1.0 INTRODUCTION

With the aim to provide sustainable, safe & affordable technological solutions for faster & cost effective construction of houses suited to various geo-climatic and hazard conditions of the country, the Government of India has set up a Technology Sub-Mission as a part of "Pradhan Mantri Awas Yojana (Urban) – Housing for All" Mission.

The conventional construction system are primarily a cast in situ, slow pace construction system besides being energy intensive and dependent on natural resources which cannot meet the present requirement of Housing Shortage. Therefore, it is the call of the day to adopt new construction systems which are fast track and at the same time which meet functional & structural requirements, ensuring a paradigm shift from a slow track system to fast track emerging Systems without compromising structural & functional performance. This will require judicious selection and evaluation of globally acceptable contemporary technologies to suit the Indian Specification including utilization of local available resources, wherever feasible.

With this objective in mind, BMTPC initiated identifying, evaluating & certifying new emerging construction systems from all across the globe which can help in replacing the conventional cast-in-situ RCC construction. Endeavor has been to bring innovation, speed, safety & sustainability in the existing construction methodology without compromising structural & functional performance. Also, BMTPC has been conducting capacity building programmes across India, in partnering with states, so as to educate practicing engineers & architects, students, policy makers, contractors and artisans about these technologies.

Now, BMTPC have a set of 16 such new emerging technologies which can bring in speed, safety, sustainability in the construction sector.and also in order to showcase these technologies, demonstration housing projects are being executed in different states.

Formwork Systems

1) Monolithic Concrete Construction System – (a) using Plastic - Aluminium Formwork; and (b) using Aluminium Formwork
2) Modular Tunnel form
3)Sismo Building Technology Precast Sandwich Panel Systems
4)Advanced Building System – EMMEDUE
5) Rapid Panels
6) Reinforced EPS Core Panel System
7) QuickBuild 3D Panels
8)Concrewall Panel System
9)Glass Fibre Reinforced Gypsum (GFRG) Panel System Light Gauge Steel Structural Systems
10) Light Gauge Steel Framed Structure (LGSFS)
11) Light Gauge Steel Framed Structure with Infill Concrete Panels (LGSFS-ICP) Steel Structural Systems
12) Factory Made Fast Track Building System
13)Speed Floor System Precast Concrete Construction Systems
14)Waffle-Crete Building System
15) Precast Large Concrete Panel System
16)Industrialized 3-S system using cellular light weight concrete slabs & precast columns

This office made study on "Innovative Construction Technology for Affordable Housing" using EPS core panel system, as per the instructions given by Superintending Engineer, MERI, Nashik vide letter dated 24 & 25/4/2018.

2.0 EPS Core Panel System

EPS panel system is a modern, efficient safe and economic construction system/material for construction of building. These panels can be used both as load bearing and non load bearing elements.EPS core panel is a 3D panel consisting of 3-dimensional welded wire space frame utilizing a truss concept for stress transfer and stiffness.provided with the polystyrene insulation core. Panel is placed in position and shotcrete on both the sides. as shown in Fig. 1.

EPS panel after shotcrete has the following five components (as Fig. 1.)

i. The outer layer of shotcrete.

ii. Welded reinforcing mesh of high wire.

iii. The core of expanded polystyrene sheet.

iv. Diagonal wire (stainless or galvanized wire).

v. The inner layer of shotcrete.

The welded mesh fabric connected piercing polystyrene with truss of steel wire, welded to the welded fabric at an angle. It gives a rigidity spatial structure, and simultaneously prevents polystyrene core shifting.

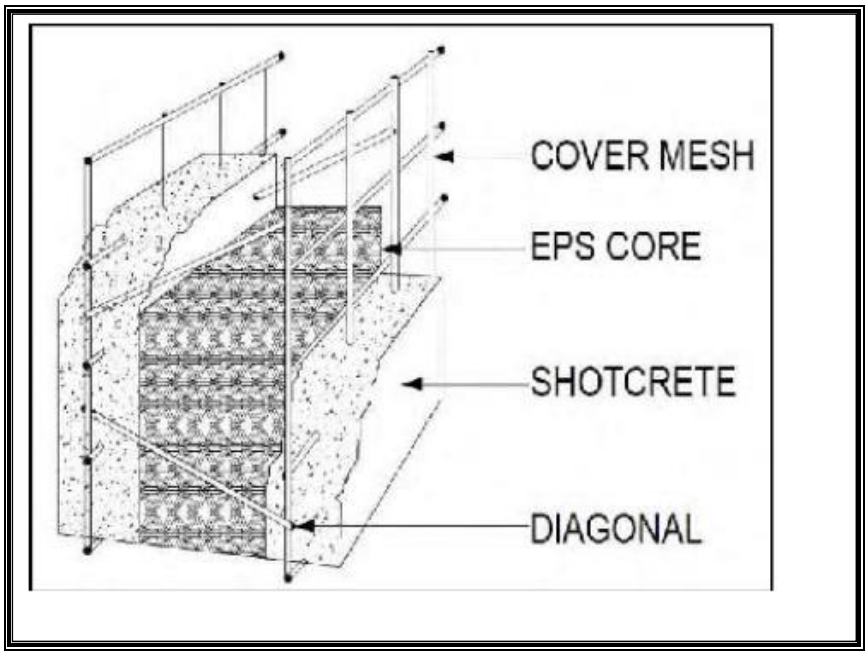


Fig 1: Typical cross section of wall panels

Individually welded internal strut wires or diagonals extend through the panel core between each surface. These galvanized strut wires are welded continuously in the required spacing so they form, with the welded wire fabric, into a triangulated truss system which greatly increases the panel strength.
EPS panel is a versatile structural element designed for floors, walls, partitions, roof and stairs.

Fig. 2 & Fig. 3 shows the welded reinforcing mesh of the EPS panels at different cross-sections.

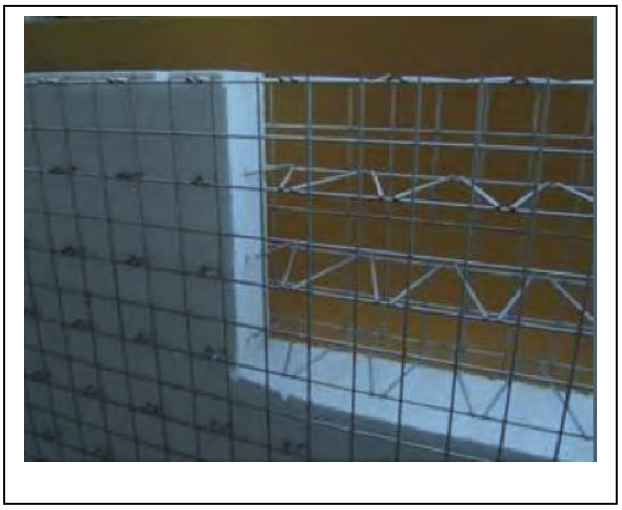


Fig 2: Reinforcing mesh expanded polystyrene core and diagonal wire.

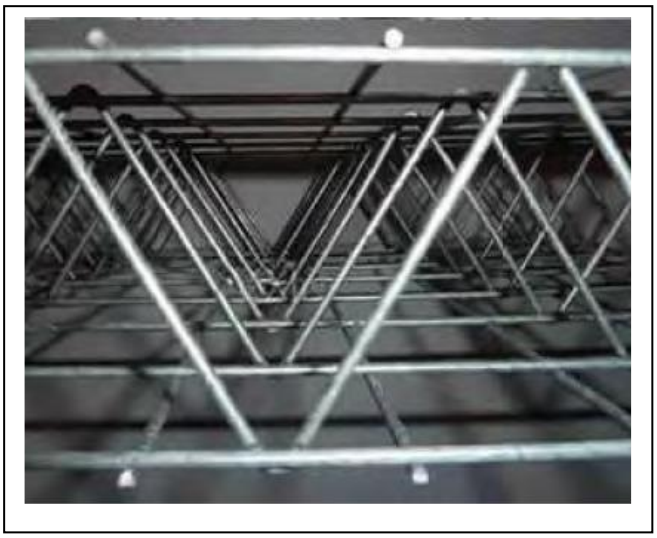


Fig 3: Welded reinforcing mesh 3-D panel without expanded

The typical EPS panel is generally manufactured with dimensions of 1200 mm width, 3000 mm length and over all thickness range of 80-230 mm.The panels are finished at the site using minimum 30 mm thick shotcreting of cement & coarse sand in the ratio of 1:4 applied under pressure. The shotcreting coat encases the EPS Core with centrally placed steel welded wire mesh.

3.0 Present Status of use of EPS core panels

Present Status of use of EPS core panels across the world

The technology (developed about 30 years back) is in use successfully in many countries like ltaly, Morocco, Algeria, South Africa, Kenya, Austria, Malasiya, Ireland, Romania& Australia and other countries.

Present Status of use of EPS core panels in India

CSIR –Central Building Research Institute, Roorkee issued a manual for Expanded Polystyrene (EPS) Core Panel System and its field Application and it is sponsored by Ministry of Housing and Urban Poverty Alleviation, Government of India.

BMTPC – Building Materials and Technology Promotion Council Ministry of Housing and Urban Poverty Alleviation, Government of India issued a Compendium of Prospective Emerging Technologies for Mass Housing using this Technology and issued performance appraisal certificate for 1) Advanced Building System-EMMEDUE 2) Raid Panels 3)Reinforced EPS Core Panel System 4) QuickBulid 3D Panels 5)Concrewall Panel System

PWD, Maharashtra and CPWD Delhi incorporated items with construction of 3D panels in the Schedule of rates.

3 D Panel Projects in various Government Organisations in India

- Nirmiti Kendra, Karnataka has constructed 100 Anganwadis
- BMTPC executing a project in Bhubaneshwar.
- Telangana and Chhattisgarh actively considering 3D panel technology for mass housing.
- UP Government has constructed a housing project for UP Police.
- CSR Projects- Vedanta group has constructed 100 Anganwadis out of planned 5000 units in various states.

In addition to JSW has constructed a residential colony of 1 million sqft at Angul Orissa. Also various private projects are in progress/completed across India.

4.0 Materials

Expandable polystyrene - self extinguishable expandable polystyrene grades designated as FR grades are directly produce in the reactor from styrene monomer,pentane gas is used for expanding the granules.these beads are characterized by low steam consumption/ good thermal and sound insulation properties/excellent fusion and low post moulding drying time FR grades SE 250FR, SE230FR & SE200FR.conform to the standards are suitable for construction purpose.
Steel Wires- steel welded wire fabric confirming to ASTM A185 is used for reinforcement
GI Wires- Zinc coated (Galvanised) steel wire confirming to ASTM B606 /B606 M08 are used for joining the steel wires diagonally through polystyrene core.

5.0 Method of Construction

Plinth:Based on the detailed architectural drawing and design requirement plinth is constructed with conventional footing and plinth beam and dowels are led along the plinth.The panels are then lifted & placed in between the dowels which are initially plotted along the plinth.
Panel Types: The panels being manufactured are of different types depending upon the functionality. The Wall Panels are of two types: Single wall panel and Double wall panel. Floor and Roof panels are thicker and with grooves for providing additional reinforcement. The Stairs Panels are fabricated with wire meshes on all sides. After placing the panels at desired position, Aluminium or Steel rods are inserted for better rigidity of stairs Further the wire meshes can be welded for continuity before concreting.The typical EPS panel is generally manufactured with dimensions of 1200 mm width,3000 mm length with thickness of 80mm-230 mm.
The panels are of three types depending upon the application as shown below:
1) Single load bearing Panel
2) Single Non Load Bearing Panel
3) Single Floor Panel -Used as floors or roofs span upto 5 m x 5m and supported by the walls in all the sides. The panels are finished on site by 50 mm of casted concrete in upper side and 30 mm of projected plaster in the lower side.
4) Two Pot Floor Panel-With span up to 9 m, these panels are characterized by the presence of joist. The joists are reinforced on site by the steel bars according to the structural verification and are finished by 40 mm of casted concrete (M25) on the upper side and 25 mm of projected plaster (M15) in the lower side.

Angular Meshes & Reinforcements: The angular meshes are especially used for the window and door sections. They are also used to connect the perpendicular wall, floor, stair & roof panels.
Accessories: This technology requires Bending wires, Wire cutters, Hot air gun, Clipping gun, Knives, Shotcrete gun and other light tools.
Anchorage: The panels placed next to each other are joined by crimping the wires. The panels can be welded for better connectivity and continuity.
Door and Window: These shall be made by marking and cutting the mesh of the wall panel with a circular saw, reciprocating saw, or with wire cutters, and reinforcing the edges on both sides with zigzag mesh. The zigzag mesh should extend 300 mm from the edges of the doors and windows. Afterwards, diagonal zigzag mesh shall be installed on every corner of 400 mm. Where edges and corners are reinforced, the polystyrene along the perimeter of the opening shall be removed and the space is filled with mortar or concrete to form a rigid boundary. In the area on top of the opening, the polystyrene shall be removed and reinforcing steel placed to form a lintel beam.
Preparation of ducts: Ducts/ Channels are made using Hot-air guns, to install pipes (electrical, water and gas) easily behind the steel meshes Further, the ducts and wire mesh is covered by spraying concrete.

Plumb and Alignment

It shall be assured that the wall panel is plumb and in line, and to maintain right angles between them,tension wire and metal rulers shall be used. The polystyrene in the center of the panel shall be toothed on the surface to ensure better mortar connection and less wastage.

Finishing

i. Floor finishing

- It must be ensured that the floor area is completely clear of any debris, dust and soil etc.
- It must be ensured that the floor surface is damp prior to finishing and it should be fully moist without any water stagnating on it.
- Cement mortar of mix 1 cement: 3 sand shall be prepared and required quantity of mortar shall be Applied to the floor to provide a smooth finish.

ii. Ceiling finishing

- A stiff mix of 1 cement: 3 sand mortar shall be prepared and applied to the ceiling, providing a level but rough surface.
- It must be ensured that the first layer of plaster is damp prior to applying the finish layer.
- Cement mortar of mix 1 cement: 4 sand shall be prepared and required quantity of mortar shall be Applied to the ceiling to provide a smooth finish.
- The total thickness of the ceiling finish should not exceed 19 mm below the panel wire mesh.

iii. Wall finishing

- Cement mortar of mix 1 cement: 4 sand shall be prepared and 25 mm plaster shall be applied to the predamp wall to give a finish surface.
- Wall plaster should be allowed to be cured for at least 7 days after placement.

Roofing and Finishing: Roof panels are placed & adjacent meshes are crimped or welded for connectivity. The mesh is then covered with concrete, then the waterproofing coat is applied over the concrete surface Concrete is again spread over for an even surface and tiles are laid.Fig 4 and 5 shows EPS panel structure during Finishing and after Finishing.

Shortcrete: Shortcrete with Shortcrete gun applied under pressure to cover the mesh The plaster is again spread to give an even surface to the wall and floor. Now the wall surface is ready to paint or apply wallpaper. In case of the Double Panels, the concrete is also added in between the two panels fcr strength.

Fig 4 During Finishing

Fig 5 After Finishing

6.0 SPECIAL FEATURES

Structural Stability:- Numerous lab tests, performed in different parts of the world, have highlighted the high load resistance of the panels which after compression testing with centred load performed on a single finished panel, 2700 mm high, have shownthat they withstand a maximum load of up to 1530 kN/m =153 ton/m. The Monolithic joints of the building system provide a high level of structural strength to buildings.

Durability :-Durability is achieved with the use of proper grade and thickness of concrete as per IS 456. Minimum 45 mm thick plaster is recommended for structural and fire safety point of view. No deficiency effects are to be expected from EPS fills for a normal life cycle of 100 years.

Behaviour in earthquake:-Buildings made using panels are particularly lightweight, so have a low seismic mass, but are at the same time rigid due to two sheets of reinforced plaster that interact to create an enveloping shell of the whole structure.

Fire Safety:-The quality of the expanded foam polystyrene used for panels is self-extinguishing and is perfectly encased by layers of reinforced concrete as external coat to sides of the panel and inhibit combustion.

Thermal Performance:-The thickness and density of the panel can be customized to deliver specific thermal insulation requirements. Furthermore, the EPS core extends throughout the surface, which makes up the building envelope eliminating thermal bridging. For example, a wall with 80 mm core and finished thickness of about 150 mm provides the same thermal insulation as an insulated solid masonry wall of about 400 mm, with obvious advantages in terms of additional space.

Acoustic Performance:-The panel has got good acoustic behaviour, coupling with sound-absorbing materials (such as plasterboard, cork, coconut fibre, rock wool, etc.), further optimizes the acoustic insulation of those walls.

Behaviour under high winds/Cyclone:-Laboratory tests conducted on buildings, to determine the resistance of cyclone impact and damage caused by wind- borne debris confirm the strength of the building system against such loads. Building constructed in cyclone prone area have shown very high resistance to cyclonic wind.

Sustainability and Energy efficiency:-The insulating envelope provided by polystyrene core eliminates thermal bridges and ducts within the panel. This brings high level of energy efficiency. The system provides significant improvements in indoor thermal comfort by greatly reducing energy consumption and promoting strategies aimed at sustainable development.

Cost Effectiveness:-Compared to traditional products, panels achieve far better results at considerably reduced cost. The speedy construction represent additional savings.

Lightness, ease of transport and handling:-Being light weight and rigid, panels are both easy to handle and transport even in most adverse conditions. Prior to an application of shotcrete, a panel weighs between 3.5 kg/m2 to 5 kg/m2 which means that a single worker can easily handle a 3 m2 wall, i.e. a panel as high as a storey height.

Water absorption:-The water absorption of Expanded Polystrene is low. Although water absorption decreases as density increases.

Density kg/cum	Percentage Volume of water Absorption	
	After 7 days	After 1 years
15	3	5
20	2.3	4
25	2.2	3.8
30	2	3.5
35	1.9	3.3

7.0 General Requirements

- The design shall satisfy the standards of IS 456, IS 1905, IS 11447, IS 875 (Part 1-5), IS 1893 (Part 1), IS 4326, IS 13920.
- In construction using EPS panels as load-bearing structural walling, the walls in the ground floor shall be typically founded on the reinforced concrete (RC) plinth beam.
- Appropriate starter bars shall be embedded at the locations in a staggered way to a minimum specified distance. This ensures the connections of the super structure with the foundation spread over the entire wall length over the network of RC plinth beams.
- Plinth beams shall be supported on appropriate foundations, typically comprising spread footings or raft foundations suitably designed.
- In the case of multi-storey buildings in high seismic zone, the design and detailing shall ensure proper transfer of base shear at the interface of the foundation and the super structure.
- EPS panels used as walls or floors shall be shotcrete with a concrete of grade not less than M20 using aggregate of size less than 5mm.
- The insulation core of expanded polystyrene (EPS) must comply with ASTM C578 and IS 4671: 1984. With 40 mm of shotcrete applied to both sides, each panel achieves a fire rating of 90 minutes [EVG].
- Reinforcement mesh with steel wires shall be used in accordance with ASTM A185 [EVG].
- The diagonal truss wires, as well as the wire used in the manufacture of welded wire fabric, must be in conformity with ASTM A82 [EVG].
- In case of cantilever projections such as balconies, suitable RC beams (Concealed within EPS forms) may be designed and detailed as required.
- Special care shall be taken during construction to ensure proper connections at the junction such as plinth to wall panels, wall panel to wall panel, wall panels to slab panel etc.

8.0 Design of EPS Core Panels

The design of EPS panels is based on National and International standards, codes and engineering practices.

The design should be such that the structure should withstand safely all loads (as per relevant Indian Standards) likely to add from the structure during its lifetime. It shall also satisfy serviceability requirements such as limitations of deflection and cracking. In general the structure shall be designed on the basics of most critical limit state and shall be checked for other limit state design.

Loads-The structure is designed for dead load, live load, wind load, seismic load and checked for serviceability criteria. Serviceability performance concerns the limits on deflections due to loading and the control of vibrations, due to regular activities. Appropriate limits are specified, depending on the application.

List of Codes (National & International)

National Codes

IS 875-1: 1987	Code of Practice For Design Loads (Other. Than Earthquake) For Buildings And Structures, Part 1: Dead. Loads - Unit Weights of Building Materials and Stored Materials
IS 875-2: 1987	Code of Practice For Design Loads (Other. Than Earthquake) For Buildings And Structures, Part 2: Imposed Loads
IS 875-3: 1987	Code of Practice For Design Loads (Other. Than Earthquake) For Buildings And Structures, Part 3: Wind Loads
IS 1893-1: 2002	Criteria for Earthquake Resistant Design of Structures, Part 1: General Provisions and Buildings
BS 13163: 2001	Thermal Insulation Products for Buildings- Factory made products of expanded polystyrene (EPS) – Specification
IS 9012: 1978	Recommended Practices for Shotcreting.

International Codes

ACI 318-08	Building Code Requirements for Structural Concrete and Commentary
ASTM E 72-15	Standard Test Methods of Conducting Strength Tests of Panels for Building Construction
ASTM C578 - 15b	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM E695	Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM E84 − 15b	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM C1141/C1141M – 08	Standard Specification for Admixtures for Shotcrete
ASTM C1436 – 13	Standard Specification for Materials for Shotcrete
ASTM B606/B606M – 08	Standard Specification for High-Strength Zinc-Coated (Galvanized) Steel Core Wire for Aluminum and Aluminum-Alloy Conductors, Steel Reinforced1.
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

9.0 Quality control

The properties of the completed structure shall be consistent with the requirements and the assumptions made during the planning and the design, The construction should result in satisfactory strength, serviceability and long term durability so as to lower the overall life-cycle cost. Quality assurance in construction activity relates to proper design, use of adequate materials and components to be supplied by the producers, proper workmanship in the execution of works by the contractor and ultimately proper care during the use of structure including timely maintenance and repair by the owner.

The job of quality control and quality assurance would involve quality audit of both the inputs as well as the outputs. Inputs are in the form of materials for concrete and shotcreting, workmanship in all stages of batching, mixing, transportation; placing, compaction and curing; and the related plant, machinery and equipments; resulting in the output in the form of concrete and shotcreting in place. To ensure proper performance, it is necessary that each step in concreting/ shotcreting which will be covered by the next step is inspected as the work proceeds.
The following parameters should be considered to measure the performance of EPS panels, based on the physical characteristics:

1. Safety - Shear, axial ,bending ,tension,point loads, surface loads, impact loads, lifting &transportation load etc.
2. Dimensions - Shape, size, thickness & tolerance
3. Durability - Surface material, degradation, moisture penetration & corrosion
4. Energy - Thermal conductivity (performance)
5. Fire - Smoke, fuel, flame spread etc.
6. Functions - Visual assess, acoustic, pipes, conduits, fixtures,
7. Aesthetics - Surface material, colour, texture etc.
8. Connectivity - With other walls, floors, roofs, openings etc.
9. Handling - Transportation, lifting, settling etc.

10.0 Advantages and Limitations of EPS Core panel systems

Some of the advantages of the EPS Core panel systems are as follows:

i. No need of column beams and bricks upto G+3 Storied building .
ii. Reduce the cost of construction
iii. Reduce Construction period
iv. Reduce transport cost. Light weight panels: do not requires cranes and other heavy construction equipment. (A Standard panel of size (1.2×3) m without shotcrete weighs 20 kg).
v. The installation does not need heavy construction equipment.
vi. Ensure high levels of thermal insulation, sound insulation, as well as sanitary and fire safety.
vii. EPS 3-D panels allow no additional cost to erect buildings in areas with moving soil, especially heaving, subsidence, frozen ground, and remote areas.
viii. Strength and durability - used extruded polystyrene virtually inert and does not absorb moisture, is durable and resistant to decay.
ix. Being monolithic structure it is having high seismic resistance.

Some of the Limitations of the EPS Core Panel System:

i. EPS Panel construction system may only be used in the construction of foundation walls supporting 4 storeys or less, unless designed by a professional engineer.
ii. Considerable amount of site work is involved in this type of construction which sometimes may lead to quality control issues.
vi. Improper construction schedule may lead to deterioration of EPS panels (yellowing of panels) which may lead to degradation of insulation property of EPS.
vii. There can be movement of moisture in EPS Core panel due to improper shotcreting, presence of gap in between the panels which may give rise to serious maintenance issues after the construction.
viii. The current practice of Shotcreting the EPS-LB/NLB panels do not ensure even thickness and depth of concrete in the panel.
ix. Initial cost of investment in setting up of factories for production of EPS panels is high.

11.0 Site Visited

Ongoing and completed projects constructed with 3D panels were visited along with following officers and company representatives on 27/06/2018.

Officer present

1.	Shoaib A. Shaikh	Researh Officer	MERI, Nashik
2.	N. U. Patil	Assisst, Research Officer	MERI, Nashik
3.	P. U. Sonawane	Assisst, Research Officer	MERI, Nashik
4.	Amol Desai	GM Development	Supreme Petrochem Ltd, Mumbai
5.	Rajeev Gaonkar	GM Development	Supreme Petrochem Ltd, Mumbai
6.	Sunil Panchal	Project Manager	Beardsell Ltd., Chennai

1. Bungalow at Khardi, Tal. Shahapur, Dist. Thane.-

Owner- Our Home Construction Company.

Building type- Bungalow having only ground floor of built up area about 900sqft.

Location – 3 to 4 km away from Khardi railway station (In hilly and inaccessible area).

EPS 3D work-3D wall and slab panels erection is completed including necessary doors and windows opening as per architectural drawing. Wall panels are different than slab panels. Wall panels are load bearing panels. Slab panels having grooves at specific distance for steel reinforcement as per deign.

Angular meshes - C- Mesh are specially used for doors and window openings and they are (L-Mesh)also used to connect perpendicular wall, wall to roof panels. Panel placed next to each other are joint by linear I-mesh.

Construction stage- Plinth completed with conventional open foundation and plinth beam structure, considering EPS panel loading & as per architectural drawing, dowel bars are embedded at 30cm c/c for anchorage of walls in the plinth. Shotcrete work and plumbing and electrification conduits are yet to be completed.

2. Suite in Resort at Kasara, Tal. Shahapur, Dist. Thane.

Owner- Relax Adventure Resort.

Building type- Suite in resort having only ground floor of built up area about 350 sqft.(1 room with attached toilet block with verandah)

Location – 16 to 17 km away from Jawhar phata on NH-3. Site is in hilly and inaccessible area.

Construction stage- Work was completed with concealed electrification and plumbing in 2016 using EPS 3D wall and roof panels with conventional plinth.

Present condition- Building is in good condition. Completed building can not be identified from conventional RCC or load bearing structure.

No cracks are seen at joints i.e plinth to wall, wall to slab and at corners.

No leakages are seen in toilet block area and from slab also.

3. Mango tree Marriage Hall at Deolali, Dist. Nashik.

Owner- Mango Tree Lawns.

Building type- Marriage hall having only ground floor of built up area about 6000 sqft. Composite structure with steel column and steel truss roof Having ht approx 35 ft at gable with 3D panel non load bearing walls.

Location – Deolali village, Nashik.

Construction stage- Work completed in 2017 with conventional plinth and steel column and steel truss roof. Walls are constructed with 3D panels. Height of the wall is about 30 feet and at gable end it is of 35 feet. Wall panels are nominally tied with 10-12 mm bar welded to steel column, however no horizontal and vertical bracings are provided. Walls having about 10-12 feet door opening, RCC lintels are provided for the same. There are number of opening at the gable end, no RCC lintels are provided for the same.

Present condition- Building is in good condition. No cracks are seen at joints and corners. No bulging in walls are observed.

12.0 Conclusion

- EPS core Panel system is a modern, efficient, safe and economic construction system for the construction of buildings. It has got the potential in achieving the Government of India's ambitious project "Housing for all by 2022".
- The EPS Core panel system is environment friendly and aesthetically appealing. It can be constructed quickly resulting in savings in construction time and money. also due to high level of thermal insulation there is a energy saving and also due to resistance to water seepage low maintenance cost.
- From extensive search on net,links available on website and from study of Manual For Expanded Polystyrene (EPS) Core panel system and its field Application by CSIR- Roorkee and Compendium of Prospective Emerging Technology for Mass Housing- by BMTPC and various site visits. EPS Core panel system seems to be
  i. 3 times faster than conventional RCC construction
  ii. 12 – 14 % cheaper than conventional RCC construction
  iii. Low carbon footprint, as the material used in the construction is sustainable in nature.

13.0 Recommandations

This office is of the opinion that use of EPS core panel system for (G+3 load bearing) mass housing may be used in government operated scheme/ govt.building as well as EPS core panel can also be used for non load bearing walls in combination with RCC structure.

14.0 References

i) Manual for Expanded Polystyrene (EPS) Core Panel System and its field Application sponsored by Ministry of Housing and Urban Poverty Alleviation, Government of India.

ii) Compendium of Prospective Emerging Technologies for Mass Housing issued by BMTPC – Building Materials and Technology Promotion Council Ministry of Housing and Urban Poverty Alleviation, Government of India

iii) Links - https://youtu.be/eHnKvKP8qN0
https://www.youtube.com/watch?v=bTYd5EWy9Yc
https://www.youtube.com/watch?v=LNhl1raXYeM

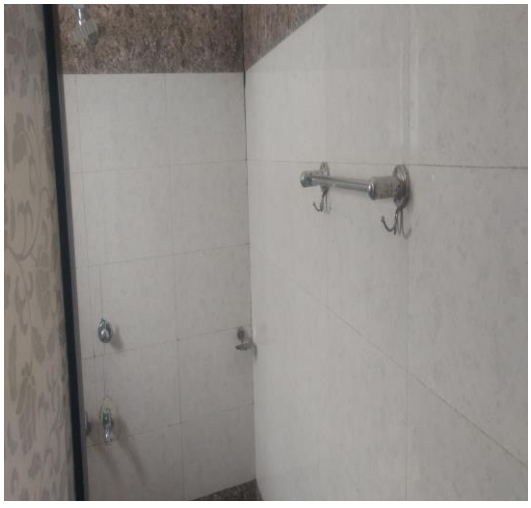
15.0 Photographs of site Visited

Photographs showing work in progress /completed with Expanded Poystyrene(EPS) Core panel system.

Bungalow at Khardi, Tal. Shahapur, Dist. Thane.- (work in progress)

Bungalow at Khardi, Tal. Shahapur, Dist. Thane.- (work in progress)

Suite in Resort at Kasara, Tal. Shahapur, Dist. Thane.(work completed in 2016)



Marriage Hall (Mango tree) at Deolali, Dist. Nashik(work completed in 2017)