प्रधान मंत्री आवास योजना-शहरी
Pradhan Mantri Awas Yojana-Urban

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

सत्यमेव जयते
Ministry of Housing & Urban Affairs
Government of India

आत्मनिर्भर भारत

स्वच्छ भारत
एक कदम स्वच्छता की ओर

LIGHT HOUSE PROJECT
AT INDORE, MADHYA PRADESH

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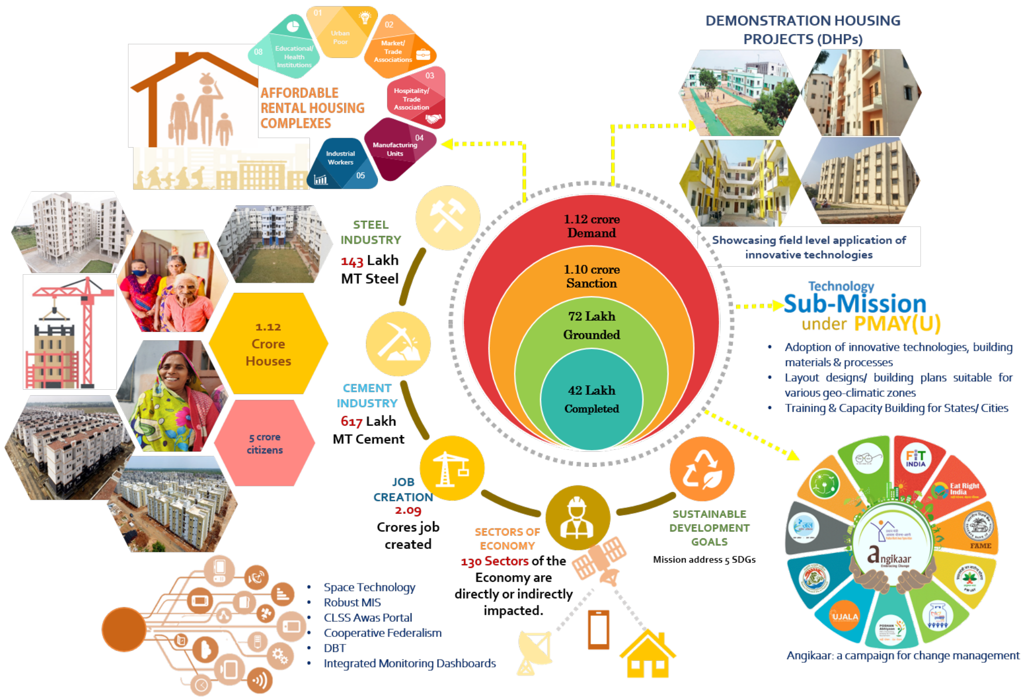
"The country is going to get a new technology to build houses for the poor and the middle class. In technical parlance, you call it the Light House Project. I believe these six projects are really like light towers. These six light house projects would give a new direction to the housing construction in the country. The coming together of states from the east-west, north-south and every region of the country is further strengthening our sense of cooperative federalism. These light house projects will be constructed through modern technology and innovative processes. This will reduce the construction time and prepare the more resilient, affordable and comfortable homes for the poor. In a way, these projects will be incubation centres and our planners, architects, engineers and students will be able to learn and experiment with new technology."

Narendra Modi
Prime Minister of India
1.1.2021

1. Background

The Ministry of Housing and Urban Affairs (MoHUA) is implementing Pradhan Mantri Awas Yojana-Urban (PMAY-U) Mission, one of the largest public housing programs in the world, with a goal of providing all weather pucca houses to all eligible urban families by 2022. Against an assessed demand of 1.12 crore houses, so far over 1.08 crore have been sanctioned; out of this over 72 lakh have been grounded for construction and nearly 42 lakh have been completed and delivered to the beneficiaries.

Under PMAY(U), a Technology Sub-Mission (TSM) has been set up with an aim to provide sustainable technological solutions for faster & cost-effective construction of houses suiting to geo-climatic and hazard conditions of the country". TSM promotes adoption of modern, innovative & green technologies and building material for faster and quality construction of houses. It also facilitates for preparation and adoption of layout designs and building plans suitable for various geo-climatic zones.



The Country being in development phase, massive construction activities are undergoing and planned in all the States/UTs for creating affordable shelters & related infrastructures. Traditionally, houses in the country are constructed using conventional technology as in-situ reinforced cement concrete (RCC) frame & burnt clay brick masonry. With the massive construction requirement & taking into consideration the important factors such as fast depleting natural resources, achieving Sustainable Development Goals (SDGs) & international commitments to reduce Carbon Dioxide emissions, there is urgent need to find alternate, sustainable and resource efficient solutions.

Globally, there has been technological advancement in the area of building materials and fast track prefabricated/pre-engineered construction practices. However, the use of alternate construction technologies in our country is in a limited extent so far. Hence, there was a need to look for new emerging, disaster-resilient, environment-friendly, cost-effective and speedy construction technologies which would form the basis of housing construction in India. Hon'ble Prime Minister envisaged a paradigm shift through technology transition using large scale construction under PMAY(U) as an opportunity to get the best available construction technologies across the globe.

In the light of above, MoHUA initiated Global Housing Technology Challenge India (GHTC-India) in January, 2019 which aimed to identify and mainstream globally best available proven construction technologies that are sustainable, green and disaster resilient through a challenge process which could bring a paradigm shift in construction practices for housing sector.

2. Construction Scenario in India

Housing for All by 2022 is the firm resolve of the Government to provide pucca shelter to each household of India and is a humble beginning towards building New India. The number of housing units that need to be constructed are huge. There is a requirement of 11.2 million dwelling units in urban areas by 2022. Also, construction sector is emerging as third largest sector globally to take India towards $5 trillion economy.

Conventionally, houses are built with traditional materials, i.e., burnt clay bricks, cement, sand, aggregates, stones, timber & steel. Sand and aggregates are already in short supply and due to irrational mining, it is banned in number of states in India. Burnt clay bricks use top fertile soil as raw material and also, its production makes use of coal, a fossil fuel. Cement and steel are also energy intensive materials and produced from natural resource, i.e., limestone rock and iron ores respectively. Further, the construction requires clean drinking water which is already in short supply even for drinking.

The way out is:

i. To make use of alternate materials which are based on renewable resources & energy

ii. Optimize the use of conventional materials by bringing mechanization in the construction

iii. Utilize agricultural & industrials waste in producing building materials.

In conventional method, the materials are gathered at the site and then construction takes place by laying bricks layer by layer to construct walls and pouring concrete over steel cages (reinforcement) to make floors, vertical members, i.e., columns and horizontal members i.e. beams through a labour intensive process with little control on quality of finished product. Also, this construction process is slow paced. Further, in being cast in situ construction, there is ample wastage of materials and precious resources and at the same time there is enormous dust generated polluting the air. Therefore, there is need to bring construction methodologies which impart speed to the construction, bring in optimum use of materials, cut down wastages and produce quality product.

In today's context, a few more terms have become significant with construction and need to be dovetailed with future construction practices. These are sustainability, climate responsiveness and disaster resilience. The construction industry poses a major challenge to the environment. As per the UN Environment Programme (UNEP), more than 30% of global greenhouse gas emissions are building related and emissions could double by 2050 on a business-as-usual scenario. As per report of the Green Rating for Integrated Habit Assessment (GRIHA), globally, buildings consume about 40% of energy, 25% of water and 40% of resources. In addition, building activities contribute an estimated 50% of the world's air pollution, 42% of its greenhouse gases, 50% of all water pollution, 48% of all solid wastes and 50% of all CFCs (chlorofluorocarbons) to the environment.

Further, disasters due to natural hazards i.e. earthquakes, cyclones, floods, tsunamis and landslides have been happening with ascending frequency and effects. Every year due to faulty construction practices and bad performance of built environment during disasters, there are not only heavy economic losses but also losses of precious lives of humans leaving irrevocable impact on human settlements and therefore, disaster-resilient construction is also paramount.

In view of the above, it is obvious that construction sector requires a paradigm shift from traditional construction systems by bringing innovative construction systems which are resource-efficient, environmentally responsible, climate responsive, sustainable, disaster-resilient, faster, structurally & functionally superior. These kinds of systems are being practiced world over successfully and have shown their versatility through the passage of time.

3. Innovative Construction Technologies: Salient Features

i. Resource Efficiency

A conventional building tends to focus on the use of basic materials namely cement, bricks, sand, aggregates, steel which are based on natural resources. Also, there is over dependence on fossil fuels for production & transportation. These natural resources are finite and cannot be replenished quickly. Also, their extraction and manufacturing have direct and indirect consequences on environment & energy requirements and pose danger to our planet in terms of greenhouse gas emissions, land & air pollution etc. Therefore, natural resources are to be used efficiently which is one of the key features of alternate construction systems as they employ industrial techniques to produces building components and use cement, steel and other aggregates optimally. The other feature of alternate construction systems is to make use of renewable resources.

ii. Structural Design Efficiency

The alternate systems follow the path of optimization. Right from the concept & design stage, the building components, including structural configuration, is designed in a manner to optimize the performance. The performance-based design instead of prescriptive design philosophy is the key for design efficiency while dealing with these alternate construction systems.

iii. Disaster Resilience

The alternate construction systems are designed to be resilient in terms of natural hazards as it entails performance-based design of buildings.

iv. Cost & Payoff

The most criticized issue about alternate construction systems is the price. The stigma is between the knowledge of up-front cost vis-à-vis life cycle cost. The cost of a building is defined as follows:

Total Cost = Initial construction cost + Running cost during life of building + disposal cost
(This is also known as life-cycle cost)

Most of the time, the criterion in selection of technology is cost per m^2, which is initial cost and can be incongruous if green aspects are to be considered. The buildings with alternate systems may cost 10-15% higher initially as of now (It can also be questioned as today these systems require initial push but once mainstreamed the initial cost will also be equivalent to cost of conventional construction) but will be less by couple of times over the entire life of the building. During the life span of a building, the financial payback will exceed the additional initial cost of using alternate systems several times. And broader benefits, such as reductions in greenhouse gases (GHGs) and other pollutants have large positive impacts on surrounding communities and on the planet.

v. Energy Efficiency

Alternate construction systems often include measures to reduce energy consumption, i.e., the embodied energy required to extract, process, transport and install building materials and the operating energy to provide services such as heating and power for equipment. The buildings with alternate systems use less operating energy, embodied energy. These buildings will have a lower embodied energy than those built primarily with brick, mortar, concrete, or steel.

vi. Water Efficiency

The conventional construction systems primarily are cast-in-situ reinforced concrete systems which require large quantity of potable water for curing and most of the time, the water of curing go waste. The new systems employ better techniques of curing such as pressurized curing, chemical curing etc. which help in conserving the water during construction.

vii. Material Efficiency

Building materials are typically considered to be sustainable if they are based on renewable/waste resources and can be reusable and recyclable. Most of the alternate construction systems either make use of industrial waste, renewable resources, energy efficient building materials or optimize the use of basic raw materials, i.e., cement, sand, aggregates, steel consumption. For example, The Glass Fiber Reinforced Gypsum (GFRG) panels make use of phospho-gypsum which is a by-product of fertilizer plant, sandwich panels make use of EPS beads which are energy efficient.

viii. Indoor Environmental Quality Enhancement

The Indoor Environmental Quality refers to providing comfort, well-being, and productivity of occupants. Indoor Air Quality seeks to reduce volatile organic compounds, or VOCs, and other air impurities such as microbial contaminants. The alternate systems employ construction materials and interior finish products with zero or low VOC emissions during the design and construction process which enhance indoor air quality. Also, well- insulated and tightly sealed envelope reduce moisture problems which often leads to dampness.

ix. Operation & Maintenance Optimization

The construction systems identified are based on factory made building components which are manufactured with high precision under strict quality control and therefore, more durable, requiring no or minimum maintenance. The alternate technologies are industrial products having SOPs for building's Operations and Maintenance (O&M).

x. Waste Reduction

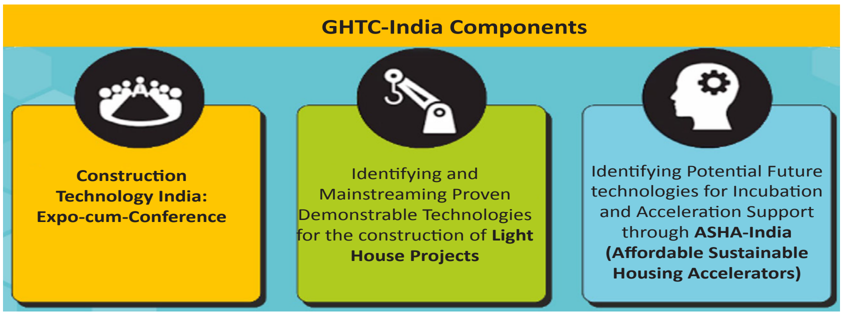
Alternate construction systems not only seek to reduce waste of energy, water and materials used during construction but also generate less construction & demolition waste after completion of the building. Well-designed buildings also help reduce the amount of waste generated by the occupants. When buildings reach the end of their useful life, they are typically demolished and disposed to landfills. In case of alternate systems, most of the deconstructed components can be reclaimed into useful building materials.

End-User Benefits
• Improved structural & functional performance
• Safer and disaster resilient house
• Better quality of construction
• Low maintenance, minimum life cycle cost
• Speedy construction resulting in early occupancy
• Cost-effective and environment-friendly
• Better fire resistance & thermal efficiency
• Less air pollution and waste generation

4. Global Housing Technology Challenge-India

MoHUA has initiated the Global Housing Technology Challenge-India (GHTC-India) which aims to identify and mainstream a basket of innovative construction technologies from across the globe for housing construction sector that are sustainable, eco-friendly and disaster-resilient. They are to be cost effective and speedier while enabling the quality construction of houses, meeting diverse geoclimatic conditions and desired functional needs. Future technologies will also be supported to foster an environment of research and development in the country. GHTC-India aspires to develop an eco-system to deliver on the technological challenges of the housing construction sector in a holistic manner.

Construction Technology India (CTI) – 2019: 1st Biennial Expo-cum-Conference was inaugurated by Hon'ble Prime Minister on 2nd March 2019. He also declared the year 2019-20 as the 'Construction Technology Year' to promote new and alternate technologies at a large scale in the country. The Expo brought together multiple stakeholders from across the world involved in innovative and alternative housing technologies for exchange of knowledge and business opportunities and master classes.



MoHUA, through a Technical Evaluation Committee (TEC), shortlisted 54 innovative proven technologies suiting different geo-climatic conditions that could be considered for demonstration through actual ground implementation of six Light House Projects (LHP) in six different States/UTs of PMAY(U) regions across the country. These 54 technologies were further categorized into following six broad categories:

1. Precast Concrete Construction System - 3D Precast volumetric

2.Precast Concrete Construction System - Precast components assembled at site

3.Light Gauge Steel Structural System & Pre-engineered Steel Structural System

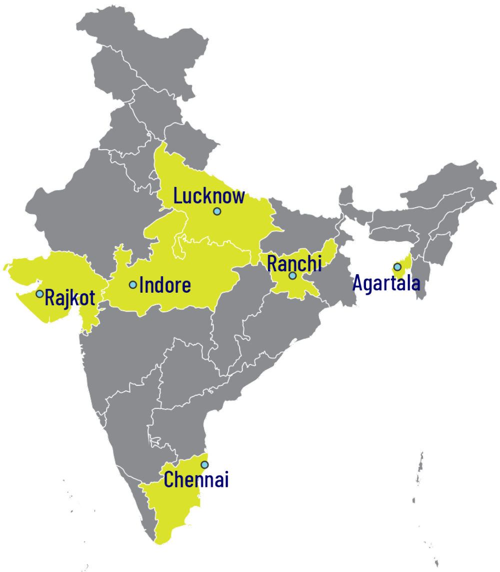
4.Prefabricated Sandwich Panel System

5.Monolithic Concrete Construction

6.Stay In Place Formwork System

The details of the shortlisted 54 technologies are available at https://ghtc-india.gov.in.

5. Light House Projects



Six distinct innovative technologies have been selected from among 54 globally best technologies that participated in GHTC-India for constructing six Light House Projects (LHPs) of about 1,000 houses each with allied infrastructure at Indore, Rajkot, Chennai, Ranchi, Agartala and Lucknow.

Hon'ble Prime Minister Shri Narendra Modi laid the foundation stone of these LHPs on January 1, 2021 and Hon'ble Governors, Hon'ble Chief Ministers of six states along with State Ministers joined the event from the LHP sites through video conference. The LHPs are model housing projects comprising of nearly 1,000 houses at each location with allied services are being constructed for showcasing use of the best of new-age technologies, materials and processes in the construction sector.

The houses are being constructed using the innovative technologies shortlisted under GHTC-India suitable to the geo-climatic and hazard conditions of the region and will be completed in challenges mode within 12 months time. LHPs will pave the way for a new eco-system where globally proven technologies will be adopted for cost effective, environment-friendly and speedier construction.

LHPs will serve as Live Laboratories for different aspects of transfer of technologies to field application, such as planning, design, production of components, construction practices, testing, etc., for both faculty and students, builders, professionals of private and public sectors and other stakeholders involved in such construction.

Details of six Light House Projects are as given below:

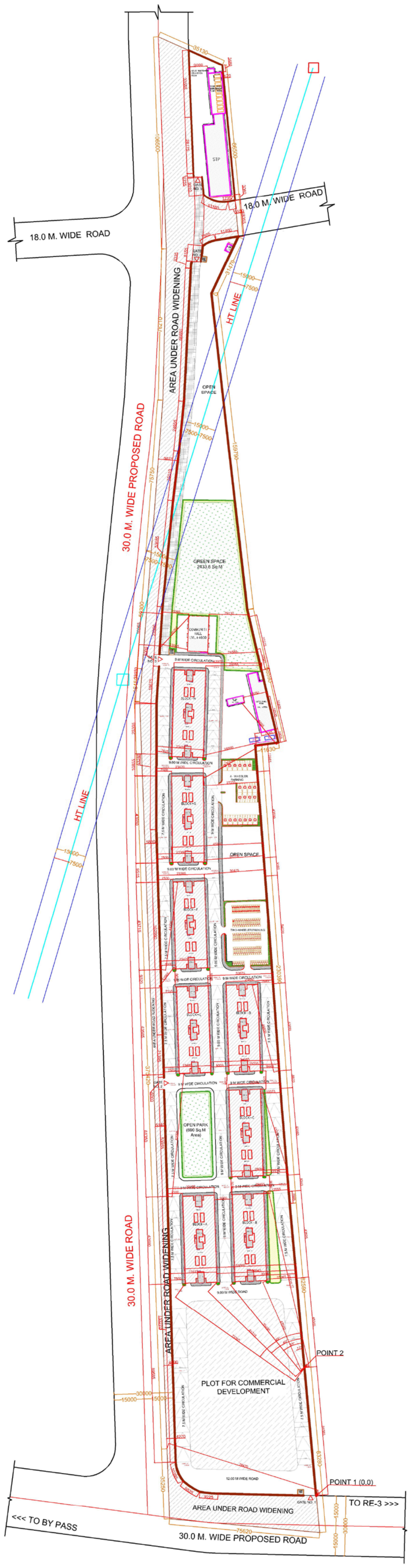
Location	DUs (Storeys)	Technology	Construction Agency
1. Indore, Madhya Pradesh	1,024 (S+8)	Prefabricated Sandwich Panel System	M/s KPR Projectcon Private Limited
2. Rajkot, Gujarat	1,144 (S+13)	Monolithic Concrete Construction using Tunnel Formwork	M/s Malani Construction Co.
3. Chennai, Tamil Nadu	1,152 (G+5)	Precast Concrete Construction System – Precast Components Assembled at Site	M/s B. G. Shirke Construction Technology Pvt. Ltd.
4. Ranchi, Jharkhand	1,008 (G+8)	Precast Concrete Construction System – 3D Volumetric	M/s SGC Magicrete LLP
5. Agartala, Tripura	1,000 (G+6)	Light Gauge Steel Structural System & Pre-engineered Steel Structural System	M/s Mitsumi Housing Pvt. Ltd.
6. Lucknow, Uttar Pradesh	1,040 (S+13)	PVC Stay In Place Formwork System	M/s JAM Sustainable Housing LLP

Light House Projects : Salient Features

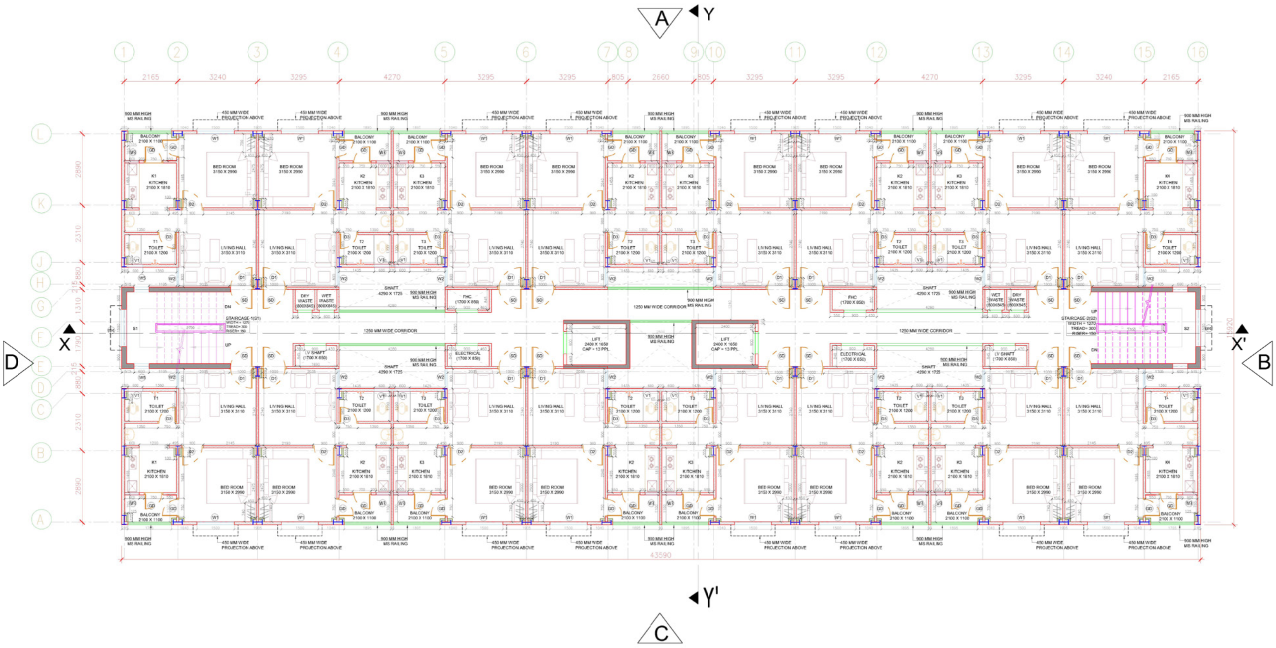
- LHPs are model housing project with approximately 1,000 houses built at each location with shortlisted alternate technology suitable to the geo-climatic and hazard conditions of the region.
- Constructed houses under LHPs will include on site infrastructure development such as internal roads, pathways, common green area, boundary wall, water supply, sewerage, drainage, rainwater harvesting, solar lighting, external electrification, etc.
- Houses under LHPs are designed keeping in view the dimensional requirements laid down in National Building Code (NBC) 2016 with good aesthetics, proper ventilation, orientation, as required to suit the climatic conditions of the location and adequate storage space, etc.
- Convergence with other existing centrally-sponsored Schemes and Missions such as Smart Cities, Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Swachh Bharat (Urban), National Urban Livelihood Mission (NULM), Ujjwala, Ujala, Make in India were ensured during the designing of LHPs at each site.
- The structural details were designed to meet the durability and safety requirements of applicable loads including earthquakes, cyclone, and flood as applicable in accordance with the applicable Indian/International standards.
- Cluster design may include innovative system of water supply, drainage and rainwater harvesting, renewable energy sources with special focus on solar energy.
- The period of construction will be maximum 12 months. Approvals were accorded through a fast track process by the concerned State/UT Government.
- For the subsequent allotment of constructed houses under LHPs to the eligible beneficiaries in States/ UTs, procedures of existing guidelines of PMAY (U) will be followed.

Light House Project at Indore, Madhya Pradesh

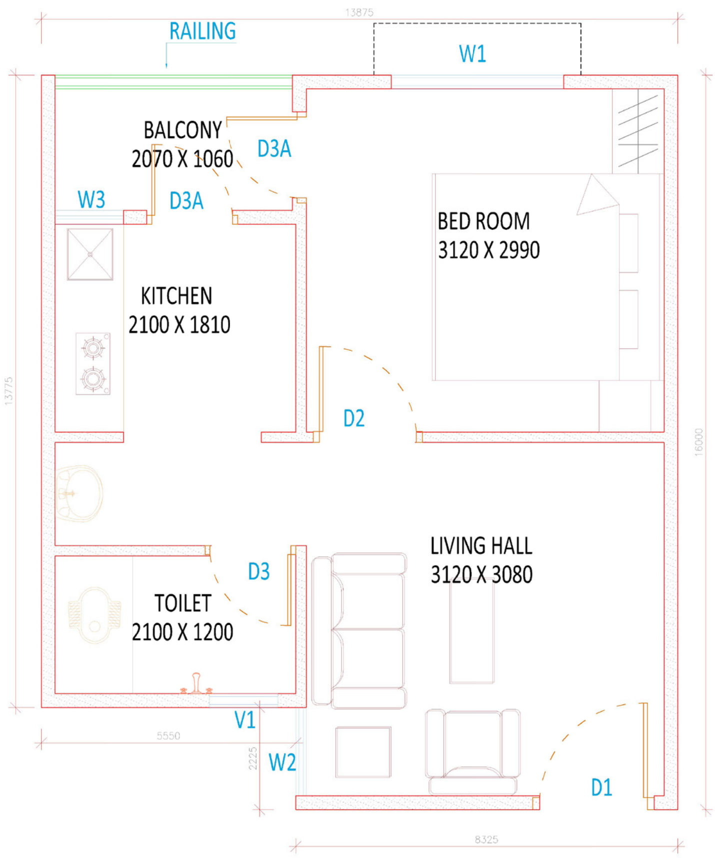
Project Brief	
Location of Project	Kanadia Ext., Sanyogitaganj Mandal, Indore, Madhya Pradesh
No. of DUs	1,024 (S+8)
Plot area	34,276 sq.mt.
Carpet area of each DU	29.92 sq.mt.
Total built up area	44,798 sq.mt.
Technology being used	Prefabricated Sandwich Panel System with pre-engineered steel structural system
Other provisions	Community Centre/Hall
Broad Specifications	
Foundation	RCC isolated column footing
Structural Frame	Pre-engineered steel structural frame
Walling	Prefabricated Sandwich Panel
Floor Slabs/Roofing	Cast in-situ deck slab with concrete screed
Joinery & Finishing	Door Frame/Shutters: • Pressed steel door frame with flush shutters • PVC door frame with PVC Shutters in toilets. Window Frame/ Shutter: • uPVC frame with glazed panel and wire mesh shutters. Flooring: • Vitrified tile flooring in Rooms & Kitchen • Anti-skid ceramic tiles in bath & WC • Kota stone Flooring in Common area. • Kota stone on Staircase steps. Wall Finishes: • Weather Proof Acrylic Emulsion paint on external walls • Oil Bound distemper over POP on internal walls
Infrastructure	Internal Water Supply, Laying of Sewerage Pipe Line, RCC storm water drain, Provisions for Fire Fighting, Internal Electrification, Internal Road & Pathway (CC Road and Bituminous Road), Providing Lifts in building blocks, Landscaping of site, Street light with LED lights, Solar Street Light System, Sewerage Treatment Plant, External Electrification, Water Supply System including underground water reservoir, Compound wall with Boundary Gates, Horticulture facilities, Rain Water Harvesting, Solid Waste Management.


18.0 M. WIDE ROAD
18.0 M. WIDE ROAD
AREA UNDER ROAD WIDENING
HT LINE
30.0 M. WIDE PROPOSED ROAD
HT LINE
30.0 M. WIDE ROAD
AREA UNDER ROAD WIDENING
POINT 2
PLOT FOR COMMERCIAL DEVELOPMENT
POINT 1 (0,0)
TO RE-3 >>>
AREA UNDER ROAD WIDENING
<<< TO BY PASS
30.0 M. WIDE PROPOSED ROAD

Layout Plan



Block Plan



Unit Plan

Technology Details

A. ABOUT THE TECHNOLOGY

These are lightweight composite wall, floor and roof sandwich panels made of thin fiber cement/calcium silicate board as face covered boards and the core material is EPS granule balls, adhesive, cement, sand, flyash and other bonding materials in mortar form.

The core material in slurry state is pushed under pressure into preset molds. Once set, it shall be moved for curing and ready for use with RCC or steel support structure beams and columns. These panels are primarily used as walling material but can also be used as floor and roof panels. These are non-load bearing panels to be used with structural support frame only. However, if used in G+1 structure, these can be used as load bearing panels.

B. SIZE AND TYPE OF PANELS

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

Length : 2440 mm (may be increased up to 3000 mm)

Width : 610 mm (may be altered as per requirement but should not be too wide since handling of the panels become difficult)

Thickness : 50-250 mm. Dimensions are shown in Fig. 1.

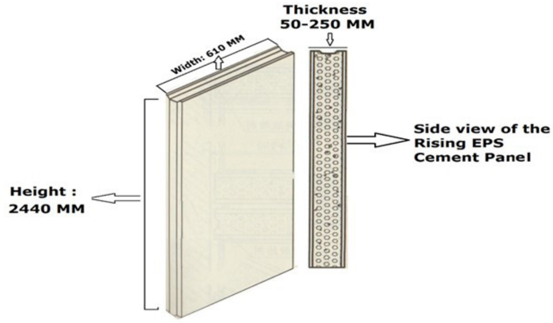
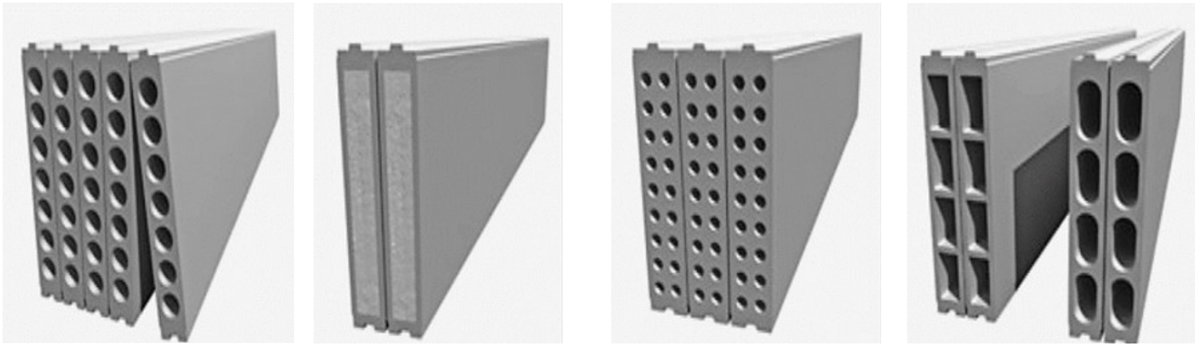


Fig.1

Type: Panels are produced in 4 types as shown in Fig. 2 below:



Pole holes *Solid heart* *Rod holes* *Block hole*

Fig.2

The above four types of panels have different applications depending on the requirements e.g. Solid heart should be used as walling material in any type of construction and pole, rod and block hole may be used where different types of inserts are used like iron rods or wires for security etc.

C. RAW MATERIALS

(i) OPC 43/53 grade cement shall conform to IS 8112:2013/12269:2013.

(ii) Fly ash shall conform to IS 3812 (Part 2):2003.

(iii) EPS beads shall conform to IS 4671:1984 and shall have density not less than 15 kg/m^3.

(iv) Fibre cement board shall conform to IS 14862:2000.

(v) Calcium silicate board shall conform to EN 14306:2009
(v) Fine (sand) & coarse aggregate shall conform to IS 383:2016.
(vi) Water shall conform to IS 456:2000.
(vii) Adhesive like HPMC and RD Powder shall be used for core and sheet bonding.

D. PERFORMANCE CRITERIA

Rising EPS panels shall meet the following performance criteria when tested in accordance with the relevant Standards:

Sl.No.	Performance Characteristics	Criteria	Test Method
1.	Flammability of EPS	≥ 600kgs/M³	IS ASTM D 7309:2013
2.	Axial compression	≥ 3.5MPa	IS 2095 (Part1):2011
3.	Resistance to continuous heating	≥ 70ºC	ASTM F 1939:2015
4.	Flexural Strength	≥ 1N/mm²	IS 516:1959
5.	Acoustic Performance	≥ 35dB	IS 9901:1981
6.	Thermal conductivity	≥ 0.1W/M² k	IS 3346:1980
7.	Thermal Resistance	≥ 0.40M² k/W	IS 3346:1980
8.	Water penetration	There should be no damage or leakage	EN1609:2013
9.	Fire rating of the panels	Should be Grade 1/3 Hrs	BS 476 (Part 20 & 22)
10.	Resistance to structural damage from a large light body	There should be no collapse or dislocation	BS 5234 (Part 2):1992, Annex E
11.	Anti-bending damage load	≥ 1.5 times of its weight	BS 5234(Part 2):1992
12.	Non-combustibility	Should be 'A' level	GB 8624:2012
13.	Water tightness behind panels after 24 Hrs at 250mm water head	No droplets should be observed	ASTM C1185:2016
14.	Drying Shrinkage value	≤ 0.1%	IS 2185 (Part 1):2005
15.	Single point hanging strength	≥ 1000N	BS 5234 (Part 2):1992

E. INSTALLATION OF EPS CEMENT PANEL, APPLICATIONS & JOINTING PROCEDURE

1. Procedure

• ***With RCC frame structure:*** If RCC frame structure is used in the construction, then the panels should be directly fixed on the walls, pillars, beams and floor with the help of cement glue and later iron locking rods should be inserted into the panels and the pillars, beams and floors at 45° so that they are firmly locked with each other and become one single unit.

The manufacturer shall inform the specialized chemical "cement glue", if available in India/manufactured by reputed chemical/ water proofing companies to the customers.

• ***With Steel frame structure:*** If steel structure frame is used in the construction, then the panels can be fixed with either with steel clips or U type channels to hold the panels with the structure. In this case additional clips should be welded with the frame pillars or beams to hold the clips / U cannel firmly with the pillars / beans and floor. Then only the panels should be inserted into the U channels. There after PU glue should be applied to hold the panels firmly. The thickness of the panels shall determine the size of U channel.

After installation of the panels in both the above systems, all gaps should be checked and filled with additives, PU and cement mixers and later thin putty should be applied to give uniform smooth surface ready for paint.


View of the Panel Production Factory


Rising EPS wall Panels with Steel frame

2. Installation of Panels

• *Receipt and inspection of Panels*

Once the panels are received, it should be checked if the edges are safe and also there are no cracks or damages on the surface of the panels which can happen during transportation and handing.

• *Laying of panels as per drawings*

Once panels received are as per the drawings, then it should be separated and laid down as per the drawings for easy installation and to avoid extra handling.

• *Marking and sizing the panels*

Once panels are placed at the proper place, marking should be down as per drawing and proper sizing should be cut of the required panels as per the drawings.

• Actual installation as wall

The panels are lifted and placed as per the drawings. For installation of the panels, following points should be considered:

2.1 Joining of panels with each other

- The panels shall be placed at the marked space and adjusted together. Dust should be cleaned on the tongue and groove of the panel to be installed. Cement mortar shall be applied and glue filled in the gaps on the panel joining parts and force them together to form one panel. Levels of both panels shall be checked.
- The panels shall be fixed with steel bar between each other or between the panels and the floor to lock them together.

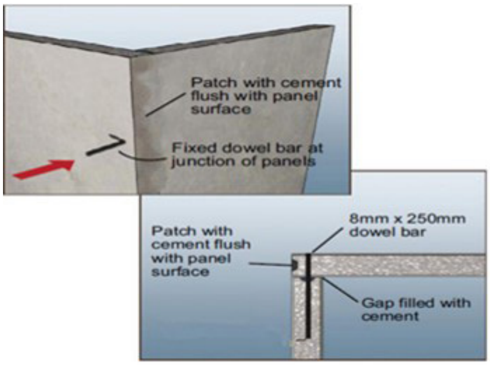
2.2 Typical Joint between two panels side by side:

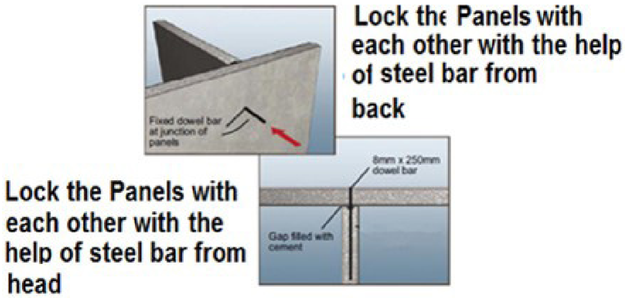
- The panels shall be fixed with dowel bars and the bars inserted in one panel at 45° and hammer it down to lock both the panels.

2.3 Typical joint with floor:

- The panels shall be placed on floor, cement and glue applied between panels and floor and L type steel bars inserted through the panels edge at 45° in the floor. The panel will then be locked to the floor.

2.4 Typical L and T joint with panels:





2.5 Joining of upper and lower panels together:

- The panels shall be placed one over the other vertical/ horizontal after applying cement and glue. The steel rod shall be inserted from the sides of the panels into each other to join them together and locked.
- A wall of these panels shall be inter-connected with steel bars inserted at 45° and fixed with cement and glue in between panels.

2.6 Connecting panels with RCC pillar/RCC Walls/RCC beams:

- For connecting these panels with RCC pillars, the panels shall be placed with the pillar after applying cement and glue on the side of the panels and pushed to make the perfect position.
  Following are three types of connections depending on the situation:
  Steel rods/screw or bolt shall be inserted in the pillar and the panels locked with the help of the above. Thus the panel will be fixed and becomes part of wall connected with pillars.

2.7 Wall head fixing:

- Dowel bar of 250mm length and 8mm dia shall be fixed into pre-drilled hole of the panels and lock the panel to the overhead beams or RCC roof slab.

2.8 Fixing panels to the Steel frame (Pillars & Beams)

- *Connection of wall panel to RHS column*
  Steel L-angle/C Channel/Z channel shall be welded to the side of RHS column and the panel inserted inside the angle/channel and locked. The thickness of the panels shall determine the size of angle/ channel.

2.9 Cutting of space for doors and windows

- The space on the drawing where doors and windows are required to be placed shall be marked and then while making walls keep that space. There is another way also where the space is cut later on once the walls are set fully.

2.10 Door Opening

- The panels shall be placed horizontally to keep space for doors.

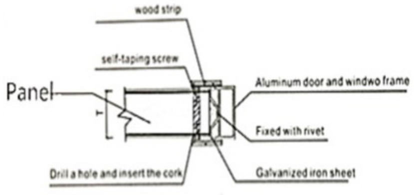
2.11 Window Opening

- The panels shall be placed horizontally to keep space for windows.

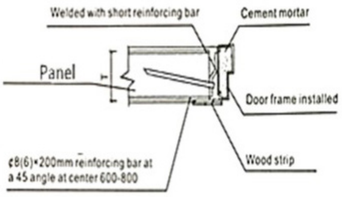
2.12 Cutting space for doors and windows after the panels are fixed.

- The position of steel inserts shall be marked to protect the wall from any movement while cutting of panels. All the steel bars shall be inserted at 45° angle to lock the panels with each other to stop further movement.

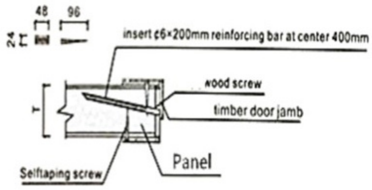
2.13 Frame Fixing



Door and window frames fixed on the panel



Door frame fixed on the panel



Door jamb fixed on the panel

3. Laying of electrical conduits

- The wire shall be embedded from the ceiling into the trench.

4. Hanging Force

- Expandable metal bolt shall be used and hooked on the wall panel.
- Tile adhesive shall be used for fixing heavy granite tiles.

5. Fixing the Panels as floor

- Steel frame shall be fixed if this is to be a raised platform otherwise the panels can be used directly as floor after making the ground level properly.
- Floor tiles can be fixed on these panel, if required.

6. Fixing the Panels as roof

- These panels can be used in the roofing as long as it is non-load bearing application.
- Steel frame shall be fixed as base for fixing the panels as roof.

F. CERTIFICATION

Under Performance Appraisal Certification Scheme, the present formwork system has been evaluated and certified by BMTPC PAC No. 1032-S/2017 has been issued to M/s Rising Japan Infra Pvt. Ltd., New Delhi.

G. MANUFACTURING IN INDIA

RISING EPS CEMENT PANELS ARE NOW MANUFACTURED IN INDIA IN NAGPUR AND PUNE

H. USES

Rising EPS Cement panels may be used for the applications in Housing, offices, Commercial complexes, Schools, offices, Electric sub- stations, Hotels and resorts, High rise buildings, Boundary walls, Highway railings, Bridges side support, river lining etc.

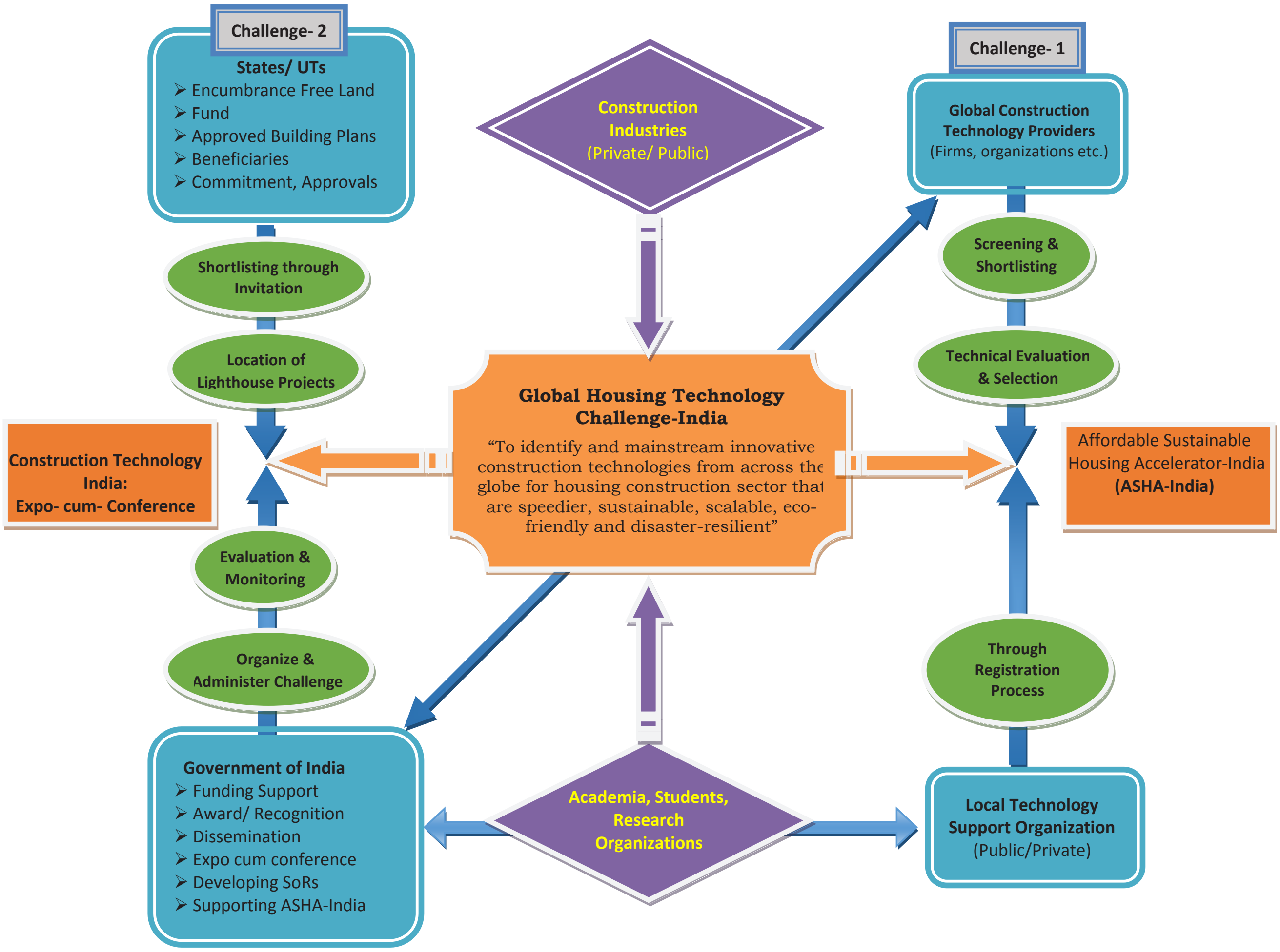
I. LIMITATIONS ON THE BASIS OF PERFORMANCE, SAFETY, GEO-CLIMATIC CONDITIONS

These are non–load bearing panels and should be used as walling, floor and roofing with additional structural support, steel or RCC depending on the design. However, these may be used as single floor construction or stairs case slabs, kitchen/bathroom slabs etc. without support structure.

These panels are non-load bearing only if they are used without any pillar and beam support. However, they may be used as walling material with RCC or steel frame structure.

The panels, if used for floors/roofs, shall require screeding concrete of 35mm thick with nominal reinforcement/ GI wire mesh for shrinkage monolithic action to avoid leakage through the panel joints.

Process Flow of GHTC-India



Notes:

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सत्यमेव जयते

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Ministry of Housing and Urban Affairs
Government of India
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