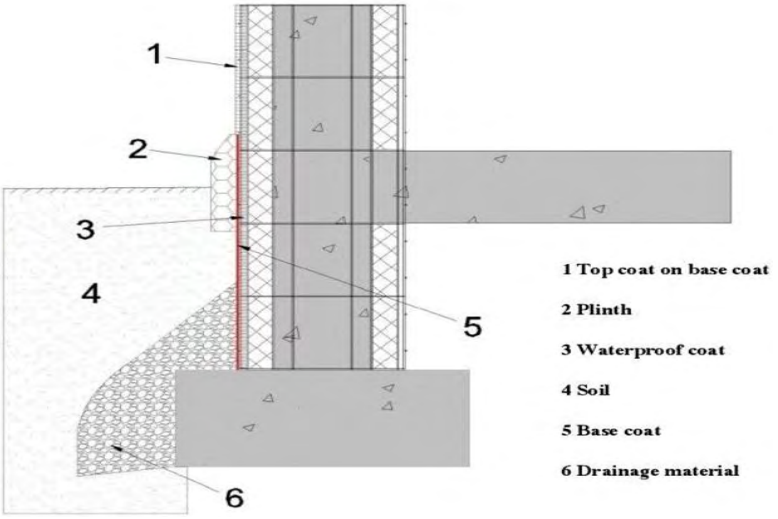


Fig. 81 Finishing on Sismo foundation

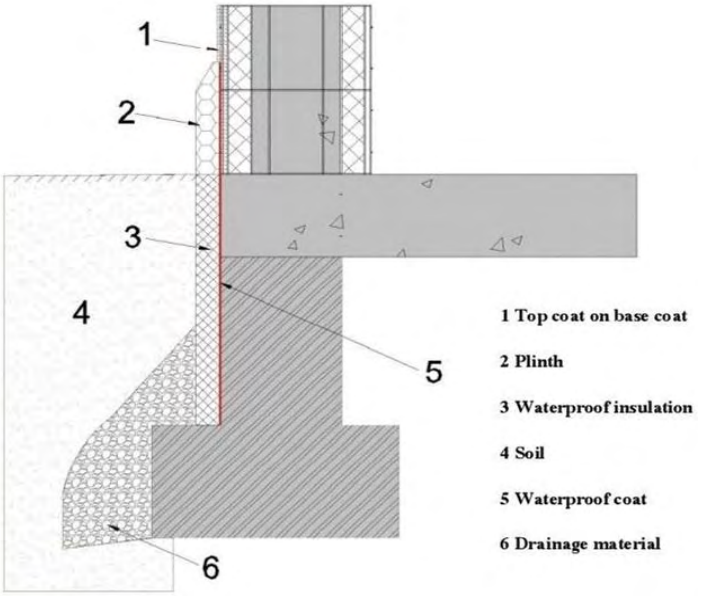


Fig. 82 Finishing on existing foundation

Underground Finishing

2.4 Selection & Installation

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

2.4.2 Choosing size and thickness

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

2.5 Experience in actual use

The manufacturer has constructed a G+1 building with this technology in Kingdom of Dream complex in Gurgaon. They have also initiated a project of constructing (G+2) in Kashipur, Uttarakhand.

2.6 Skilled /Training needed for installation

Workers are required to be trained on handling of modules and infilling of reinforcement and concrete etc. with all required safety measures taken. PAC holder shall arrange training of workers, as required in this regard.

PART 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Basis OF Assessment

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

3.2 Site Inspection & Mock Exercise

Inspection of manufacturing process was done by some of the TAC members and Officers of BMTPC on the production of modules at factory of the manufacturer. A mock exercise of erecting the panel was observed during the event.

The exercise demonstrated the convenience of erection of panels, placement of reinforcement along with joints and use of internal scaffolding. The entire operation was found to be satisfactory and with minimum training of manpower, this can be done.

3.3 Usage of the System

Sismo Building Technology, Belgium has constructed numerous residential and utility projects mostly in Belgium, France, Portugal, Italy, Turkey, Korea and Middle East etc. The Indian firm has a tie up with M/s Hari Habitat Developers for construction of about 70 G to G+2 housing units at Kashipur (Uttarakhand) by using this technology. The project is likely to be completed by 2017.

PART 4 STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

4.1 The certificate holder shall continue to have the product reviewed by BMBA.

4.2 The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.

4.3 The quality of the product shall be maintained by the certificate holder. Complete testing facilities shall be installed for in-process control.

4.4 The product user should install, use and maintain the product in accordance with the provisions in this Certificate.

4.5 This certificate does not cover uses of the product outside the scope of this appraisal.

4.6 The product is appraised against performance provisions contained in the standards listed in Part-V. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.

4.7 Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part V to this Certificate)

4.8 The certificate holder agrees to inform BMBA of their clients with details of construction on six monthly basis.

4.9 The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.

4.10 If at any time during the validity period, PACH is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, PAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.

4.11 In granting this Certificate, BMBA takes no position as to:

(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.

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

Place: New Delhi
Date of issue_____

Chairman, TAC & for and on behalf of
Member Secretary, BMBA

PART 5 LIST OF STANDARDS & CODES USED IN ASSESSMENT

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

5.1.1 IS 456:2000 -- Code of practice for plain and reinforced concrete

5.1.2 IS 875 (Part 1):1987 -- Code of Practice for Design Loads (Other Than Earthquake) for Buildings & Structures Part 1 Dead Loads - Unit Weights of Building Material & Stored Materials (Incorporating IS 1911: 1967)

5.1.3 IS 875 (Part 2):1987 -- Imposed Loads

5.1.4 IS 875 (Part 3):1987 -- Wind Loads

5.1.5 IS 875 (Part 4):1987 -- Snow Loads

5.1.6 IS 875 (Part 5):1987 -- Special Loads and Combinations.

5.1.7 IS 1893 (Part 1):2002 -- Criteria for Earthquake Resistant Design of Structure

5.1.8 IS 4326:1993 -- Code of Practice for Earthquake Resistant Design and Construction of Buildings

5.1.9 IS 4671:1984 -- Specifications for expanded polystyrene for thermal insulation purposes

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

5.1.11 IS 14862:2000 – Fibre Cement flat sheets

5.1.12 EN13501-2:2007/ BS 476(Part 22):198 -- Fire resistance

5.1.13 ASTM E 90-90 -- Sound Proofing

5.1.14 UNI EN ISO 10211(Part 1& 2):1996 -- Thermal insulation

5.1.15 UNI EN ISO 140(Part 3):2006 -- Acoustic Insulation

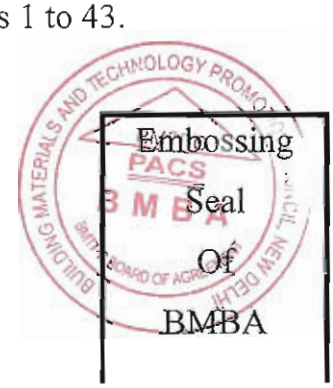
Part 5.2 Company Standards of the PAC holder – The branded design & specifications of the raw materials and finished product are as submitted by the manufacturer. The PAC holder has to make available the company standards to the consumers according to which testing have been done.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Sismo Building Technology** bearing the mark manufactured by M/s M K S Infosolutions Pvt. Ltd. is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No. 1025-S/2016** is awarded to **M/s M K S Infosolutions Pvt. Ltd., Manesar/ New Delhi.**

The period of validity of this Certificate is for a period of two years i.e. from 08-04-2016 to 07-04-2018. This Certificate consists of pages 1 to 43.

Dr. Shailesh Kr. Agarwal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing & Urban Poverty Alleviation, (Govt. of India)
Core 5A, Ist Floor, India Habitat Centre,Lodhi Road,
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, New Delhi, 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.

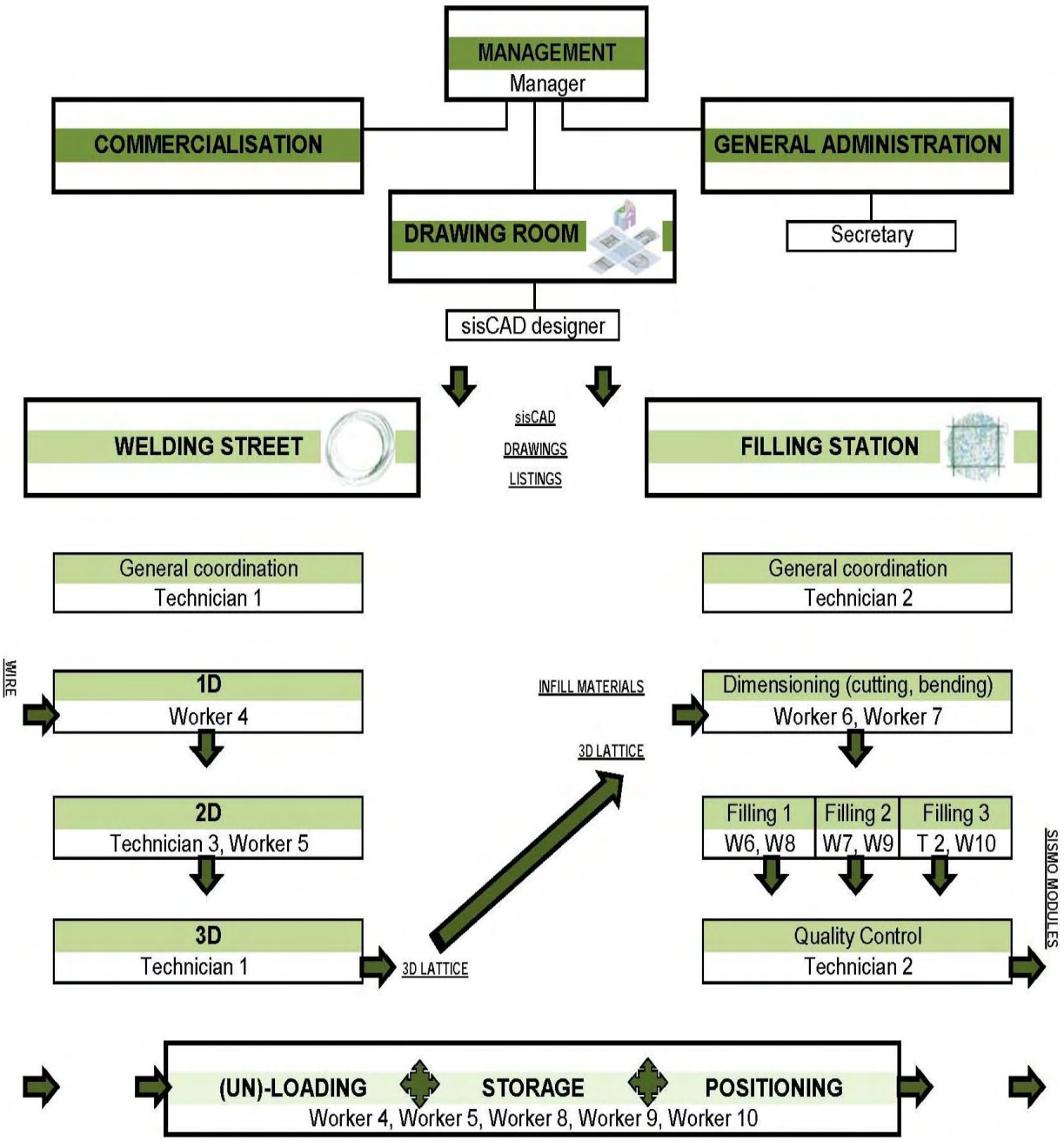
Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

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

ANNEX I

(Clause 1.6.1)

Production Flow Chart



ANNEX II

(Clause 1.6.1)

QUALITY ASSURANCE PLAN FOR SISMO BUILDING TECHNOLOGY

S.No	Parameters to be inspected	Requirement Specified	Test Method	Frequency Of Testing
I.	**Raw Material**			
A.	*GI Wire*			
1.	Diameter mm	Thickness	Guage meter	Every fresh procurement
2.	Chemical composition %	C=0.02% min., Mn=0.15% min, P=0.03% max, S= 0.03% max, Si =0.25% max	As per manufacturer lab	Every fresh procurement
3.	UTS (N/mm^2)	680 N/mm^2 min	As per manufacturer lab	Every fresh procurement
4.	Zinc coating	60 g/m^2 min	IS 4759:1996	Every fresh procurement
5.	Elongation %	5 % min	As per manufacturer lab	Every fresh procurement
B.	*Expanded Polystyrene (EPS)*			
1.	Dimensions mm	Length, width & thickness – as per manufacturer	Rule tape test	Every fresh procurement
2.	Bead size %	97% to 99%	Sieve analysis	Every fresh procurement
3.	Density kg/m^3	15 kg/m^3 min	Lab P E	Every fresh procurement
4.	Fire resistance	Exposing to direct flame	BS 476 (Part 22) :198	Every fresh procurement
5.	Moisture Content (%)	0.20 to 0.50	KFR	Every fresh procurement
6.	Environmental hazardousness (ppm)	Lead <2, Cadmium <2, Mercury <2, Chromium <2	BS EN 1122:2001 (Method B)	Every fresh procurement
7.	Blowing agent (%)	6.50 to 7.00	Oven	Every fresh procurement
II.	**Finished Product**			
	3D Panel Dimensions	As per the project requirement	Rule tape test	Every project