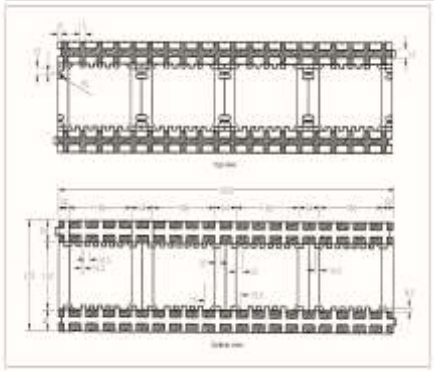
Monolithic Insulated Concrete System (MICS)

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 Maiwir Ecotech Pvt. Ltd., **6-1-23, VDOS Colony,** **Khammam – 507002 (Telanagana)** **Phone No. 9505600009** **Email: info@maiwir.com**	PAC No.:1**036-S/2018** Issue No. **01** Date of Issue: **12-03-2018**



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PERFORMANCE APPRAISAL CERTIFICATE

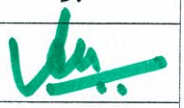
FOR

Monolithic Insulated Concrete System (MICS)

ISSUED TO

M/s MAIWIR ECOTECH PVT. LTD., KHAMMAM

Status of PAC No.: 1036-S/2018

S. No	Issue No.	Date of Issue	Date of renewal	Amendment		Valid up to (Date)	Remark	Signature of authorized signatory
				No.	Date			
1.	2.	3.	4.	5.	6.	7.	8.	9.
1	1	12-03-2018	12-03- 2019	--	--	11-03-2019	--	

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PART 1 CERTIFICATION

1.1 Certificate Holder: M/s Maiwir Ecotech Pvt. Ltd.

6-1-23, VDOS Colony,
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Phone No. 040-65556780
Email: info@maiwir.com, scp@maiwir.com

1.2 Description of System

1.2.1 *Name of the System – Monolithic Insulated Concrete System (MICS)*

1.2.2 *Brief Description* – Monolithic Insulated Concrete System (MICS) is a system of formwork for reinforced concrete made with a rigid thermal insulation that stays in place as a permanent interior and exterior substrate for walls, floors and roofs. Monolithic Insulated Concrete System (MICS) results in cast-in-place concrete walls that are sandwiched between two layers of modules i.e. *Expandable Polystyrene* (EPS) separated by hard plastic ties. The modules are interlocking modular units that are dry stacked (without mortar) and filled with concrete once laid out. The units lock together and create a form for the structural walls or floors of a building. When cured, the wall supports the structural loads from floors and roofs, and the shuttering provides thermal insulation. Reinforcing steel shall be as required from design.

Upper and lower surfaces of the polystyrene modules are castellated and the vertical mating surfaces are tongue-and-groove to form a tight fit when joined together. The inner surfaces have tapered grooves running vertically and have offset on opposite faces to ensure uniform concrete thickness. They also form locks for end stops. The outer surfaces are grooved vertically to aid cutting and trimming.

The modules are manufactured by Styro Stone, Spain and are presently imported by the applicant from Spain.

Maiwir and Styro Stone, Spain have jointly agreed to promote building construction using MICS Innovation in India and Maiwir is a Trade mark holder of Styro Stone.

The firm proposes to install the plant in India shortly for manufacture of these modules.

A plan view of MICS is shown in Fig. 1.

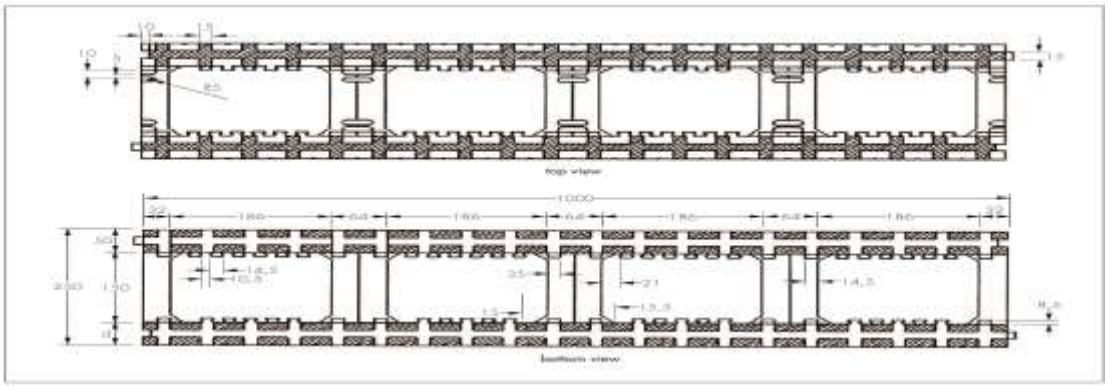


Fig. 1

1.3 Classification and Types of Modules

1.3.1 Standard *Module* – These form bulk of the m*odules* and have 50mm EPS panels on both sides with 8 hard plastic ties holding the panels. Dimensions of these modules are 1000 x 250 x 250mm.(Fig. 2)

1.3.2 *Lintel Module* – In combination with Half Height modules, these form the top layer of all wall gaps and hold the concrete thus preventing thermal leaks. Dimensions of these modules are 1000 x 125 x 250mm. (Fig. 3)

1.3.3 *Half Height Module* **–** Together with the lintel, these form the top layer of all gaps in the wall and hold the required steel reinforcement. Dimensions of these modules are 1000 x 150 x 250mm. (Fig. 4)

1.3.4 *Floor Edge Module* – These form the top most layer, where the wall ends and floor begins. This envelopes the floor slab and thus prevents thermal bridging. Dimensions of these modules are 1000 x 375/125 x 250mm. (Fig. 5)

1.3.5 *Corner Module* – These constitute 45° & 90° corners of the building. The two sides are 50mm EPS panels held together with 8 hard ties. Dimensions of these modules are 750/500 x 250 x 250mm. (Fig. 6A & 6B)

1.3.6 *End Module* – These create wall ending by fitting in inside the Standard or Corner form and provide a smooth and thermal bridge ending to the wall. Dimensions of these modules are 150 x 125 x 50mm. (Fig. 7)

Fig. 2 Standard

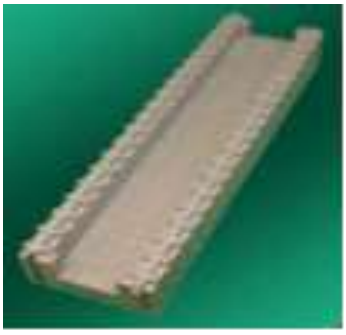


Fig. 3 Lintel

Fig. 4 Half Height

Fig. 5 Floor Edge

Fig. 6A Corner 90°

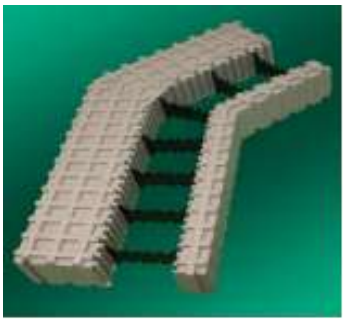


Fig. 6B Corner 45°

The other customized modules can also be manufactured as per the design requirements. (Fig. 8)

Fig. 7 End Module

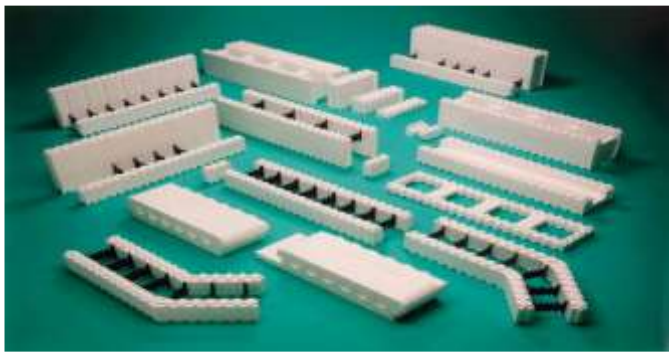


Fig. 8 Form Blocks

The detailed schematic drawings of the above modules are given in Annex III.

1.4 Manufacturing Machinery & Equipment

The manufacturer shall install machines and equipment of required capacities and specifications as per the requirement.

1.5 Manufacturing Process of Modules

1.5.1 *Pre-expansion*

Expanded Polystyrene in the form of resin or beads of styrene shall be used. Each bead shall have a microscopic dot of pentane formed into its center. This shall be brought in air tight bags. These bags shall keep the beads "fresh" by assuring that the pentane within each bead cannot escape into the atmosphere and render the material unfit. The beads of styrene shall be about the size of a grain of salt and have a similar consistency. The beads shall be stored in a tightly controlled environment where the amount of pentane within their plastic shell remains consistent.

The beads of resin shall then be loaded into a machine called a "pre-expander". Steam shall be injected into the beads. The heat accomplishes that the wall of each bead shall be softened and become flexible and the increased temperature shall also cause the

pentane to expand within the softened beads. The beads puff up like popcorn to 30 times their original size.

1.5.2 *Conditioning*

After expansion, the beads shall undergo a maturing phase between 12 to 48 hours to enable equilibrium temperature and pressure to be reached.

1.5.3 *Moulding*

The individual expanded beads shall then moulded into a single, homogeneous block. Once again, steam shall be used to deliver heat to the process. A precisely measured quantity of beads shall be blown into a steel mold. Steam is then injected into the pre-expanded beads to heat the mix and causes the wall of each bead to soften and remaining pentane within each bead expands. This expansion shall cause the beads to increase in size within the steel mould. This expansion increases the pressure and the beads shall be forced together to form a single block. The soft bead walls shall allow the beads to melt together into a single solid block. At this point the mould opens like a clam shell and the block is removed.

After the block has been removed from the mould, this shall be weighed and marked so that it can be traced throughout the production process. Adherence to the proper weight assures that the correct “density” or “weight per cubic meter” is maintained.

Once the blocks have been moulded, perforated, weighed, and tested for proper fusion, these shall be moved to the “drying room”. Large blowers then circulate the air within the room. This process removes as much of the moisture from the block as possible. The increased temperature also helps to reduce any internal stresses that may exist within the block as a result of the moulding process.

Manufacturing Process Flow Chart shall be as given in Annex II.

1.6 Design Considerations

1.6.1 *General*

1. The design grid or module shall be derived from the basic MICS system. This is 1000 mm long, 250 mm high and 250 mm wide. The thickness of the side walls is 50 mm, allowing for a mean 150mm mean width of retained concrete. The ends of the shutters are open so that when shutter units are joined, the concrete is continuous. The internal faces are grooved to receive stop-end inserts. These shall used to stop the wall and form the reveals at window and door openings. Grooves are provided at 25 mm c/c and so wall lengths and opening widths require a 25 mm design module.

2. The faces shall be tied by integral wall ties, which restrain differential movement. These are staggered vertically and horizontally

at 125mm c/c; any reinforcing steel should be specified at this spacing.

3. The shutter ties shall have V slots at 30mm, 50mm, and 75mm c/c from each shutter internal face. These slots will accommodate reinforcing steel up to 16mm dia. Horizontal lintel, internal & external wall reinforcement may be accurately located in these Vs and vertical reinforcement may be tied accurately, ensuring correct spacing and cover.

4. Except for lintels, steel reinforcement in walls shall normally only be required for earth retaining walls and basements and for wall panel sizes larger than vertically loaded panel sizes, assume a roof span of 10.0m and floor span of 4.5m, houses which vary significantly from these assumptions may need a qualified designer.

5. A 125mm depth lintel module is available to span over openings. This is used in conjunction with a 125mm half height form. This is the normal combination and produces a lintel with an overall minimum depth of 250mm and brings the coursing back to level with the wall on either side of the opening.

6. The 125mm half height module may be used in conjunction with a 50mm height adjusting form to give any height to a multiple of 25 mm; any finer reductions to the height may be had by careful trimming of the final lift beneath wall or roof plate level, or at the underside of the initial base course. Clearly adjustments should be avoided at intermediate lifts because the interlocking castellation will be lost.

7. Preferred design modules are 25mm horizontally and vertically.

8. When a wall changes direction at 90°, special corner forms may be used. Alternatively, and where a side wall butts up the internal part of the shutter bridging, the core is carefully cut away using a fine tooth saw. This maintains a continuous cavity and produces a monolithic, continuous concrete wall without transverse bridging.

1.6.2 *Structural*

1. The MICS shall be designed using the Auto Cad Software. The buildings constructed with EPS modules shall be studied and designed as reinforced concrete structure since the parameters required for their design are the same as needed for traditional reinforced concrete. In the calculation model, the building shall be designed in accordance with IS 456:2000, as applicable, as a structure composed of load bearing walls with a box- like structure. The basis of design is given at Annex IV.

2. The system is intended for use where Architectural drawings are available and satisfy the various requirements. The Architects and the designer team of the concerned developer (client) is responsible for the drawings and overall building design to comply with the various regulatory requirements applicable to the area.

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

4. The system shall be designed to provide the required performance against the loads to be taken into account in accordance with IS 875 (Parts 1-5):1987 and the data given by manufacturer for various panels. It shall also provide the required bearing resistance for earthquake and wind forces as per IS 875 (Part 3):2015 and IS 1893 (Part 1):216, wherever applicable.

5. Foundation shall be specifically designed in accordance with provision given in IS 1904:2005. The design concept is same as that of the conventional building design. The safe bearing capacity and soil properties (soil investigation report)) shall be provided from the site after soil investigations. Foundation shall be designed based on the soil investigation report. Both single and double panels should have starter bars from either foundation or ground floor slab. All foundations should be designed by experienced engineer with appropriate reference.

6. 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.

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

1.7 Uses and Limitations of MICS

1.7.1 *Uses*

MICS construction technology may be used as load bearing and non-load bearing walls for wide variety of buildings including apartments, villas, low-rise buildings, commercial complexes, hotels, industrial buildings, etc.

1.7.2 *Limitations*

1. Door and window position shall not be changed after pouring of concrete

1.8 Basis of Assessment

1.8.1 *Scope of Assessment* – Suitability of MICS for use as a load bearing and non-loadbearing internal or external walls to build residential, commercial and industrial buildings.

1.8.2 *Assessments*

Assessment of the suitability of Monolithic Insulated Concrete System (MICS) is based on:

(i) Styro Stone Technical Manual
(ii) British Board of Agreement No. ETA-05/0144
(iii) Three dimensional earthquake FE simulation for a school building by using Styrostone formwork by Hagger & Partner, USA.
(iv) MICS Field Testing Report by RDH Building Engineering Ltd., Canada as per ASTM E 1105-00 (2008) Window Test Report: HPO Test Modules 1-4.
(v) Vapour Barrier Test by Logix Insulated Concrete Forms, USA.
(vi) Inspection of 1000 modules of various types and size imported from Germany for construction of a G+1 storey building in Khammam by TAC member and BMTPC Officers.
(vii) Inspection of a single storey Prototype house of about 100 sq m constructed at Khammam by the firm in 2016 using the modules by TAC members and BMTPC Officers.
(viii) Test Report of samples of modules of total thickness of 250mm collected by the Officer of the Council for carrying out the following tests by Star Wire (India) Pvt. Ltd. (Diagnostic Centre), Ballabgarh

1.9 Conditions of Certification

1.9.1 *Technical Conditions* – Raw materials and the finished product shall conform to the requirements of the prescribed specifications.

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

1.9.3 *Brochure/ Guidelines* – The Certificate holder shall provide detail instructions of installation of the MICS and subsequent maintenance, if any

1.9.4 *Handling of User Complaints*

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

1.9.4.2 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.

1.10 Certification

1.10.1 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 1 & 2 of this Certificate, MICS covered by this Certificate are 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 in accordance with the requirements specified in the PAC. In addition it shall follow the requirements of various materials used in the manufacture of these panels given in PAC.

2.2 Specifications of the MICS

2.2.1 *Technical Specifications*

2.2.1.1 *Raw materials*

(i) *Expanded Polystyrene (EPS):* Self-extinguishing type EPS shall conform to IS 4671: 1984 having density not less than 25 kg/m^3 and valid Restriction of Hazardous Substance (ROHS) test certification.
(ii) *Polyurethane (PU) Foam Adhesive*: Shall have Skin Formation of 8 min, Density 25 kg/m^3, Sound insulation 58 dB, Insulation factor 35 mW/mK, Shrinkage< 2%, Fire rating B3, Insulation factor 35 mW/m.K and Water absorption of 1 % volume as per the specifications of Soudafoam 1K manufactured by McCoy Soudal, N Delhi.
(iii) *Plasticizer*: Slump retaining super plasticizer for self-compacting plastic concrete (CEMWET SP-3000) shall conform to IS 9103:1999
(iv) *Hard Plastic Tie:* Shall be made with High density polyethylene and shall be as per manufacturer's specifications.
(v) *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 *Tolerance*
(i) Length, width & height of modules shall have tolerance within ± 2mm

2.3 Selection & Installation

2.3.1 The user is responsible for the proper use of the modules at site. PAC holder shall provide required guidance and instructions for usage of the product at site.

2.3.2 *Good practice for installing the system at site* – MICS shall be used at site in accordance with the applicable specifications, instructions and guidelines of the manufacturer. The user shall also follow the Brochure of the technology supplied by the manufacturer.

2.4 Installation Procedure

2.4.1 *Footings*

(i) Level footings shall be designed to transfer and distribute the load that will be supported and be in compliance with codal requirements and building regulations. Level footings shall be constructed within a vertical tolerance of ±6mm corresponding with design plans. Shims or a bed of mortar may be used under the first course to compensate for unleveled footers. Level footer and/or a level first course shall be very important. Size of footings shall be min. 200 mm thick by 500 mm wide.

(ii) Step footings shall have vertical steps of 400 mm. Although modules may be cut in half horizontally when 200 mm height is needed. This technique shall be accomplished by alternating the top and bottom halves as the first course by securing them with foam adhesive. The second course will also need to be secured with foam adhesive.

2.4.2 *Wall Layout*

(i) The corners shall be located and the exact building dimensions be marked on the footings, making sure that all corners are square and/or correctly aligned in accordance with the design plans.

(ii) Chalk lines shall be marked on the footings along building perimeter and a temporary 2 x 4 guide board shall be installed on the footings along and on outside of the line using 70 mm cut concrete nails or specified screws at every 1200 mm.

(iii) The location of window and door openings shall also be marked on the footer at this time and during installation of first course.

2.4.3 *Materials and Tools*

(i) Tools and materials required to install and construct the buildings using Standard modules shall be the hand and power tools used in work associated with ordinary carpentry, concrete and re-bar installations.

(ii) Placement of materials and tools, and locating the general work area inside the perimeter of the wall will make the installation of the wall assembly and concrete placement easier and safer.

2.4.4 *Handling and Storage*

(i) Proper handling and storage of forms is important as damage may weaken the forms and compromise its effectiveness as a concrete form.
(ii) Forms shall be stored properly to protect them from high winds, storms and activities associated with a construction site. For long term storage, the forms shall be protected from effects of exposure to UV rays from sunlight.

2.4.5 *First Course*

(i) The First course shall begin at the corners. All corner forms shall be positioned on the first course in one direction only – left or right facing and on inside of the temporary 2 x 4 guide board that is installed along the wall perimeter, marked with chalk lines. Work from opposing corners toward center of the wall, gluing all forms in place to the footing with two good size beads of minimum expanding foam adhesive.

(ii) The form tongue and groove ends shall be tied together tightly while setting the forms in place with the tongue-side-up. The footers should be clean and free of standing water. Alternate the direction of the corner forms as the courses are stacked in place to ensure proper stud alignment and staggering of joints.

(iii) The location of window and door openings, utility penetrations and other significant wall features shall be marked with a magic marker on inside of the first course at this time. A form 6mm smaller than the measured opening shall be cut to eliminate the possibility of having too much material in the wall length making it difficult to straighten and/or plumb the wall. The 6mm gap may be filled, when the wall is fully assembled and before concrete is placed, with minimum expanding foam adhesive.

(iv) To minimize the need to make additional measurements, length of the first cut piece shall be marked on the side of the panel that faces the interior of the building, as all subsequent forms in this vertical location of the wall will be of the same length. The marked measurement should be large enough to be seen from a distance. Before the second course is put in place, any re-bar positioning devices used be installed.

2.4.6 *Cut Forms and Splices*

(i) A form shall be cut to fit into a space that is less than 1200 mm long, creating a series of cut forms and splices somewhere within the length of the wall assembly. The cut forms and splices should have a staggered vertical alignment and are best located wherever there is window or door openings to minimize the amount of cute and splices.

If there are no window or door openings in the wall, the location of the staggered and vertically aligned cut forms and splices may be anywhere between the two corners.

(ii) As the stud wall-tie brackets will not have a stacked continuous alignment in the location of the cut forms and splices, some stop-blocks located on inside of the top tongue will need to be trimmed off the form below, before setting the cut form in place. To eliminate waste, save and try to use all cut pieces with one or more wall-ties in place.

(iii) Splices shall be placed on both sides of all cut forms when the cut-end creates a distance between stud wall-tie brackets that is more than 250 mm, or when the cut-end of a form is more than 100 mm from stud wall-tie bracket. This shall be done by attaching a piece of wood across the middle of the cut joint on both sides of the forms using course thread screws. The wood piece shall be long enough to bridge the cut-end gap and shall be attached to at least two stud flanges. Splices may also be used to strengthen other weak places in the wall assembly.

(iv) Additionally, straight forms that are mitre cut and assembled to create a 45º and other acute or obtuse angle corners, shall be reinforced and braced to accommodate the pressures of concrete during its placement.

2.4.7 *Cutting Forms*

(i) Standard modules may either be cut in half horizontally or have as much as 100mm cut off the top on either side of the form. Use of a table saw can speed full length horizontal cuts. A small "keyhole type" drywall saw is handy for making cuts, trimming forms to fit and for cutting holes for utility penetrations.
(ii) Cutting the wall-tie part of a bracket should be avoided.

2.4.8 *Gluing Forms*

(i) For the sake of quality, it is recommended that all horizontal joints be glued.

(ii) The modules that were cut to fit in difficult or complicated areas and where straight forms were miter cut to form corners may also be glued.

(iii) The horizontal joints shall be glued with a 10 to 12 mm bead of minimum expanding foam adhesive along the outside edge of the horizontal tongue on both sides of the lower form just before setting a form in place.

2.4.9 *Additional Courses*

(i) The second course and all additional courses may begin as soon as the horizontal re-bar is placed in the first course. Like the placement of the first course, start at corners and work toward the center of the wall.

2.4.10 *Horizontal Re-bar*

(i) Horizontal reinforcement bars (re-bar) required as per design shall be placed as the wall assembly is erected. The re-bar is placed in the tandem saddles provided on the saddle of each wall-tie every 300 mm center, although it may be necessary to place horizontal re-bar every

second or third course. These dual re-bar saddles will accept both 12 mm & 16 mm bars.
(ii) All overlapping splices including at corners, should overlap 36 times the diameter of the bar and tied with wire.

2.4.11 *Vertical Re-bar*

(i) Vertical steel reinforcement (re-bar) required as per design shall be placed in the footer at regular intervals to correspond with the design of reinforcement required in the wall. This will provide solid attachment to footings. The vertical re-bar is most easily put in place full length after the wall assembly is erected and prior to concrete placement. Ways to hold vertical bars in place as are follows:
(a) An open wire loop may be attached at the top of re-bar dowels large enough so that the vertical re-bar may be passed through and held in place at the bottom once the wall assembly is completed.
(b) A 50mm length of PVC pipe (a ring) may be slipped over the dowel and serve the same purpose as the wire loop. Both the wire loop and the PVC ring shall be sized correctly so that the re-bar is held reasonably tight to the vertical dowel protruding from the footer.
(c) The vertical re-bar may be pushed into the correct location as the first lift of concrete is pumped in place.
(d) The vertical re-bar may be installed in two or more pieces with joints that overlap 36 times the bar diameter and tied with wire. The vertical bar may be tied to the horizontal re-bar with wire and the forms will be installed by slipping them over the vertical re-bar.

(ii) If vertical re-bar is not to extend and connect to a wall of an additional storey above, it should be cut to length 25mm/50 mm shorter than the wall height. If vertical re-bar is to extend and connect to a wall of an additional storey above, it should be cut to length so that it overlaps 36 times the bar diameter with the vertical rebar that will be erected above.

(iii) The vertical re-bar may be tied in place when concrete is being pumped into the forms. For below grade foundations where there is lateral load against the wall, the vertical re-bar is held off center on the tension side of the wall with a minimum of 25mm concrete cover.

2.4.11 *Intersecting Walls (T-Walls)*

(i) To connect intersecting walls, concrete and steel re-bar of both walls shall be linked together. In order to accommodate the re-bar and concrete, sections of the foam panel on one side of the adjoining wall shall be removed. In order to form a non-fire rated T-wall, sections of foam located above and below the wall-ties and between the flanges of the studs shall be removed.

(ii) When cutting of wall-ties is unavoidable, it shall be necessary to reinforce the intersecting area in order to withstand the pressure created during concrete placement.

2.4.12 *External Bracing*

(i) Bracing is not required under normal circumstances for pre-molded corner forms e.g. if the horizontal joints are glued and correct concrete slump is used during its placement.

(ii) External corner bracing is required when corners are made from straight forms mitre cut to form a corner. In this case, the corners shall be reinforced and braced to withstand the pressure created during concrete placement. To reinforce mitered corners, the cut joints should be glued with foam compatible contact adhesive. The corners shall have temporary wood or metal supports applied vertically and tied together through the wall with wall-ties made by using tie wire and braced with kickers from two directions.

2.4.13 *Window and Door Openings*

(i) Window and door frames shall be installed by placing a vinyl or wood frame that has the same inside dimensions as the required opening size.

(ii) Pressure treated 2 x 12 dimensional lumber shall be used to construct top and sides of the frame and two 2 x 4's on the bottom leaving a space between them for concrete to be placed under window or door openings. This space should be filled with a third piece 2 x 4 once the concrete has filled the cavity under the frame. The firm shall be left in place after the concrete is cured providing a fastening surface for installation of windows and doors.

(iii) Temporary 1x 4 wood flanges shall be attached on all edges of the wood frame to position and hold the form in alignment with the wall. Additionally, temporary vertical, horizontal, diagonal and/or cross bracing should be installed to reinforce the frame to prevent weight of concrete from pushing it down and up against the frame causing to move and/or change shape.

(iv) Metal fasteners should be fixed into the frame prior to placement of concrete so that they prelude into the wall cavity securely anchoring the wood frame in-place once concrete is cured.

2.4.14 *Bulkheads*

(i) Bulkheads are required to stop concrete at open-ended walls and external support shall be provided to keep them in place. A bulkhead shall be made by using 2 x 12 with temporary 1 x 4 flanges attached vertically to each side and placed over end of the wall. Adequate bracing must be provided to keep the pressure of concrete from pushing the bulkhead out during concrete placement. If the bulkhead is to be kept in place, treated 2 x 12 shall be used. Concrete nails, screws or bolts shall also be used to extend into the wall cavity before placing concrete. Bulkheads and other custom

areas may also be secured plumb, in two directions using turnbuckles.

2.4.15 *45-Degree and Other Custom Corners*

(i) Two straight forms shall be laid with tongue side up and facing in the same direction. The measurements on each form starting from the groove end on opposite sides creating an axis that divides each form into two asymmetrical pieces shall be made. The vertical lines on the sides of each form shall be marked with a square and vertical miter cuts made with a handsaw down the center of the lines.

(ii) The miter cut shall be made by cutting down through both panels at the same time, When both forms are cut, the pieces shall be exchanged to create a form with two opposing corners with the same angle. Each corner form should have a tongue and a groove end and a short and a long leg. Pieces shall be fitted together and glued with foam-compatible contact cement and/or tape.

2.4.16 *Rim Joists and Ledgers*

The framing of floors and ceilings shall be attached to rim joists and ledgers. To attach rim joists and ledgers, a structural side attachment shall be required using a series of anchor bolts or a ledger connector system. Only when the concrete has cured properly, structural frame should be attached to the joist/ledger that have been fixed with anchor bolts or ledger connectors.

2.4.17 *Beam and Girder Pockets*

(i) To accommodate for the end of beam, girder or truss that will carry the total loads associated with the internal structure of the building, a beam pocket shall be formed in the wall assembly before concrete is put in place. For doing this, a piece of the interior foam panel and/or parts of stud wall-tie brackets shall be removed.

(ii) The open area shall be with pieces of wood or a slab of foam inserted into the wall cavity and secured in place to create a void. The block-out pieces should be made so they can be easily removed once the concrete has cured. The bottom of the block-out should be located at the elevation designated at the bottom of the beam/girder/truss.

2.4.18 *Brick Ledge*

A brick ledge for fixing a veneer brick and stone shall be done by using a simple wood or metal form attached to the side of the wall assembly at any desired elevation. Once the elevation is done, sections of foam are removed from between the stud flanges and from between the top and bottom of the brick ledge form allowing concrete

to flow into the brick ledge form. Re-bar shall also be provided in constructing the brick ledge.

2.4.19 *Utility, Mechanical and Service openings*

(i) Openings shall be provided in walls for all utility, mechanical systems and service entrances such as electrical, telephone & television cables, water supply pipes, gas lines, air supply & exhaust pipes, ducts, vents, sewer drain pipes, beam pockets and access doors or panels etc. Openings shall be made so that these essential components may be fixed after concrete is poured.

(ii) This can be done by sawing a hole in the desired location through both panels of the form to allow for fixing of a sleeve or chase through the wall. The sleeve or chase should be slightly larger than the actual utility or service penetration as well. Larger access openings shall be made in the same way as window openings.

(iii) Foam adhesive may be used to secure sleeves and chases in place and to seal around the openings once it is fixed. Extra or unused holes may be filled and covered for future use when needed.

2.4.20 *Scaffolding and Bracing Frames*

(i) The wall assembly shall be kept straight, plumb and square when concrete is being placed and during curing. A safe, adequate, portable and temporary working platform shall be provided so that walls of approx. height 3.66m may be constructed. The vertical legs of the scaffolding and bracing system shall be attached securely to the wall assembly at every form course and the vertical leg be supported securely by a diagonal brace with a turnbuckle and shall be fastened securely to the ground or first floor.

(ii) Scaffolding and bracing frames should be installed on the inside of the building, starting 600mm from corners and at 1.83m interval along the length of each wall. The layout of the scaffolding and bracing system may vary depending upon the location of window & door openings and other building details. Regular 1.83m spacing helps in keeping the wall straight and stable while creating a solid base for attaching wall planks & guardrails, where required. The distance between wall planks & guardrails should not exceed 1.83m.

(iii) A level or plumb bob shall be used to check corners for plumb and a string line shall be used stretched between corners in combination with bracing, frames and adjustable turnbuckles to straighten walls prior to after placing of concrete. Walls higher than 3.66m shall be constructed in more than one installation. Special scaffolding and bracing considerations shall be made when constructing wall higher than 3.66m.

2.4.21 *Before Concreting*

(i) Modules are normally delivered direct to the site from the factory. Modules are shrink wrapped in packages which are light weight and easily handled by one person. When wrapped, the modules are kept clean and are easily stacked. They should be kept wrapped until needed and stored on their sides to protect the castellation from damage.

(ii) The surface of the foundation on which the shutter will be erected should be swept clear of all debris and any cement laitance removed. If the slab is part of a basement below ground or the wall is designed as a retaining wall to withstand lateral loads, the bottom course of forms is laid over the starter bars, threading them between the tie gridwork. Any stop ends are inserted and cut-outs at changes of direction are made according to the design.

(iii) Cutting and trimming should be made away from the work before the modules are fitted, to avoid polystyrene dust and cut-outs from getting into the shuttered void. The next course of modules is then laid to a staggered bond, together with its necessary stop-ends etc. The second course and all subsequent courses must be tightly interlocked with the lower courses.

(iv) The shutter an integrated, monolithic sheet structure which will be seen to span from any high spots on the foundation. Any obvious pebbles may be knocked off to reduce the bridging effect, but it will normally be necessary to fill any gaps which appear between the bottom of the shutter and the slab with expanding foam. Care must be taken not to use too much foam to avoid its intrusion into the shutter void.

(v) Earth retaining walls and basements shall normally be designed as reinforced concrete. The shutter ties have V slots at 30 mm, 50 mm, and 75 mm centers from each shutter internal face. These slots will accommodate reinforcing steel up to 16 mm dia. Horizontal lintel, internal & external wall reinforcement may be accurately located in these Vs and vertical reinforcement may be tied accurately, ensuring correct spacing and cover.

(vi) The positioning and fixing of steel stirrups or binders in lintels and other locations merits special consideration. The bottom main reinforcement should initially be placed to one side of its final location in order that the binders may be positioned, the main bars must then be threaded through the binders and tied to them. Space must be available to one side of its final location to allow for this. If space is restricted, it may be necessary to divide and splice the main reinforcement. The top main reinforcement supported in the V slots of the ties should be threaded through the binders and tied to them, so that the whole cage is suspended in the correct location. Binders should be dimensioned accordingly with a vertical leg not less than 210 mm.

(vii) When erected, the shutter is rigid horizontally but it remains flexible in the vertical plane along its length. It is light weight and can be blown about on exposed sites and disturbed by the flow of concrete during the pour. Necessary stability by temporary bracing shall be given, at least until the concrete pour is completed. Bracing shall be best fixed before the wall is 2m high and in any case work ceases for the day.

(viii) Bracing is a simple adjustable L shaped brace, positioned at 2.5 m max. The base of the shutter is aligned horizontally and the bottom legs are bolted to the base slab. Final adjustments to ensure verticality are made by means of a turnbuckle which alters the angle between the legs of the brace. Checks on the horizontal alignment shall be made throughout the pour and any adjustments made before the concrete stiffens.

(ix) A 125 mm lintel form is available to form lintels spanning over openings. This is used in conjunction with a 125mm reduced height to bring the coursing back to level with the walls on either side of the opening.

(x) It is strongly recommended that cutting and fitting of reinforcement, positioning of masonry wall ties, wall returns and stop-ends, clearance of debris to ensure a clean cavity and all other preparation work be completed before the pour. When the pour commences, the rate at which the walls are filled will prelude all other work.

2.4.22 *After Concreting*

(i) The concrete should not exceed more than 3m depth during the period when it remains in a fluid state. Under favourable conditions and after the initial set has been achieved, the pour may be continued.

(ii) The concrete specified shall be highly workable, free flowing mix. It is required to be self-compacting because the shutter is not designed to withstand the stresses induced by vibrators.

(iii) The infilling pour shall best be commenced at a location furthest from the pump. The initial pour should be restricted to 450mm in height, to give stability to the shutter. The alignment should be checked and adjusted before the main pour is commenced. The reduced rate of filling shall be maintained until concrete has filled up approx. one-third of the height of the shutter. When the initial filling has reduced the height of the vertical drop, the restrictor shall be removed, increasing the pour rate so that the wall is filled by the concrete flowing down the inside slump faces.

(iv) At window and similar openings in the wall, the bottom horizontal run of the modules is left open; the concrete shall be filled from either side and trowelled off level in the opening. The concreting shall then continued elsewhere to allow the concrete at the bottom and sides of

the opening to soften. When this has happened, the pour may be resumed and the lift continued on either side of the opening.

(v) As the pour proceeds, the alignment of the shutter must be checked continually. Adjustments shall be made using a heavy hammer and a stout timber bolster on either face of the shutter, in conjunction with adjustments to the turnbuckles on the braces.

(vi) If freezing weather or heavy rain is expected after completion of concreting, the top surface of concrete must be protected with sacking. The insulation provided by the shutter ensures that additional cold weather protection is not required to protect the vertical faces.

(vii) Day joints between pours should be prepared by washing and brushing away any cement laitance as soon as possible after the initial set, to expose the aggregate. This will ensure a good bond with the following pour. Horizontal day joints are best located approx. 50mm down from top of the forms. This will keep the castellation clear. Any concrete spilled into the castellation should be washed away before it sets.

2.4.23 *Electrical*

(i) Route of all planned electrical wiring or conduits and location of boxes on surface of the walls shall be marked with a magic marker. Then a 38mm deep groove, using a router, shall be made through foam and hard plastic stud-flanges. The groove will allow the wire or conduit to be buried below the surface of the finished wall. The wire or conduit may be friction fit or held in place with spots of foam adhesive.

(ii) Electrical boxes with surface mounting side ears shall be installed similarly by removing a piece of foam next to a stud flange and using course threaded screws secured to the flange. Boxes may be held in place with foam adhesive or may be anchored to the concrete wall.

(iii) Hot wire knives may be used to make grooves and to remove excess pieces of foam for installing wire, conduit and boxes. These forms have a designated electrical wire and conduit chase with a saw or router while avoiding wall-ties. These forms also provide a place in the stud flange for fixing 100 mm boxes, if required, without encountering the wall-ties in the bracket.

2.4.24 *Plumbing*

Good practices of plumbing shall be followed.
Plumbing pipes shall usually be not fixed on exterior walls, except kitchen sinks. A channel of required size shall be made for drain, vent and water supply pipes having 60mm foam on inside of the wall.

2.4.25 *Interior and Exterior Finishes*

All commonly used standard finishes shall be applied on the modules. Finished materials shall be attached with course threaded screws to the stud flanges and the corner bracket or bonded directly to the foam surface. However, when attaching wood siding, wood furring strips shall be added to provide an air space that aids in stabilizing the wood. Furring may also be provided for other siding or wall covering applications.

2.4.26 *Waterproofing*

All walls below plinth level shall be waterproofed. The waterproofing materials applied to the foam wall surfaces shall be compatible with EPS foam and plastic and shall be as per the manufacturer's recommendations.

2.4.27 *Backfilling*

For plinth walls which require backfilling, bracing shall be removed after the wall has developed adequate strength and is supported at the top by floor or roof, and at the bottom by floor.

Construction photographs showing the above activities are given in Annex IV.

2.4.28 *Requirement of Modules*

The requirement of modules needed for a particular project may be calculated as follows:

2.4.28.1 *Gross number of modules needed*

The total number of modules needed may be calculated by multiplying the wall height, which is calculated in increments of 250mm (height of Standard module) by the length of the building walls, this will be equal to the total area in square meter of walls to be built. Then divide this by 0.25 sqm (total surface are of a form) which will give the gross number of modules needed.

2.4.28.2 *Total number of corner modules needed*

The total number of modules needed may be calculated by dividing the wall height by 250mm, which will be total number of courses. Then multiply this by number of building corners which will give the total number of corner modules needed.

2.4.28.3 *Total number of modules displaced by window and door openings*

Considering the size of standard modules, 1000 x 250mm, full size uncut forms that will fit in each opening may be calculated. Add the total number of full size uncut modules for each opening to determine the total sum of modules that will be displaced.

2.4.28.4 *Total number of straight modules needed*

Add the total numbers of corners and the number of modules displaced by window and door openings, and then subtract the same from the gross number of modules needed. The remainder will be total number of straight modules needed.

It is always not possible to determine the exact number of modules needed to complete a project. As such, some extra modules may be needed to make up for errors, miscalculations and oversights.

For detailed information of the above applications, Styro Stone's Installation & Instruction Manual shall be referred which is available with the manufacturer.

2.5 **Skills/Training Needed for Installation –** Special skills of a mason/carpenter as required for construction of a building shall be required for this system. However, the PAC holder shall provide on request necessary guidance to the users at site, if required

2.6 **Guarantees/ Warranties Provided by the PAC Holder**- The Certificate holder shall furnish warranty as per the mutual agreement between the users and the Certificate holder. A ten year warranty for structural defects is recommended. A structural defect is defined as physical damage to the building's designed load bearing elements caused by failure that will affect its load-bearing function to the extent that the building becomes unsafe, unsanitary or otherwise unlivable.

2.7 Services Provided by the PAC Holder to the Customer

2.7.1 The PAC holder shall provide pre-sale advisory regarding the system. Customer/user may obtain from the PAC holder details of the advice that may be provided to him.

2.7.2 Users/Customers should ascertain from the PAC holder the type of service, the PAC holder is prepared to provide.

Part 3 BASIS OF ASSESSMENT AND BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Assessment

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

3.2 Inspection of the Modules and Visit of a building

1000 modules of various types and sizes imported by the firm from *Spain* lying at a site in Khammam were inspected by the TAC member and Officers of the Council. These modules will be installed for construction of a building which is under progress there.
A single storey Prototype house of about 100 sq m constructed at Khammam by the firm in 2016 using the modules was also inspected by the TAC member and Officers of the Council. The work was generally found to be satisfactory.

3.3 Laboratory Tests Done for Assessment

3.3.1 *Evaluating the Water penetration resistance of ICF Window Installation techniques by RDH Building Engineering Ltd., Canada*

3.3.1.1 *Water Penetration Testing in accordance with ASTM E 1105*

Water Penetration Testing was performed on each of the four modules of size 1320 x 1740mm. The results of this testing is shown in the Table below:

Test Pressure	**Module 1 – Internal Buck with SAM Flashing**	**Module 2 – EIFS Basecoat**	**Module 3 – External Buck with SAM Flashing**	**Module 4 – Direct to concrete**
150Pa	Pass	Pass	Pass	Pass
300Pa	Pass	Pass	Pass	Pass
700Pa	Fail	Pass	Fail	Pass

Out of the window installation details tested, two modules successfully prevented water ingress at 150, 300 and 700 Pa (Modules 2 & 4). Modules 1 & 3 successfully prevented water ingress at 150 & 300. Thus, the specimen, as prepared, prevented water ingress as defined by the standard at pressure of 150 & 300 but failed to prevent water ingress at 700Pa.

3.3.1.2 *Water Tightness of the Assembly*

Based on the laboratory and field testing of the module samples, the most air and watertight layer in the wall assemblies tested was the reinforced concrete core and the basecoat applied to the exterior of the wall. Uncoated walls allow some water to enter joints between the foam modules and run behind surface applied membranes all flashings if they are not sealed back to the core at terminations. This was observed at the base of the wall where it interfaced with the below grade waterproofing membrane and was the ultimate failure mechanism on modules 1 and 3 at the higher test pressures. On more exposed buildings, this risk can be mitigated by making the exterior surface watertight by using a water resistant membrane or

coating (module 2) or by sealing to the core at all interfaces with adjacent enclosure systems (module 3). Water leakage was not observed though the concrete core in any of the samples tested on site or in the laboratory. However, the water tightness of the core will be highly dependent on the manufacturer, installation, reinforcing, soil conditions, concrete quality and application. If the core is used as the primary water penetration resistance layer in the enclosure system it is critical that individual manufacturers test and develop installation procedures to ensure that the system will perform as intended on site.

3.3.1.3 *Suitability as a Water Resistive Barrier (WRB)*

Based on the testing performed, all of the test samples resisted water penetration better than the benchmark sheathing paper module from Phase 2. In addition, modules that either waterproofed the exterior surface or sealed all penetrations to the concrete core out-performed the options that used the exterior foam layer as part of the moisture barrier. These high performing WRB strategies may be appropriate for moderate and high exposure buildings.

3.3.2 *Engineering Evaluation of Logix Water Vapour Transmission Test by Intertek Testing Services NA Ltd., USA*

Intertek has conducted an engineering evaluation of Logix Insulated Concrete Forms Ltd., on Logix to determine if the Logix meets the 2005 National Building Code as a vapour barrier. The analysis showed that Logix meets the water permeance requirements and can be installed without a vapour barrier.

3.3.3 Test Report of samples of modules of total thickness of 250mm collected by the Officer of the Council for carrying out the following tests by Star Wire (India) Pvt. Ltd. (Diagnostic Centre), Ballabgarh (Haryana):

Sl.No.	Test Parameters	Unit	Result	Limits
1	COMPRESSIVE STRENGTH AT 10% DEFORMATION	Kg/cm^2	2.0	Min. 1.1
2	DENSITY	Kg/m^3	25.0	
3	THERMAL STABILITY	%	0.5	Max. 1.0
4	WATER VAPOUR PERMEANCE IN 24 HOURS	gm/m^2	25.7	Max. 30.0
5	MOISTURE ABSORPTION	%	0.79	Max. 1.0
6	LOAD TEST OF PANELS	KN	1.0	--
7	FLAMMABILITY TEST	--	PASSES THE TEST (SELF – EXTINGUISHING)	

3.4 Execution of Projects

The buildings constructed by MICS in India and by Styro Stone

abroad are listed below (buildings constructed by Styro Stone abroad have not been seen by BMTPC) :-

S. No.	Name of Project	Location	Period of Construction
1.	Construction of a single storey Prototype house by Maiwir Ecotech Pvt. Ltd.	VDOS Colony, Khammam (Telangana)	2016
2.	Construction of a two storey Commercial building for Clean Footprint Ltd. by Styro Stone	Penarth (Great Britain)	2012
3.	Construction of a two storey German Energy Centre & College by Styro Stone	Shangai, China	2010
4.	Construction of six storey Apartments in University of Nanjing by Styro Stone	Kunshan, China	2010

PART 4 STANDARD CONDITIONS

The certificate holder shall satisfy the following conditions

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

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

4.3 The quality of the product shall be maintained by the certificate holder.

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

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

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

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

4.8 The certificate holder agrees to inform BMBA of their distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.

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

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

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

(a) The presence or absence of patent or similar rights relating to the product;
(b) The legal right of the Certificate holder to market, install or maintain the product;
(c) The nature of individual installations of the product, including methods of workmanship.

4.12 BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.

4.13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.

4.14 In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.

4.15 The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product

4.16 The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.

4.17 The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others.

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

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, 1st Floor, India Habitat Centre,Lodhi Road,
New Delhi-110 003

Place: New Delhi

Date of issue:

PART 5 LIST OF STANDARDS AND CODES USED IN ASSESSMENT

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

5.1.1 IS 383:2016 – Specifications for fine and coarse aggregates from natural resources
5.1.2 IS 456:2000 -- Code of practice for plain and reinforced concrete
5.1.3 IS 875 (Parts 1-5):1987 -- Code of Practice for Design Loads (Other Than Earthquake) for Buildings & Structures
5.1.4 1786:2008 – Specifications for high strength deformed steel bars and wires for concrete reinforcement
5.1.5 IS 1893 (Part 1):2016 -- Criteria for Earthquake Resistant Design of Structure
5.1.6 IS 1904: 2005 – Code of practice for design and construction of foundations in soils: General requirements
5.1.7 IS 3346:1980 – Method of determination of thermal conductivity for thermal insulation materials
5.1.8 IS 4671:1984 -- Specifications for expanded polystyrene for thermal insulation purposes
5.1.9 IS 4759:2006 – Hot Dip Zinc Coating on Structural Steel Products
5.1.10 IS 9103:2004 -- Specifications for concrete admixtures
5.1.11 IS 12269:2013 – Specifications for 53 grade ordinary Portland cement
5.1.12 ISO 9705:1993 – Fire tests for evaluating contribution of wall & ceiling interior finish to room fire growth
5.1.13 ACI 318:2014 – Building code requirements for structural concrete, structural design for flat wall MICS systems
5.1.14 ASTM C 578:2015 – Standard specifications for rigid, cellular polystyrene thermal insulation
5.1.15 ASTM E 119:2014 – Standard test methods for fire tests of building construction and materials
5.1.16 ASTM E 1105:2008 – Standard test methods for field determination of Water penetration of installed exterior windows etc. by uniform or cyclic air pressure difference
5.1.17 ASTM E 2634:2011 – Standard specifications for flat wall ICF systems

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.

Part 5.3 References

1. Styro Stone Technical Manual
2. British Board of Agreement No. ETA-05/0144
3. Three dimensional earthquake FE simulation for a school building by using Styrostone formwork by Hagger & Partner, USA.
4. MICS Field Testing Report by RDH Building Engineering Ltd., Canada as per ASTM E 1105-00 (2008) Window Test Report: HPO Test Modules 1-4.
5. Vapour Barrier Test by Logix Insulated Concrete Forms, USA.
6. Inspection of 1000 modules of various types and size imported from Germany for construction of a G+1 storey building at Khammam, by TAC member and BMTPC Officers.
7. Inspection of a single storey Prototype house of about 100 sq constructed at Khammam by the firm in 2016 using the modules by TAC members and BMTPC Officers.
8. Test Report of samples of modules of total thickness of 250mm collected by the Officer of the Council for carrying out the following tests by Star Wire (India) Pvt. Ltd. (Diagnostic Centre), Ballabgarh
9. For details of the foundations, reference may be made to the sketches given in Styro Stone Technical Manual.

CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Monolithic Insulated Concrete System (MICS)** bearing the mark manufactured by M/s Maiwir Ecotech Pvt. Ltd., is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No.: 1036-S/2018** is awarded to **M/s Maiwir Ecotech Pvt. Ltd., Khammam (Telangana).**

The period of validity of this Certificate is for a period of one year i.e. from 12-03-2018 to 11-03-2019 as shown on Page 1 of this PAC.

This Certificate consists of a cover page and pages 1 to 45.

Embossing Seal of BMBA

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, 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.

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 1.8.2)

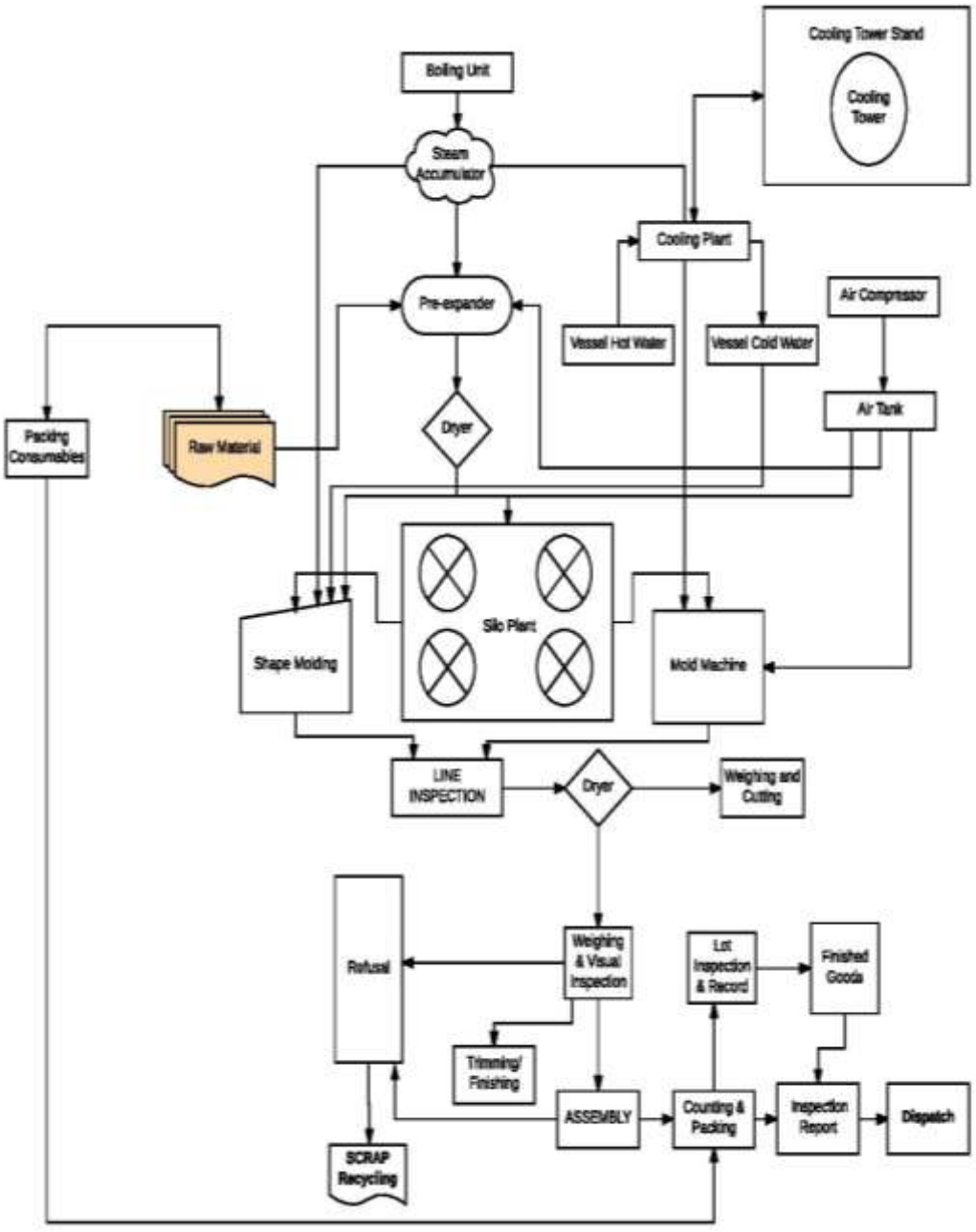
QUALITY ASSURANCE PLAN FOR MONOLITHIC INSULATED CONCRETE SYSTEM (MICS)

S. No.	Parameters to be inspected	Requirement Specified	Test Method	Frequency of Testing
	1. Raw Materials			
1.	Expanded Polystyrene (EPS)	Shall conform to IS 4671:1984	Manufacturer's test report	Every batch/ lot
2.	Polyurethane (PU) Foam Adhesive	Manufacturer's specifications	Manufacturer's test report	Every batch/ lot
3.	Plasticixer	Shall conform to IS 9103:1999	Manufacturer's test report	Every batch/ lot
4.	Hard Plastic Tie	Manufacturer's specifications	Manufacturer's test report	Every batch/ lot
	2. MICS			
1.	Dry Density	25 kg/m^3	IS 4671:1984	One time or as per requirement
.2	Compressive Strength	Min. 1.1 kg/cm^2	IS 4671:1984	One time or as per requirement
3.	Water Vapour Permeance	Max. 30.0 g/mm^2	IS 4671:1984	One time or as per requirement
4.	Thermal Stability	Max. 1.0%	IS 4671:1984	One time or as per requirement
5.	Moisture Absorption	Max. 1.0%	IS 4671:1984	One time or as per requirement
6.	Load test on panels	1.0 kN	--	One time or as per requirement
7.	Flammability test	Should pass the test	IS 4671:1984	One time or as per requirement

ANNEX II

(Clause 1.5.3)

MANUFACTURING PROCESS FLOW CHART

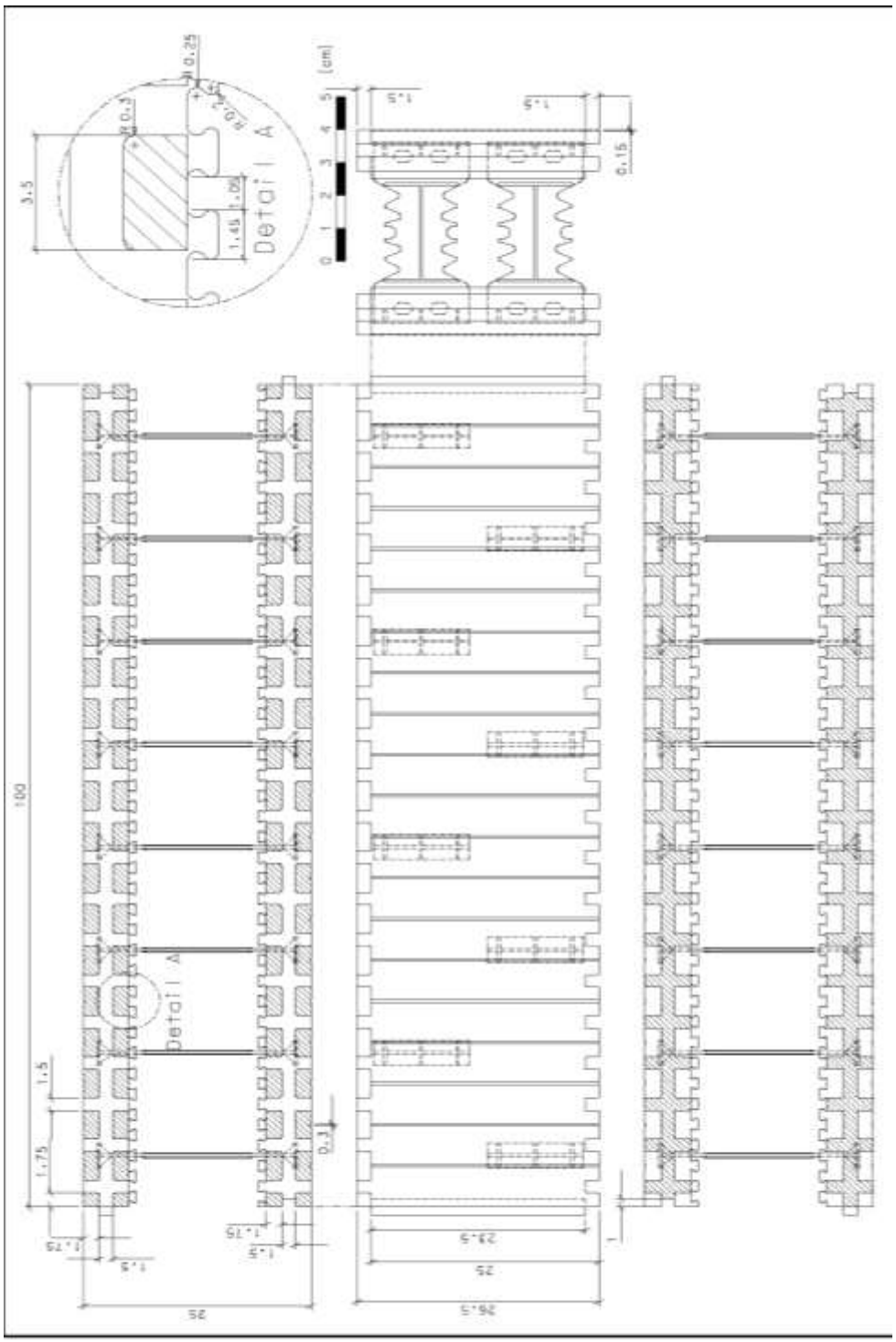


ANNEX III

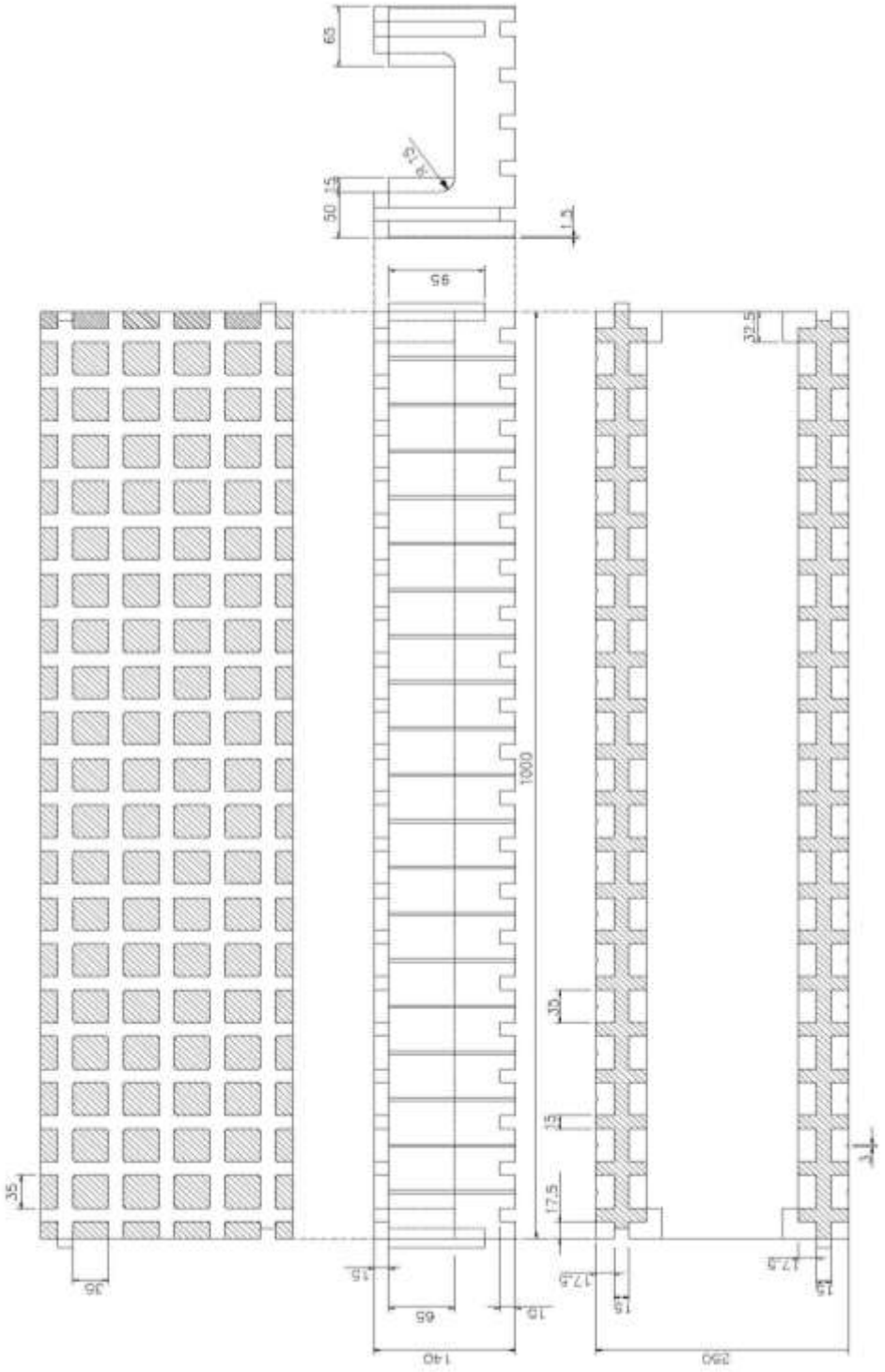
(Clause 1.3)

DETAIL of MODULES

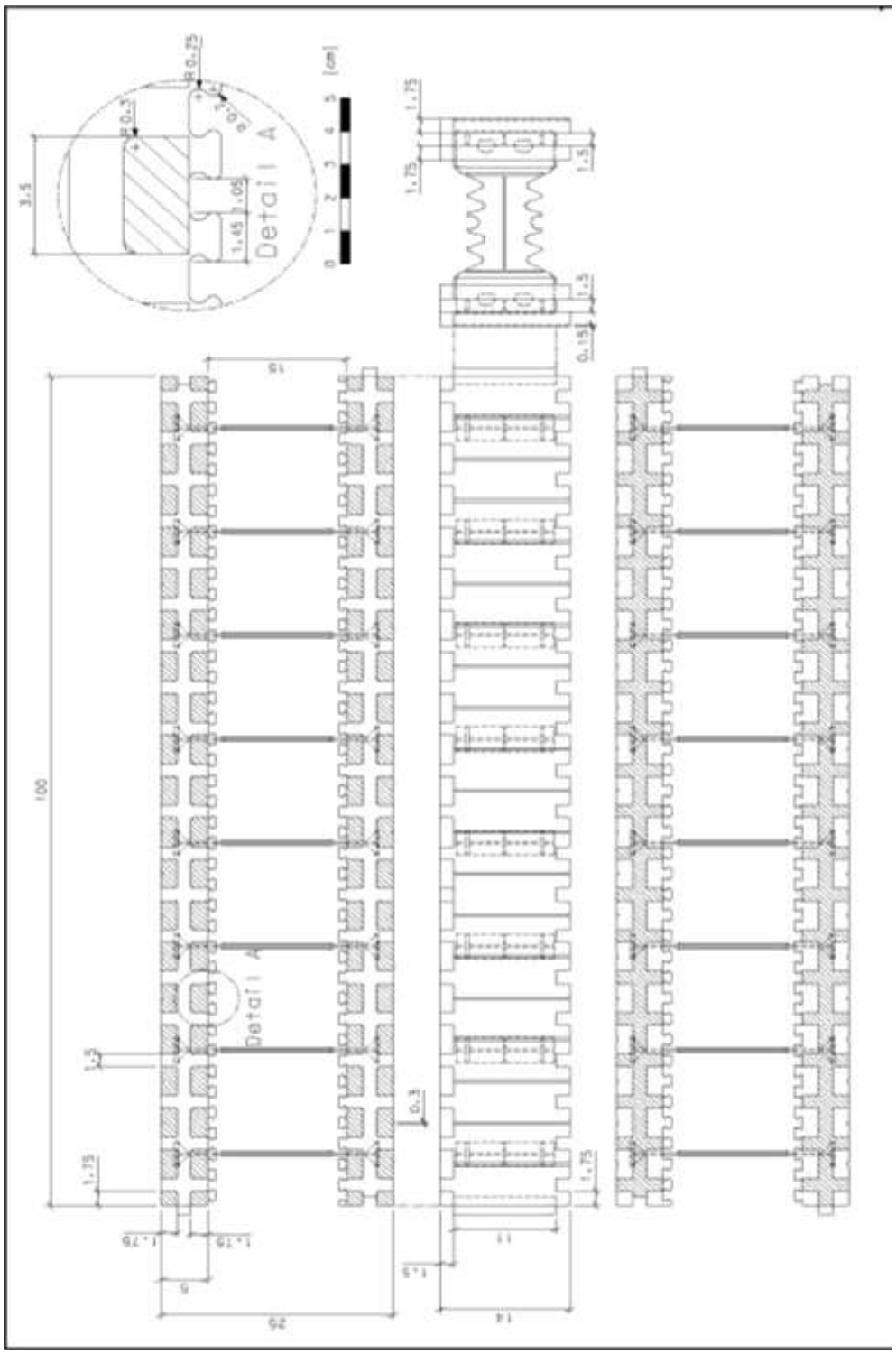
Standard Module



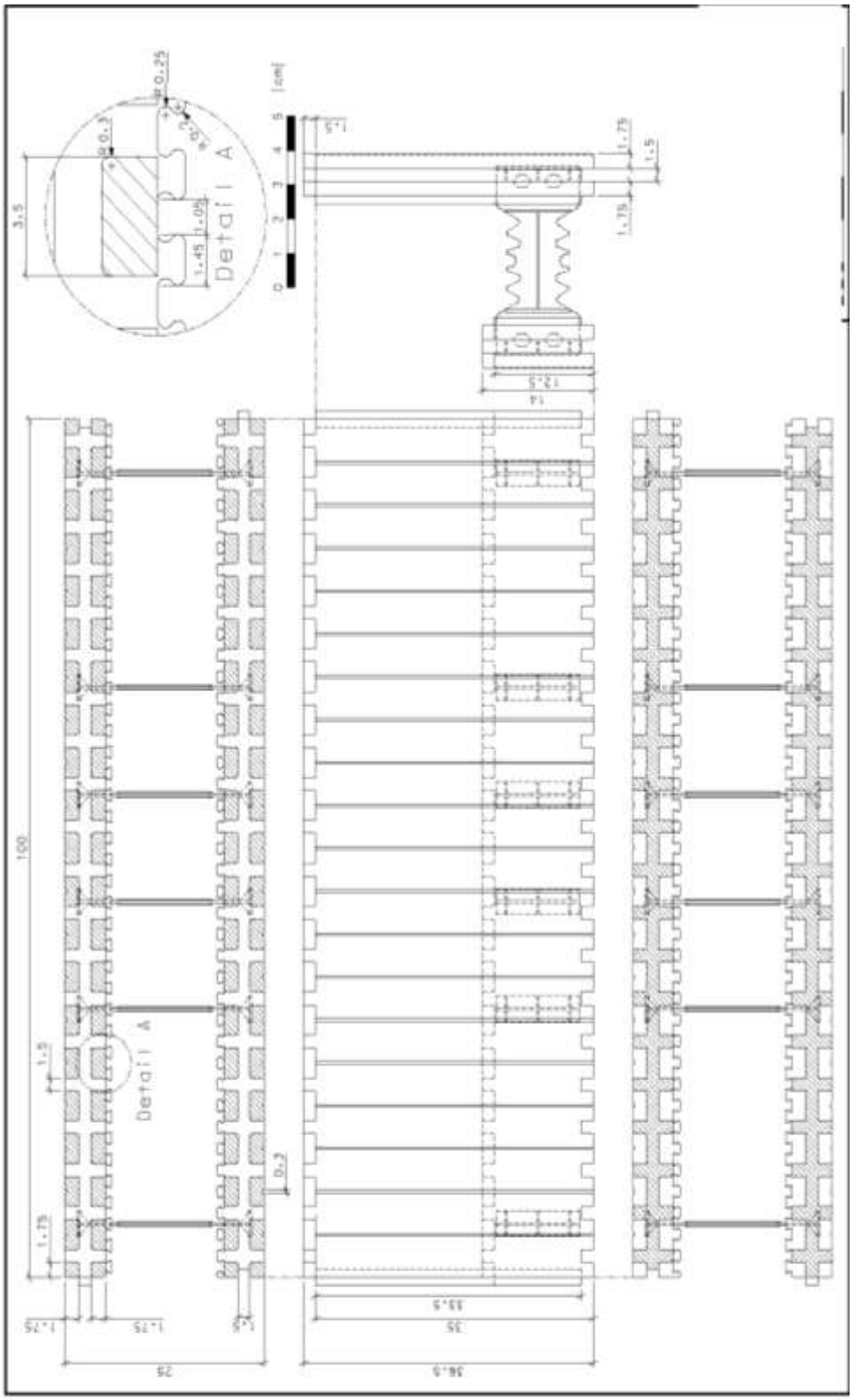
Lintel Module



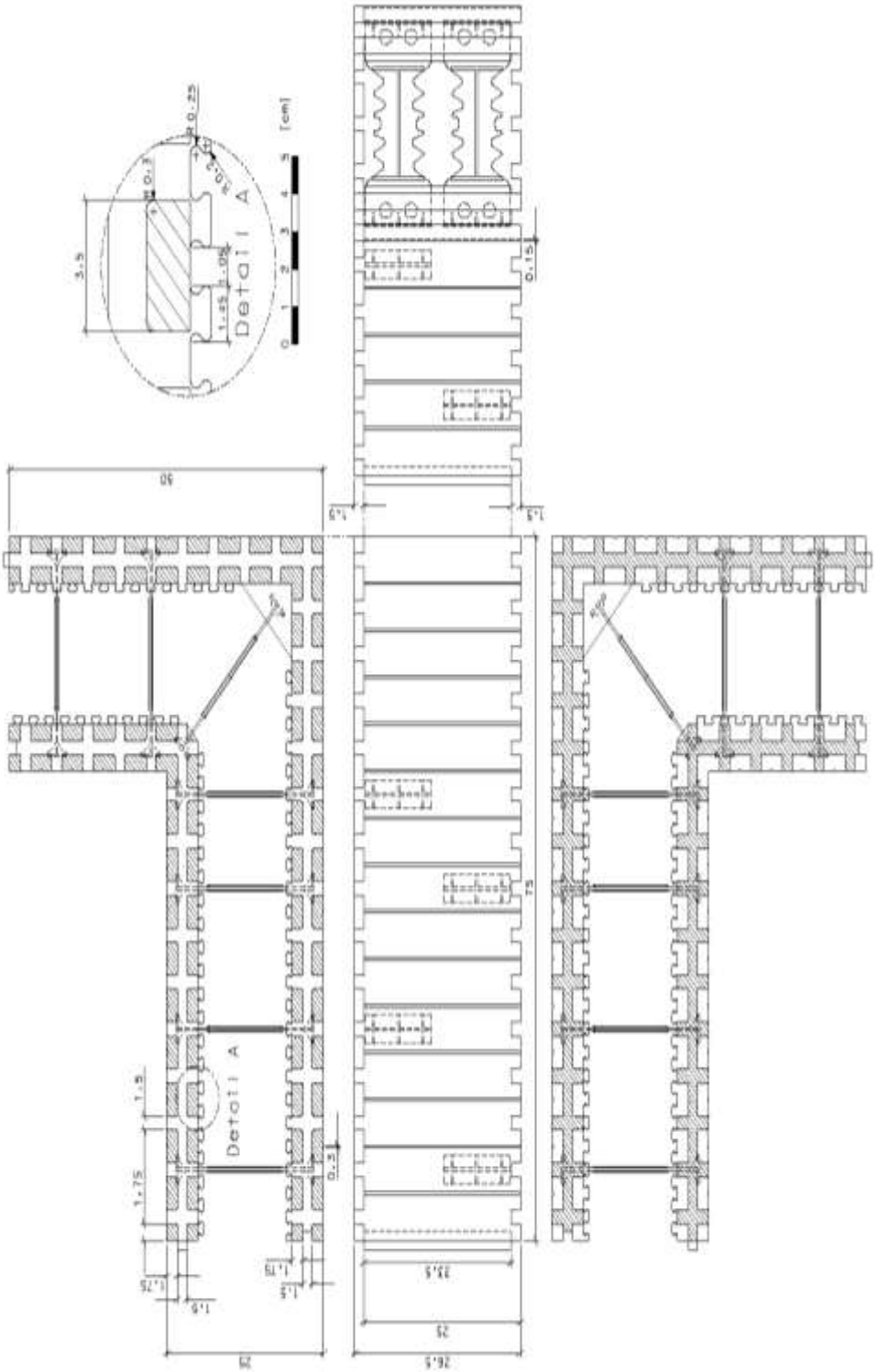
Half Height Module



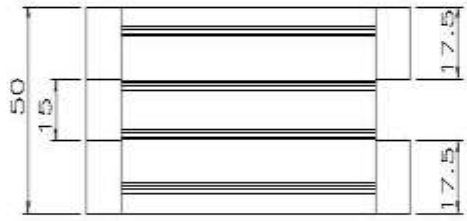
Floor Ceiling Edge Module

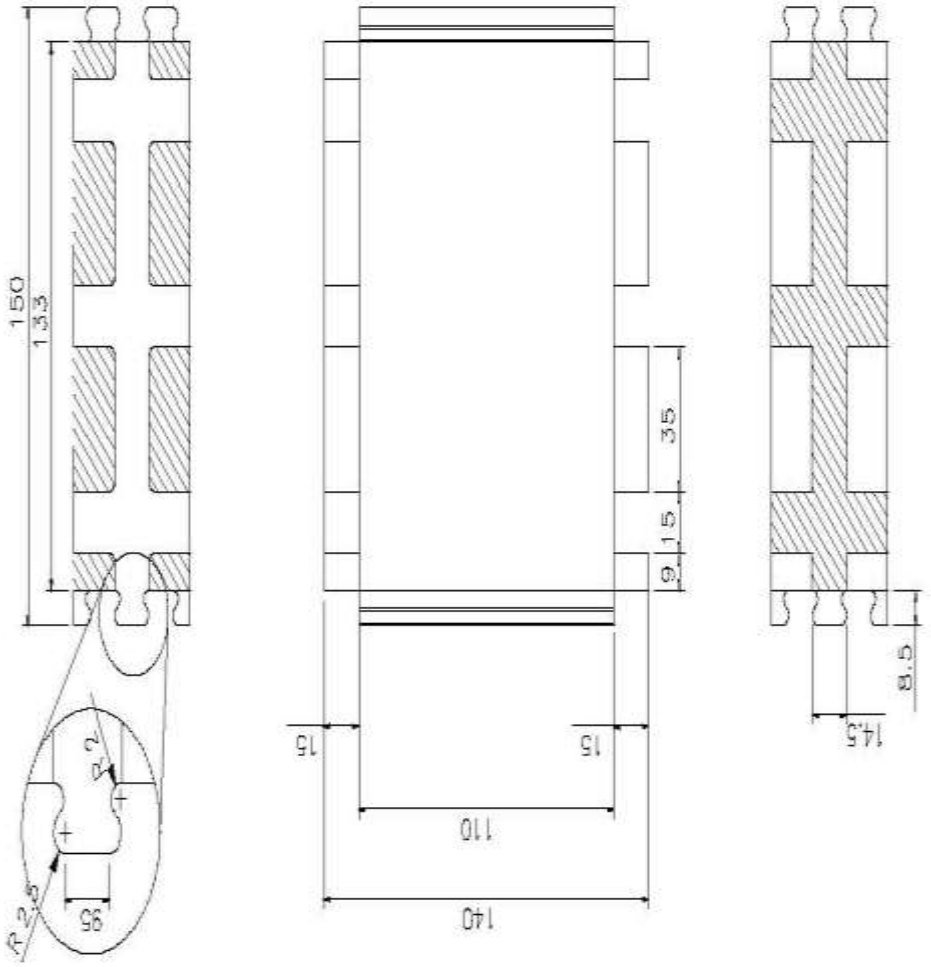


Corner Module



End Piece Module





ANNEX IV

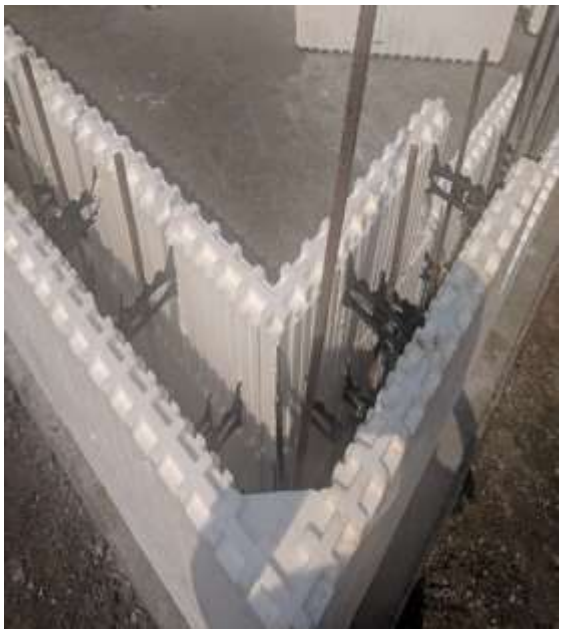
(Clause 2.4.27)

CONSTRUCTION PHOTOGRAPHS

BASE: MICS may be built on footings similar to conventional masonry footings, slabs-on-grade or piles or can also be built on step footings & shallow foundation systems, as per the prevailing soil conditions and geo-technical parameters.

Footings

Wall Layouts: Walls built by assembly of interlocking, moulded hollow modules.



Wall Layouts

Wall Layouts

Curved Walls

REBARS: Fixing reinforcement steel bars with hard ties inside formwork as per calculated structural requirement.

Inserting Horizontal Re-bars

Installing Vertical re-bar

Conduits & Pipes

Conduits & Pipes: Inside chased lines

Bracing, Propping and Scaffolding

Bracing: support to the walls before concreting frames

Propping: Fixing framework props around doors & window

Scaffolding: Platform on trestles for access & assembly of high walls

Concrete pouring

Concrete pouring: (High slump concrete poured inside formwork)

Insulated Walls: External walls

Water Proofing

Doors & Windows: Fixed after concrete poured but before walls are rendered.

Window Finishing