

Emerging Construction Systems for Mass Housing

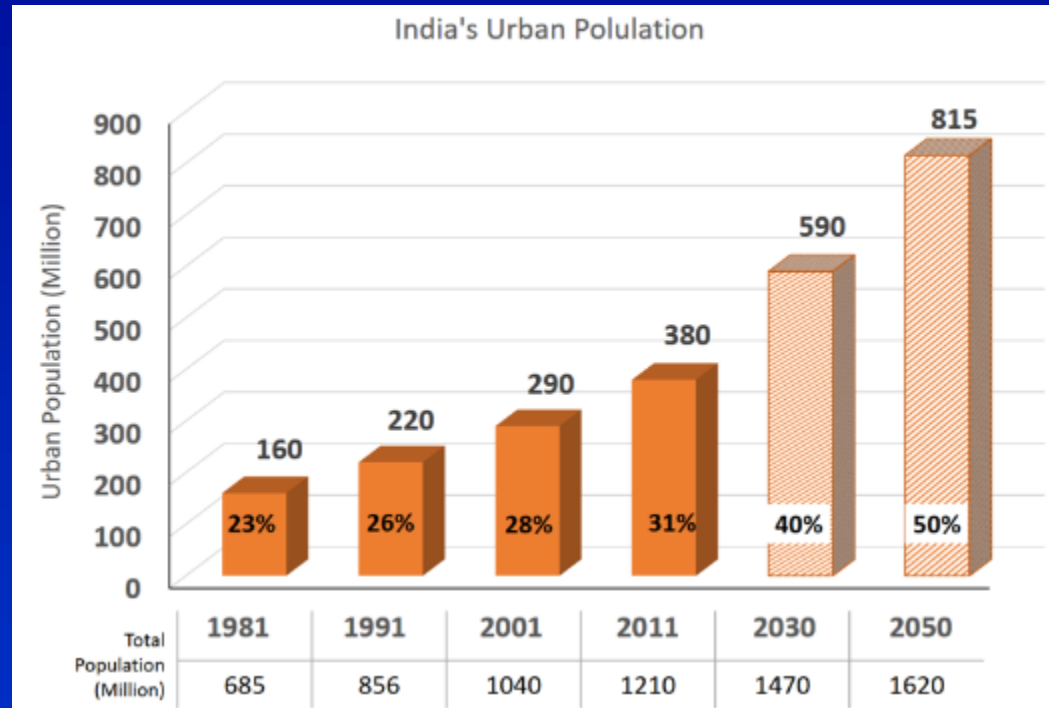
by

Dr. Shailesh Kr. Agrawal
Executive Director

bmtpc

Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Government of India

Growing Opportunities with Rapid Urbanization

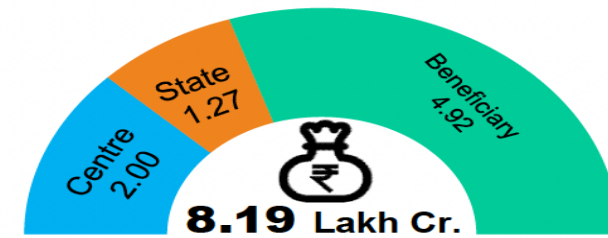
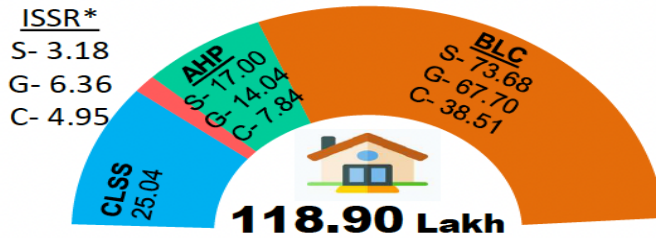
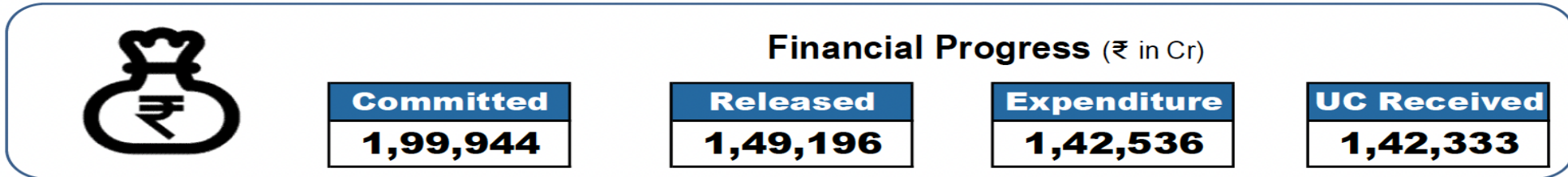


Source: UN report on World Urbanisation Prospects (2014 revision)

To cater to this growing population, India has to build 600-800 million m² urban space every year till 2030 i.e. a new Chicago every year.

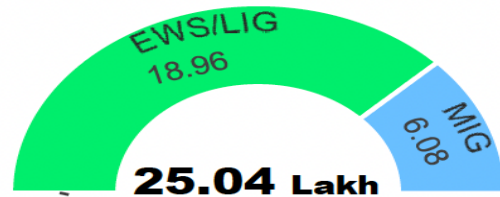
- With US \$3 trillion GDP, India is one of the largest and fastest growing economies in the world. It is witnessing massive public investment, robust private consumption, and structural reforms leading to rapid growth (> 7%).
- India is poised to become \$5 trillion economy by 2025-26 & aspiring to become a \$26 trillion economy by 2047.
- Construction in India is emerging as the third largest sector globally; it may reach US \$750 billion in value by 2022.
- Cities, which will contribute over 80% to GDP by 2050, need to be Receptive, Innovative and Productive to foster sustainable growth and ensure better quality of living.
- Hence, a comprehensive strategy of **3-S Mantra** has been adopted: **Skill, Scale and Speed**.

Overall Sanctions for 1.19 crore Houses



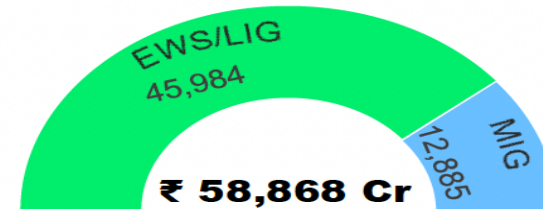
Houses in verticals (Nos in Lakh)

S- Sanctioned G- Grounded C- Completed



Beneficiaries under CLSS (in lakh)

Investment Approved (Rs in Lakh Cr.)



Interest Subsidy under CLSS (Rs in Cr.)

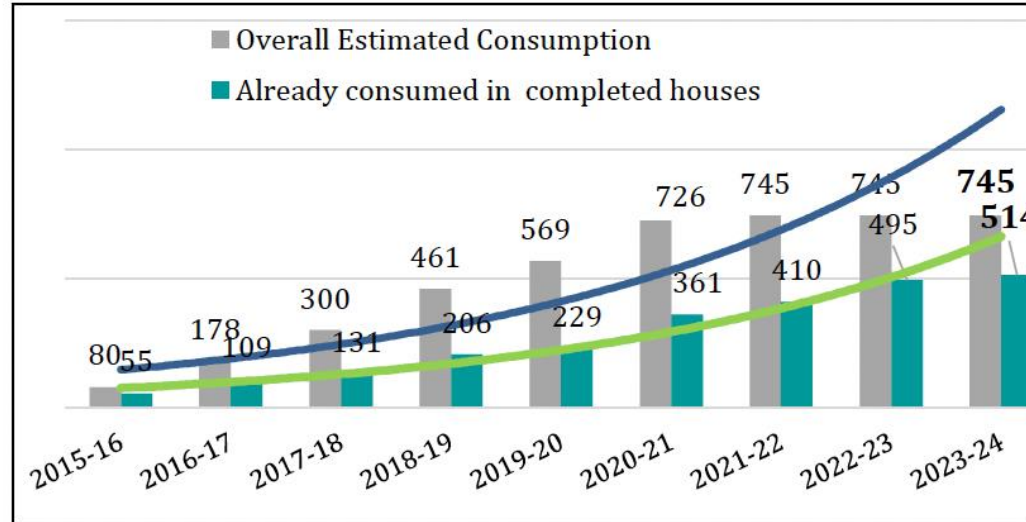
16 lakh houses are being constructed using New Technologies



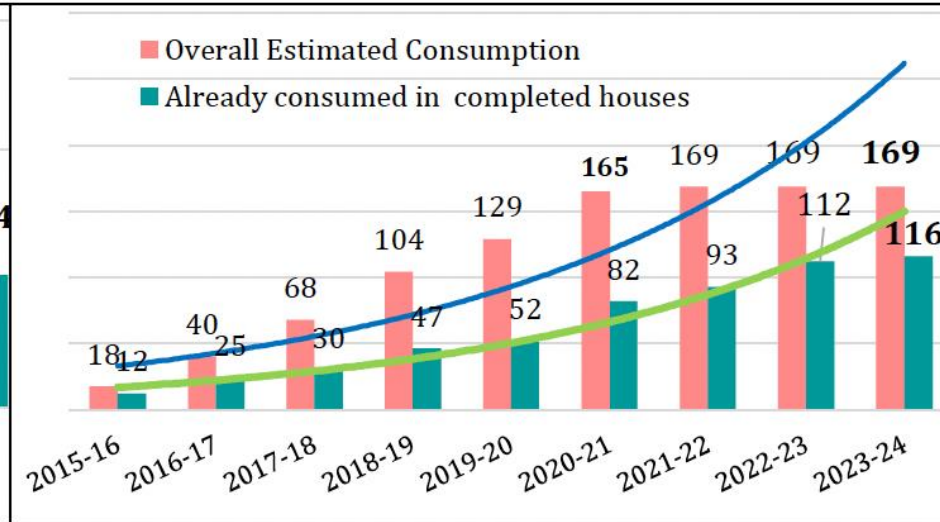
Generation of Employment

Details	Direct	Indirect	Total
Person days (Nos in Cr.)	260	588	848
Jobs (in lakh)	93	210	303

Cement Consumption (Lakh MT)



Steel Consumption (Lakh MT)



* includes incomplete works of earlier NURM.

सबका सपना, घर हो अपना



Conventional Construction Systems

business as usual approach

The prevalent construction systems in India are:

Load bearing Structure

In this system, walls are constructed using bricks/stone/block masonry and floor/roof slabs are of RCC/stone/composite or truss. It is cast in-situ system and called load bearing system as load of structure is transferred to foundation and then to ground through walls.

RCC Framed Structure

In this cast in-situ system, the skeleton of a structure is of RCC column and beam with RCC slab. The infill walls can be of bricks/blocks/stone/panels. The load of the structure is transferred through beam and column to the foundation.

Steel framed Structure

Here RCC beam and columns are replaced by hot rolled steel sections.



CONVENTIONAL CONSTRUCTION SYSTEMS

business as usual approach

- There is too much of dependency on **cement**, **aggregates** and **water** in these traditional constructions. In particular, the **fine aggregate** (sand) and water to-day are quite scarce.
- It is also seen that, on account of shortage of **skilled labour**, these constructions today, in general, are not upto the mark in terms of quality.
- In addition, traditional construction cannot be **green buildings** normally. But green buildings are the order of the day, in view of energy scarcity and, fast depletion of precious natural materials.

SLOW TRACK CONSTRUCTION

Green Aspects Ignored?

- Resource Efficiency
- Energy Efficiency

FEATURES OF GREEN BUILDING MATERIALS



SOURCE : INTERNET



SOURCE : INTERNET

- Eco-friendliness
- Health

- ❖ **Buildings consume**
 - 40% of energy
 - 25% of water
 - 40% of resource

As per UNEP, GHG emissions will double by 2050 as compared to 30% as of today on a business as usual scenario

- ❖ **Buildings activities contribute**
 - 50% of air pollution
 - 42% of GHG emission
 - 50% of water pollution
 - 48% of solid wastes

Why New Technologies for Mass Housing?

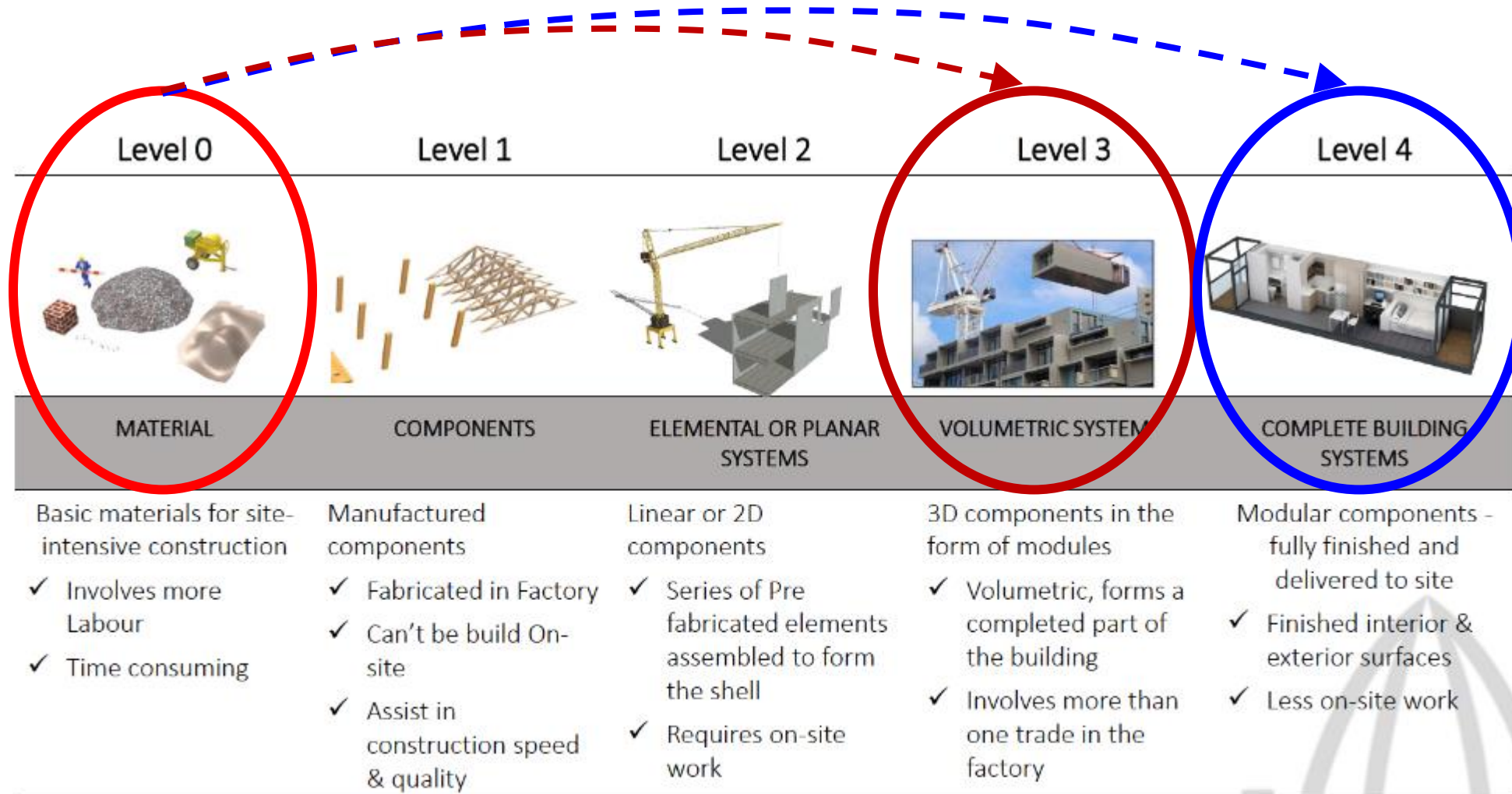
Speed ?
Quality ?
Safety ?
Sustainability ?
Life Cycle Cost ?
Thermal, Acoustics, Fire?

Sustainable Buildings

- ❖ 30%-50% reduction in energy use
- ❖ 40% reduction in water use
- ❖ 35% reduction in GHG emission
- ❖ 75% reduction in waste

Looking Back / Rear view

Levels of Construction Technology



Source: Gibb., A.G.F., *Off-site Fabrication—Pre-Assembly, Pre-Fabrication, and Modularization*

DfMA

Design for Manufacture & Assembly

Design for Manufacture
Design for Assembly

Manufacturing of Buildings

Prefabricated Prefinished Volumetric Construction

BUILDING INFORMATION MODELLING



*3D Printed
House at
Kanchipuram
by L & T*





Emerging Trends in Housing construction

- **Engineered Formwork Systems**
- **Stay-in-Place Formwork Systems**
 - ✓ *Insulating Concrete Formwork Systems*
 - ✓ *Structural stay-in-place Formwork Systems*
- **Precast Sandwich Panel Systems**
 - ✓ *EPS Panel Systems*
 - ✓ *GFRG panel Systems, Cement Panel Systems*
- **Light Gauge Steel Structural Systems**
- **Steel Structural Systems**
- **Precast Concrete Construction Systems**
 - ✓ *3D volumetric construction*
 - ✓ *2D large panel systems*
 - ✓ *Beam, column, components based systems*

Requirements for mass housing

- **Quality of construction**
(Safety, Performance, Durability)
- **Time required for construction,**
(Fast Track Construction)
- **Cost of construction**
(Economy of Scale)

Quality in any construction

•Safety of the structure

- against anticipated live loads.
- safety and stability with respect to the prevailing wind loads and with respect to the possible earthquake loads and other loads such as snow, cyclone etc.

•Performance of the structure during its life span

- Thermal efficiency of the construction during summer and winter
- Acoustics efficiency, Damp proof-ness/water tightness of the construction during rains
- Efficiency of the joinery systems, Fire resistance characteristics of the structure

•Durability of the structure

- Deterioration of components with age
- Deterioration of components due to atmospheric pollutions
- Deterioration of foundation system due to polluted/chemically adverse soil media
- Life expectancy (*Our normal housing constructions are designed for a life of 60 years and above*)

Speed of Construction

- In the present day context, it has become essential to go in for faster constructions in order to meet the heavy demand and in order to cut down wastage and overhead charges.
- The traditional constructions being adopted around us is basically 'slow track construction' and not amenable for mass housing projects.
- On account of the undue time taken, the overheads and wastages are quite high leading to time & cost overruns.

Cost of Construction



Economies of scale also plays an important role while deciding the cost/m²

End User Benefits through Technology Intervention

- *Safer and disaster resilient house*
- *Better quality of construction*
- *Low maintenance*
- *Speedy construction resulting in early occupancy*
- *Cost effective and environment friendly*
- *Better fire resistance & thermal efficiency*

ENGINEERED FORMWORK SYSTEM

Formwork Systems

Formwork is temporary or permanent moulds into which concrete is poured.

- ✓ **Traditional timber Formwork**
- ✓ **Steel Formwork**
- ✓ **Engineered formwork systems**
- ✓ **Insulated formwork systems**
- ✓ **Stay-in-place structural formwork systems**

- Replacing cast-in-situ Formwork with factory made customized formwork systems
- Formwork material is Aluminium / composites / steel having 100 to 500 repetitions
- Assembly line construction i.e. placing the formwork, pouring the concrete, moving the formwork to upper level



Monolithic Concrete Construction Technology



- The conventional mode of construction is RCC framed structure with infill masonry walls whereas in this system, all walls, floors/slabs, stairs together with door & window openings are cast in-situ monolithically using specifically custom designed modular formwork made up of aluminium/plastics/steel/ composite.
- The appropriate grade of concrete and reinforcement is used as per design and the entire casting of a modular unit is done in a single pour.
- Being modular predesigned formwork system, it acts as a assembly line production and enables rapid construction of multiple/mass scale of units of repetitive type.



A typical plan of one of the mass housing projects

Monolithic Concrete Construction





Finished 'mass houses' – integral type

Modular Tunnel form



- Tunnel formwork is a mechanized system for cellular structures. It is based on two half shells which are placed together to form a room or cell. Several cells make an apartment. With tunnel forms, walls and slab are cast in a single day.
- The formwork is set up for the day's pour in the morning. The reinforcement and services are positioned and concrete is poured in the afternoon. Once reinforcement is placed, concrete for walls and Slabs shall be poured in one single operation. The formwork is stripped the early morning and positioned for the subsequent phase.
- Here the walls and slabs are cast in a form of a tunnel leaving two sides open whereas in monolithic concrete construction the entire room is cast in a single pour..

STAY-IN-PLACE FORMWORK SYSTEM



**Insulated Concrete
Formwork System**

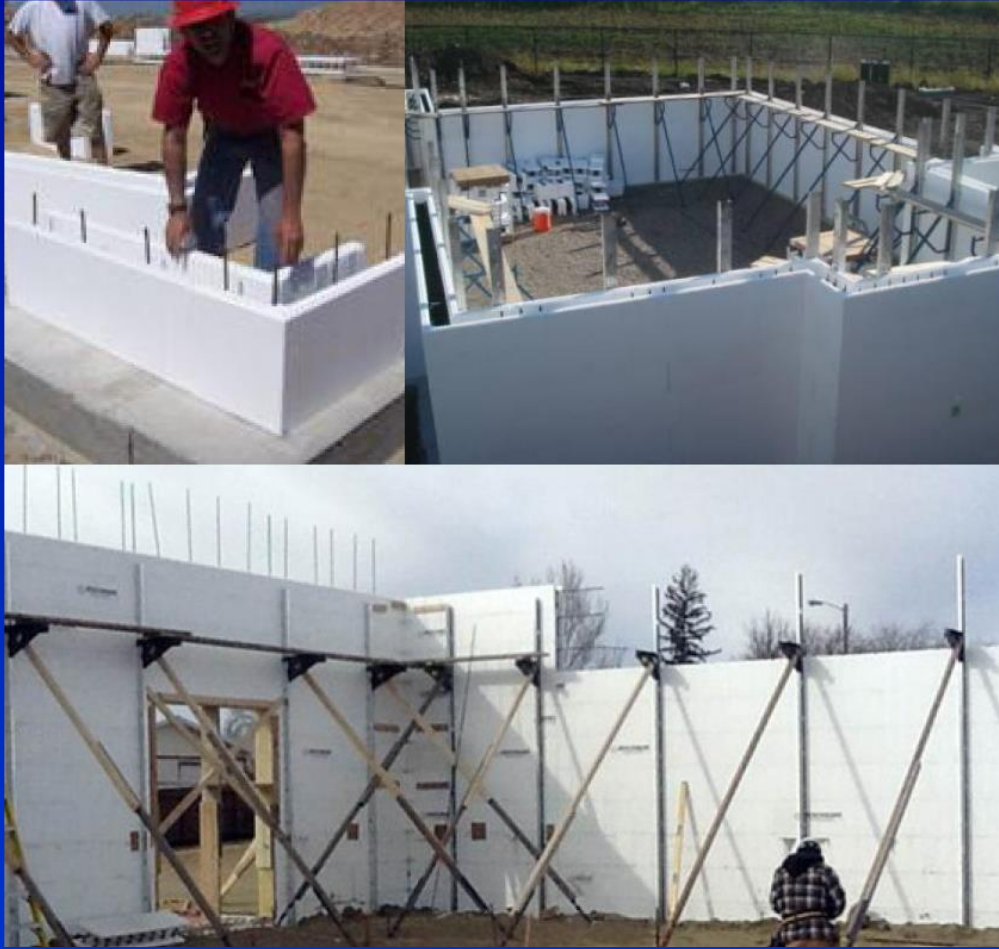


**Structural Stay-in-
Place Formwork
System**

- Replacing cast-in-situ Formwork with factory made formwork systems
- It is sacrificial formwork or lost formwork means formwork is left in the structural system to later act as insulation layer



Insulating Concrete Forms (ICF)



- These are formwork systems which are left in the structure after concreting and act as insulation.
- Insulating concrete Forms (ICF) System is a patented system of M/S Reliable Insupacks (P) Ltd and comprises of a panel of two walls of Expandable Polystyrene (EPS) separated by a nominal distance of 150mm by hard plastic ties. These are assembled on site to hold reinforced concrete.



Monolithic Insulated Concrete System (MICS)



Monolithic Insulated Concrete System (MICS) is a patented system of M/s Maiwir Ecotech Pvt. Ltd.. It is a formwork system 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.

This system consists of 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 cast-in-place concrete. 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.

Structural Stay-in-Place Formwork System (Coffor)

- Replacing cast-in-situ Formwork with factory made formwork systems
- It is sacrificial formwork or lost formwork means formwork is left in the structural system to later act as reinforcement (shear/flexure)



Structural Stay-in-Place Formwork System (Coffor)



- It is a patented structural stay in place formwork system to build load bearing monolithic concrete wall structures based on shear wall concept.
- The formwork is composed of two filtering grids comprising of rib meshes which are made up of galvanized plain steel (GP) sheets with a herringbone mesh pattern (rib lath) reinforced by C profile GP sheet vertical stiffeners. These grids are further connected by articulated horizontal MS rebar loops in one direction and Cold Rolled Close Annealed (CRCA) plate/GP horizontal connectors in other direction.
- After the erection of formwork panels in alignment, corners, edges of door and window frames are closed with rebar positioning & concrete of required Grade is poured in the panels. The concreting may be done with a pump, bucket or with a shovel loader. The inside and outside walls are finished with cement plaster of suitable grade.



Stay-In-Place PVC Wall Forms



- This is a prefabricated wall formwork from M/s Novel Assembler Pvt. Ltd. comprising of rigid Poly-Vinyl Chloride (PVC) based polymer components that serve as a permanent stay-in-place durable finished form-work for concrete walls.
- The extruded components slide and interlock together to create continuous formwork with the two faces of the wall connected together by continuous web members forming hollow rectangular components. The web members are punched with oval-shaped cores to allow easy flow of the poured concrete between the components.
- The hollow Novel Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall.

Permanent Wall Form (PVC)



- “Permanent Wall form” of M/s Kalzen Realty Pvt. Ltd. is an innovative permanent structural walling system consisting of rigid Poly-Vinyl Chloride (PVC) formwork that serve as a stay in place finished form-work for concrete walls.
- The extruded components slide and interlock together to create continuous formwork with the two faces of the wall connected together by continuous web members forming hollow rectangular components. The web members are punched with holes to allow easy flow of the poured concrete between the components.
- Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall with enhanced curing capacity due to water entrapment.

Glass Fibre Reinforced Gypsum (GFRG)/ Rapidwall Building System Technology (evaluated through PACS)

- Glass Fibre Reinforced Gypsum (GFRG)/ Rapidwall is a building panel product, made essentially of gypsum plaster, reinforced with glass fibres.
- Used since 1990 in Australia. Although its main application is in the construction of walls, it can also be used in floor and roof slabs in combination with reinforced concrete.
- The panels may be unfilled, partially filled or fully filled with reinforced concrete as per the structural requirement.



Glass Fibre Reinforced Gypsum (GFRG)/ Rapidwall Building System Technology (evaluated through PACS)..contd.







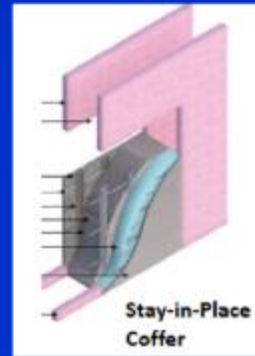
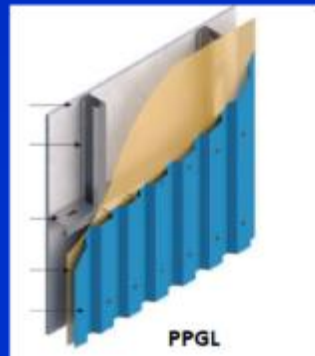
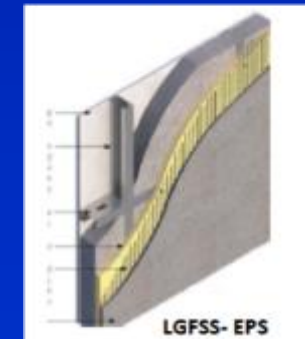




PREFABRICATED SANDWICH PANEL SYSTEMS



- EPS Core Panel Systems
- Other Sandwich Panel Systems
 - Fibre cement board
 - MgO Board
 - AAC panels



- **Replacing brick and mortar walls with dry customized walls made in factory**



Advanced Building System – Emmedue



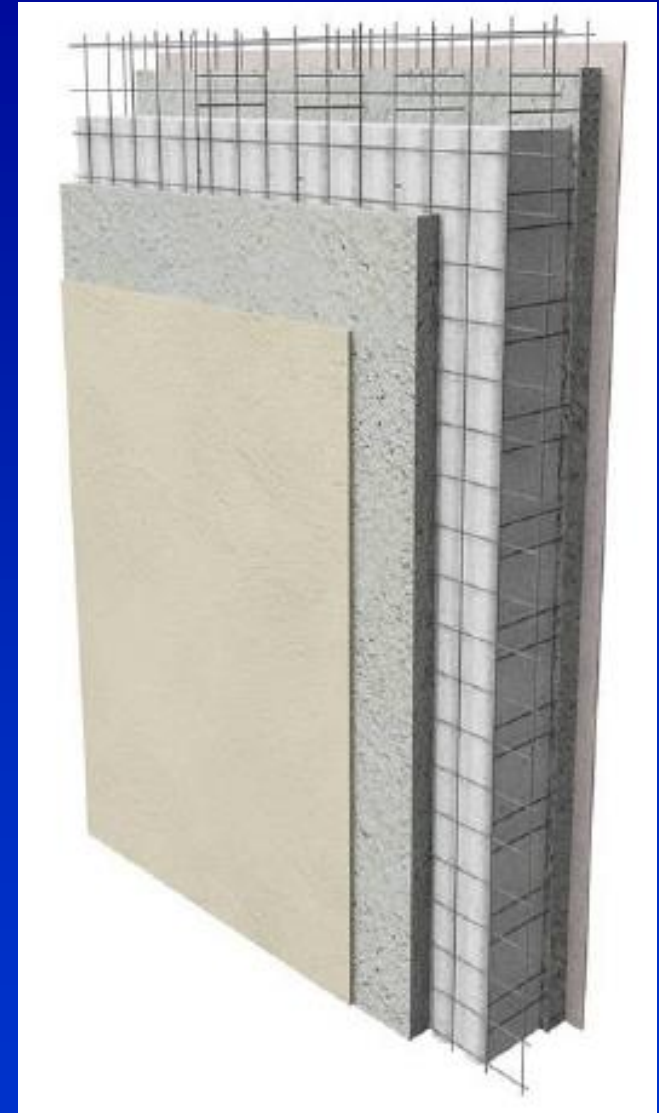
- This system is based on factory made panels consisting of self-extinguishing expanded polystyrene core (generally corrugated) sandwiched between two welded wire fabric mesh made of high strength galvanized wire. A galvanized steel truss wire is pierced completely through the core at an offset angle for superior strength and welded to each of outer layer welded wire fabric mesh.
- The panels are finished at site using shotcrete of mix of cement and coarse aggregate of required thickness on both sides.
- The panels are used for load bearing walls and floors and suitable upto 3 to 4 storey buildings.



SINGLE



DOUBLE











Concreting of floor



Finished construction

Rapid Panels



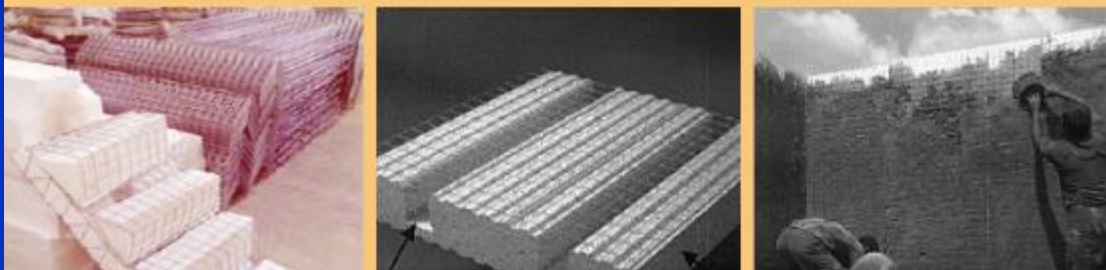
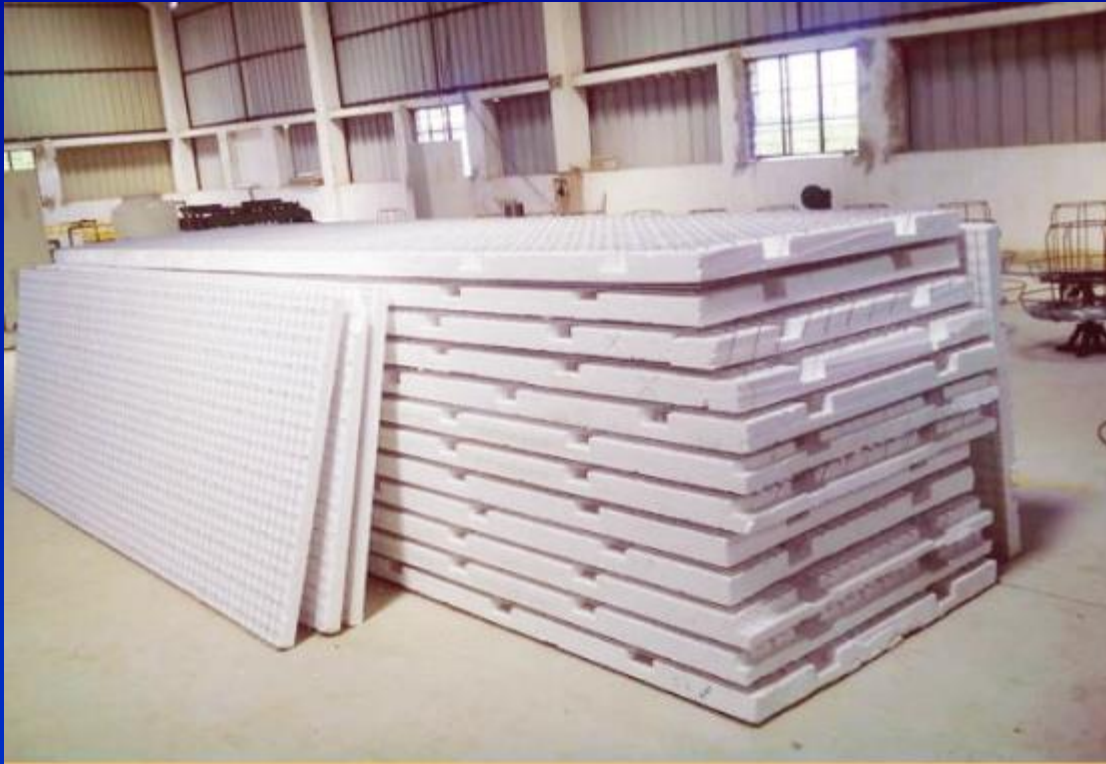
- Rapid Panel is Worldhaus Construction Pvt. Ltd. patented EPS Core Panel System.
- It is a prefabricated assembly of high-Strength steel wire forming a panel with core of expanded polystyrene (EPS).
- The basic unit of the Rapid Panel is the zig-zag truss. Steel wire is bent into a zigzag shape to form a continuous chain of web members. This bent wire is then welded to continuous chord wires at every node to form the complete truss.
- During construction, Rapid Panels are installed as walls and/or slabs. Specified mixtures of mortar or concrete are applied to the surfaces of the panels to complete the structure.

Reinforced EPS Core Panel System



- Reinforced Expanded Polystyrene Core Panel System is a factory produced sandwich panel system for the construction of low rise buildings up to G+3 and as filler walls in high rise RCC and steel frame buildings. These panels are being produced by Jindal Steel & Power Ltd., India.
- A core of undulated polystyrene is covered with interconnected zinc coated welded wire mesh on both sided reinforcement and shotcrete.
- The panels are finished on site by spraying concrete to realise the different structural elements i.e. Vertical Structural Walls, Horizontal Structural elements (slabs, floors) and non structural cladding elements.

QuickBuild 3D Panels



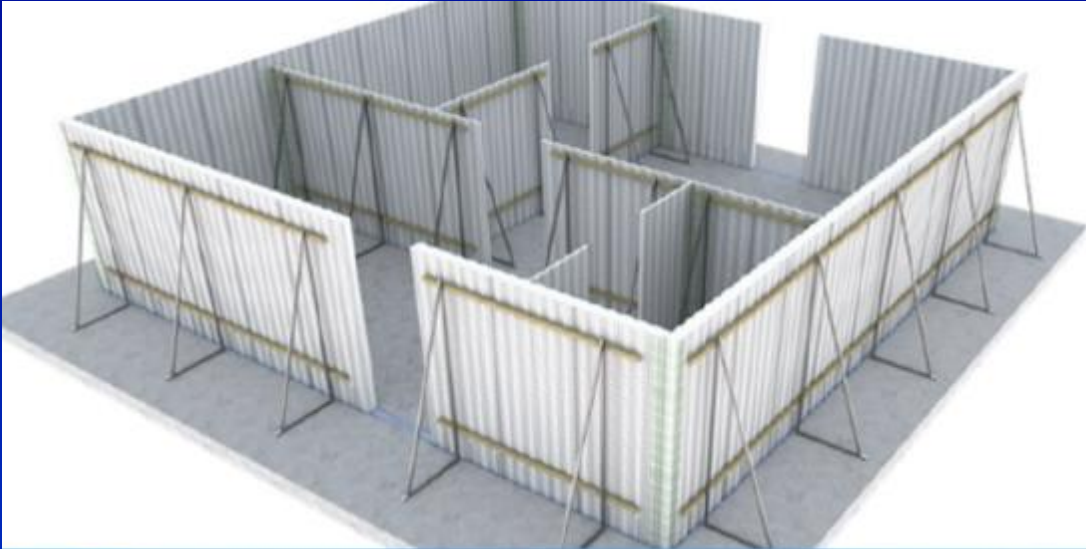
- QuikBuild panel system (Patented) of Beardsell Ltd. consists of a welded wire space frame integrated with expanded polystyrene insulation core.
- The wall panel is placed in position and a wythe of concrete of required thickness is applied to both sides. The wall panel receives its strength and rigidity from the diagonal cross wires welded to the welded-wire fabric on each side.
- The shell of the structure is built manually by erecting the panels directly onto the slab with protruding reinforcement rods and then finished by plastering with cement using the traditional method or by shotcreting to create a monolithic structure.

Concrewall Panel System



- The Concrewall is patented system of Schnell Wire System. It comprises of panels of expanded polystyrene (EPS) insulation and steel reinforcement which are applied with concrete, onsite.
- The Concrewall panel comprises of a layer of welded wire mesh on either side of EPS core welded together by steel orthogonal trusses which penetrates through EPS core. The panels are joined together in a desired configuration on site and sprayed on both sides with shotcrete to form a sandwich type construction.
- The exterior of the panels may be finished with weather proof coating such as plaster while interior surfaces (walls) and ceilings can either be plastered or lined with conventional lining material.

BauPanel System



- BauPanel System consists of panels of expanded polystyrene (EPS) and steel wire mesh which are applied with concrete at site. The system comprises of a layer of steel mesh on either side of EPS core welded together by steel trusses (orthogonal) which penetrate through EPS core.
- The panels are joined together in a configuration on site and sprayed on both sides with shotcrete to form a sandwich panel type construction for walling/roofing.
- The exterior of the panels are finished with weather proof coating or lined with conventional lining material while interior surfaces (walls) and ceilings shall be finished with water/ solvent based coating or lined with conventional lining material.

Sismo Building Technology



- Sismo (patented) Building Technology is an insulating shuttering kit for whole building unit based on a three-dimensional lattice made of galvanized steel wire and EPS panels. The lattice is filled with materials of different nature to serve as formwork.
- The basic structure of the Sismo building module is steel wire lattice. At the exterior sides of the lattice, infill panels (EPS) are inserted, which transform the lattice into a closed structure that can be filled with concrete.
- The steel wire also acts as armature and anchoring for the finished material and it holds reinforcement bars in place during concrete filling.
- The various components of the system are 3D lattice, infill panels, structural filler and finishing.

Prefabricated Fibre Reinforced Sandwich Panels



- The Prefabricated Fibre Reinforced Sandwich Panels known as Aerocon Panels are patented panels of M/s HIL Ltd. These are sandwich panels, made of two fibre reinforced cement facing sheets, on either sides of a lightweight concrete core.
- These panels have a unique tongue and groove jointing system that facilitates rapid construction and are fully cured at the factory itself. These panels are manufactured by using Flexo Board (FOB)/ Fibre Cement Board (NT).
- These panels can be used for variety of applications such as for partitions, cladding, mezzanine floors, boundary walls, etc.

Rising EPS (Beads) Cement Panels



- Rising EPS (Beads) Cement Panels are patented panels from M/s Rising Japan Infra Pvt. Ltd. These are lightweight composite wall, floor and roof sandwich panels made of thin fiber cement/calcium silicate board as outer and inner faces with a core of EPS granule balls, adhesive, cement, sand, fly ash 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 framed structure.
- These panels are presently manufactured by the firm in China and shortly a plant will be installed in India.

Flyash EPS (Beads) Cement Sandwich Panels



- EPS Cement Sandwich Panels by M/s Bhargav Infrastructure Pvt. Ltd. are lightweight solid core sandwich panels made of 5mm non-asbestos fiber cement boards on both sides of panels as facing sheet and the core material of expanded polystyrene beads, admixture, cement, sand, fly ash and other bonding materials in mortar form.
- The core material in slurry state is pushed under pressure into preset moulds. Once set, it is moved for curing and ready for use with RCC or steel framed structure. These panels are installed without any structural support up to 5m. The prefinished panels do not require plastering and water curing and are joined with tongue & groove jointing system.

V-Infill Wall (Light Weight EPS Wall)



- V-Infill Wall is factory made 8/10mm fibre cement boards (V-board) on either side of GI studs and erected to produce straight to finish walls which are filled with light weight concrete made of EPS, cement, sand and additive.
- The system is integrated with conventional column and beam for pre-engineered buildings. The walls are used as partition walls for external and internal applications.
- The GI studs are “C” cross-section with built in notch, slots, service holes etc. fixed with floor and ceiling channels using anchor fasteners at spacing of 300mm c/c. Provisions for doors, windows, ventilators and other cutouts and electrical and plumbing pipes/conduits are provided in the service holes of studs before concreting is done.

PIR Dry Wall Pre-Fab Panel System



- PIR Dry Wall Pre-Fab Panel by M/s Covestro (India) Pvt. Ltd is a walling system where two fibre cement boards (FCB) of 10 mm thickness are filled with insulation material namely Poly Isocyanurate (PIR) and erected to produce straight to finish walls.
- These non-load bearing walls are integrated with conventional framed construction of column and beams for pre-engineered buildings.
- Insulation core provides effective insulation and strong bonding for better structural stability to facilitate higher loading and wider spans.

Lost-in-Place Formwork System – Plaswall Panel System



- Plaswall Panel System is a lost in place formwork (patented system of M/s FTS Buildtech Pvt. Ltd), where two fibre cement boards (FCB) of 6mm thickness each are bonded through HIMI (High Impact Molded Inserts) spacers.
- These panels are erected in situ to produce straight-to-finish panels. A monolithic structure is then created by filling the entire structure with suitable grade of concrete to produce panels for structural applications.
- Reinforcing steel shall be as required from design. Presently, the fibre cement board (FCB) are imported from Malaysia for use in the construction of structures.

Lost-in-Place Formwork system – Plasmolite Wall Panels



- Plasmolite Panels are lost in place formwork system (patented system of M/s FTS Buildtech Pvt. Ltd), where two fibre cement boards (FCB) of 6 mm thickness are bonded together through High Impact Molded Inserts (HIMI) spacers. These panels are erected in situ to produce straight to finish panels which are filled with light weight foam concrete.
- The thus finished walls may be used as partition walls for external and internal applications and can be integrated with conventional RCC/Steel framed structure.
- Reinforcing steel shall be as required from design. Presently, the fibre cement board (FCB) are imported from Malaysia for use in the construction of structures.

Nano Living System Technology



- Nano Living System Technology comprises of an inner and outer skin of magnesium oxide (MgO) board, with an injected core of closed cell, polyurethane foam, free of Chlorofluorocarbon (CFC) blowing agent. Cold formed metal studs are incorporated within the foam and between the magnesium oxide board skins at nominal 600mm centres.
- The panels are manufactured in 150mm thickness having 80 mm cold formed steel studs, 10mm magnesium oxide board on each side and 50mm thermal packer between the internal stud and exterior magnesium oxide board with core insulation of 130mm closed cell and polyurethane foam.
- The Nano Living System Technology is suitable for use as load bearing walls in residential buildings up to G+3 storey.

STEEL STRUCTURAL SYSTEMS



**Light Gauge Steel
Structural
Systems**



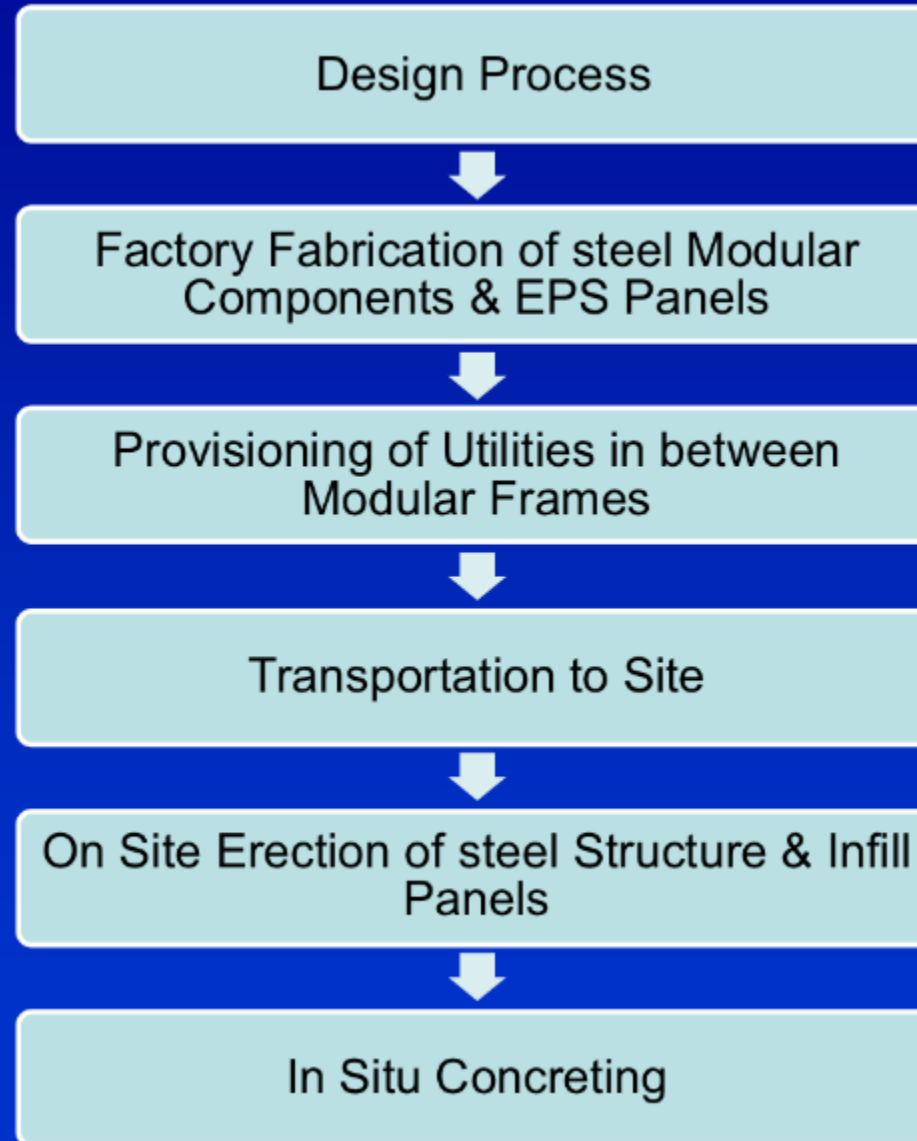
**Hot Rolled Steel
Structural
Systems**

PREFABRICATED STEEL STRUCTURAL SYSTEM

- Replacing cast in situ RCC structural frame with factory made steel (hot rolled) structural system



Concept





Typical Prefab housing



Factory Made Fast Track Building System



- Factory Made Fast Track Modular Building construction system (Patented) is hot rolled steel frame structure with different walling components, manufactured and fabricated in a controlled factory environment.
- The steel-modules pre-fitted with flooring, ceiling tiles, electrical and plumbing fittings are transported to the site for installation.
- Once all the components are assembled and erected at site, shotcreting is done on the factory made 3-D Expanded Polystyrene (EPS) panel walls making it a monolithic structure.
- The floor is composite steel floor deck slab.





Steel skeleton with Aerocon panel infills

Continuous Sandwich (PUF) Panels with Steel Structure



- Continuous sandwich panels are single piece, prefabricated, modular, factory made units which consist of an insulating layer of rigid polyurethane foam between two layers of metal sheets.
- The panels comprise of PUF bonded between two sheets of Pre-coated GI sheets of 0.5 mm thick to produce straight-to-finish panels. Insulation core provides effective insulation and strong bonding for better structural stability to facilitate higher loading and wider spans. These panels are available for both wall and roof.
- The system can incorporate all types of architectural features like coving, boxes, cantilevers, projections, infill walls, mezzanine floors etc. This system can also incorporate all types of services viz. electrical, gas and plumbing etc.

Factory Assembled Insulated Sandwich Panels using Mineral Wool



- The panels are factory assembled insulated sandwich panels consisting of an insulating layer ‘sandwiched’ between two layers of metal sheets.
- The panels are manufactured using mineral wool bonded between pre-coated steel sheets to produce profiled finish panels.
- The steel sheets can either be PPGI or PPGL, and, with a maximum thickness of 0.8 mm.
- An insulation core provides insulation and sturdy bonding for better structural stability and facilitates better load bearing capacity and wider spans for panels.

Factory Assembled Insulated Sandwich Panels using PUF



- The panels are factory assembled insulated sandwich panels consisting of an insulating layer ‘sandwiched’ between two layers of metal sheets.
- The panels are manufactured using rigid Polyurethane Foam (PUF) bonded between pre-coated steel sheets to produce profiled finish panels.
- The steel sheets can either be PPGI or PPGL, and, with a maximum thickness of 0.8 mm. An insulation core provides insulation and sturdy bonding for better structural stability and facilitates better load bearing capacity and wider spans for panels.

LIGHT GAUGE STEEL STRUCTURAL SYSTEMS

- Replacing cast in situ RCC structural frame with factory made light gauge steel (cold rolled) structural system

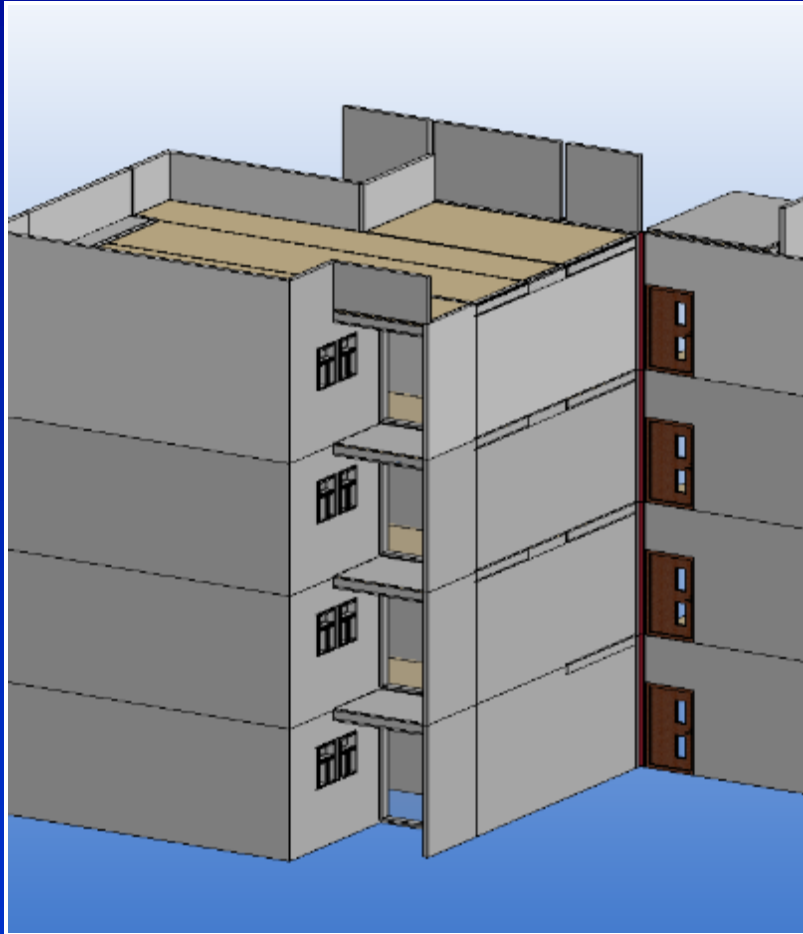


Light Gauge Structure System

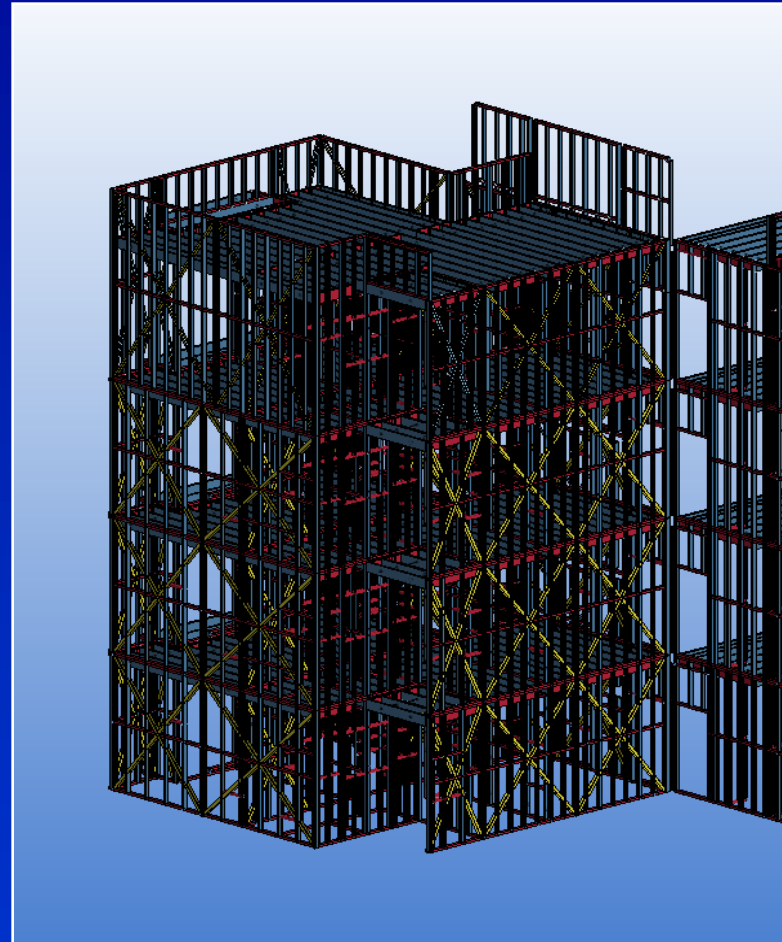
- Frame is made of cold rolled high strength steel sections and EPS panels for walling.
- Internal walls covered with gypsum and cementitious board. Exterior wall Sprayed with cementitious material directly onto the studs.
- Faster construction by prefabricated panels. All structural components are precisely pre-manufactured and simply assembled on site.
- Enhanced Thermal & Acoustic insulation with Boarding/Expanded Polystyrene (EPS) /Rockwool/Vapour Barrier.
- Eco friendly structure. Superior and sustainable performance. Minimum Impact on natural resources.



G+3 – Residential Building



Perspective View



Framing View of the model



ERECTION –DIFFERENT STAGES





**Composite construction -
In-situ concrete floor and roof**

Light Gauge Steel Framed Structure with Infill Concrete Panels (LGSFS-ICP)



- LGSFS-ICP Technology is a patented technology using factory made Light Gauge Steel Framed Structure (LGSFS). The infill wall comprises of factory made precast panels filled with light weight concrete at site.
- The LGS frame is a “C” cross-section with built in notch, dimpling, slots, service holes etc. produced by computerized roll forming machine.
- The frames are assembled using metal screws at site to form wall on a prebuilt concrete floor. The provisions for doors, windows, ventilators and other cutouts as required are incorporated in the frame. The roof structure is conventional RCC slab.

PRECAST CONCRETE CONSTRUCTION SYSTEMS



**2D Precast
Concrete
Construction**



**3D Precast
Volumetric
Construction**

2D Precast Concrete Construction

- Replacing cast in situ RCC structural frame with factory made structural components – 2D planar elements
- Customized Factory made beams, columns, wall panels, slab/floors, staircases etc.



Precast Large Concrete Panel System



- Precast Large Construction Panel (PLCP) system is a structural system comprising of various precast elements such as walls, beams, slabs, columns, staircase, landing and customized elements.
- There are two types of precast concrete elements, namely precast reinforced concrete elements and precast prestressed concrete elements, prefabricated in a precast yard or site.
- The precast elements are installed on site and supported by temporary jacks. Shims are used to carefully align the elements and grouted after the final adjustments.
- A typical construction involves design, strategic yard planning, lifting, handling, transportation and assembly of precast elements.

Concrete components prefabricated in precast yard or site and installed in the building during construction



Wall Panels



Parapet Beams



Spandrel



Solid Slab Panels



Pod Elements



Staircase

Industrialized 3-S system using RCC precast columns, beams & slabs with/without precast RCC shear walls



- The industrialized total open prefab construction technology is based on factory mass manufactured structural prefab components conforming to norms of IS standards and BIS Certification mark.
- In this Patented system, precast dense concrete hollow column shell of appropriate size are used in combination with precast dense concrete rectangular T Shape/L shape beams and lightweight reinforced autoclaved cellular concrete slabs for floors and roofs. The hollow columns are grouted with appropriate grade of in-situ concrete.
- All the connections and jointing of various structures are accomplished through in situ concreting along with secured embedded reinforcement of appropriate size, length and configuration to ensure monolithic continuous resilient ductile behavior.

Factory set-up at Delhi





Precast yard and factory set-up at Delhi



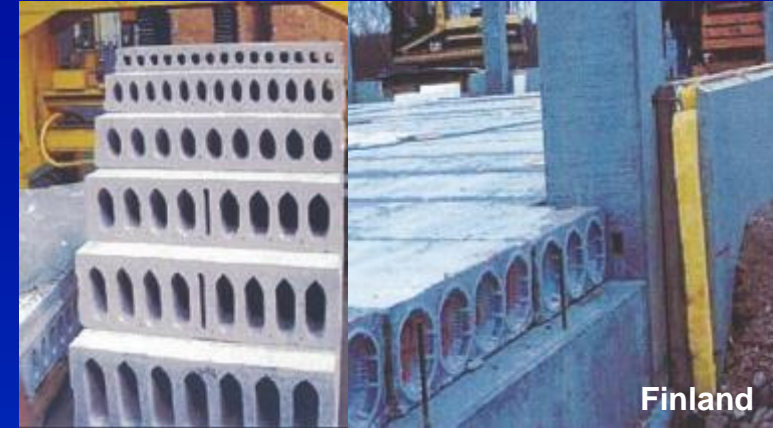
Urbanaac Precast Construction Technology



- Precast construction Technology from M/s Urbanaac Infrastructures Pvt. Ltd. is essentially a offsite precast concrete construction system under controlled environment using a reusable mould or “form”. The components produced are then transported to the construction site and later lifted & assembled to produce structure.
- Precast Construction Technology consists of various precast elements such as walls, beams, slabs, columns, staircase, landing and some customized elements that are standardized and designed for stability, durability and structural integrity of the building.
- This technology is suitable for construction of high rise buildings resisting seismic and wind induced lateral loads along with gravity loads. The building framing is planned in such a way that maximum number of repetitions of moulds is obtained.

Pre-stressed Precast Prefab Technology Using Hollow Core Slab, Beams, Columns, Solid Walls, Stairs, etc.

- Pre-stressed precast RCC technology using hollow core slabs, beams, columns, solid walls, stairs etc. are designed and manufactured in factory, shipped and erected at site.
- Multi-storey precast concrete frames are constructed with columns and beams of different shapes and sizes, stair and elevator shafts and floor slabs.
- The joints between the floors elements are executed in such a way that concentrated loads are distributed over the whole floor. This system is widely used for multi storey buildings.
- The structural frame is commonly composed of rectangular columns of one or more storeys height. The beams are normally rectangular, L-shaped or inverted T-beams. They are single span or cantilever beams, simply supported and pin-connected to the columns. Hollow core floor slabs are by far the most common type of floor slabs in this type of structure.



Pre-stressed Precast Prefab Technology Using Hollow Core Slab, Beams, Columns, Solid Walls, Stairs, etc...contd.

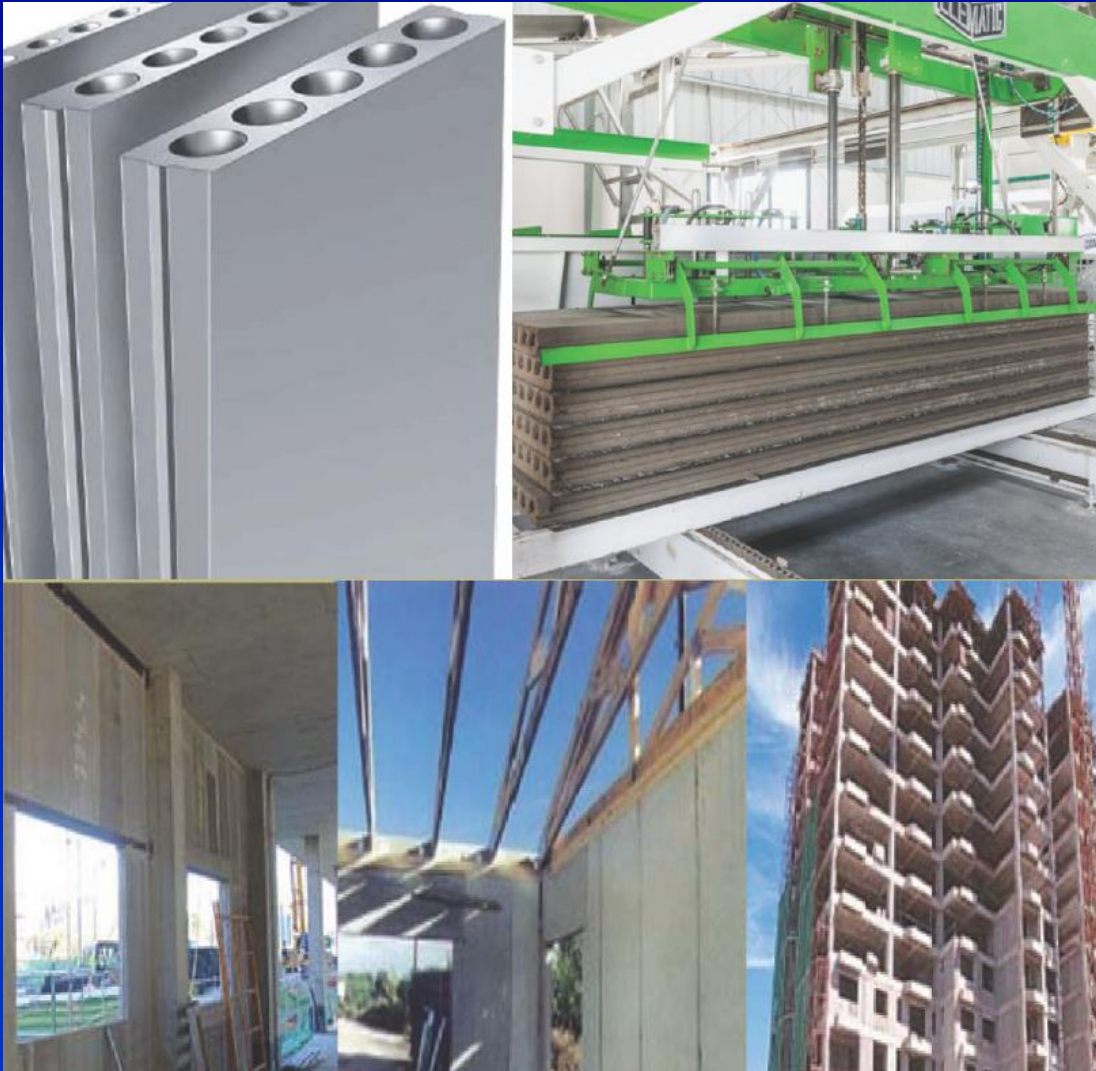


PMAY Project at Naya Raipur, Chhattisgarh

Technology: Hollow Core Slabs and Precast Large RCC Panels



Walltec Hollowcore Concrete Panel



- Walltec Hollowcore Concrete Wall Panels of M/s B N Precast Pvt. Ltd. are extruded non-load bearing concrete hollowcore wall panels.
- These panels are factory produced using light weight concrete made of river sand, crushed stone aggregate, light weight aggregate and Ordinary Portland cement.
- The concrete are extruded and cut while still wet to the requisite length. Walls have cylindrical hollow cores which helps to reduce weight, facilitate mechanical, electrical and plumbing services through hollows and provide better sound and thermal insulative properties.
- The sides of all panels are tongued and grooved to facilitate jointing.

K-Wall Panels



- K-Wall panels of M/s Pioneer Precast Solutions Pvt. Ltd. are factory produced non-load bearing hollow core wall panels using light weight concrete made of ordinary Portland cement, fly ash, perlite, foam, fevicol DDL, fiber-glass mesh, river sand and water.
- Panels have cylindrical hollow cores with 7 no. of 60 mm dia voids in the 100mm thickness, 8 no. of 50 mm dia. voids for the 80 mm thickness and 9 no. of 39mm dia voids for the 65mm thick panels.
- Hollow cores in K-wall panels help reduce weight, facilitate mechanical, electrical and plumbing services enhance sound and thermal insulation properties. The panels are joined using tongue and groove system.

Robomatic Hollowcore Concrete Wall Panels



- Robomatic wall panels are extruded non-load bearing concrete hollowcore wall panels manufactured in fully automated machines. These wall panels are factory produced using light weight concrete made of manufactured sand, crushed stone aggregate and Ordinary Portland cement.
- Hollowcores are incorporated in the walls to reduce dead weight, facilitate mechanical, electrical and plumbing services through hollows, increase sound and thermal insulation properties. The sides of all panels are tongued and grooved to facilitate jointing.
- These wall panels can be used as non-load bearing walls/partition walls and compound/ boundary walls in residential/ commercial/ industrial/ institutional buildings.

Kon_Crete Reinforced Autoclaved Aerated Concrete Panels



- KON_CRETE Reinforced AAC wall & floor/roof panels are innovative Autoclaved Aerated Concrete (AAC) products, having properties such as light weightness, high thermal resistance, acoustics & energy efficiency. It is a steam cured cementitious material manufactured from a mix of flyash, cement and other additives giving the material a unique cellular lightweight internal structure.
- The panels can be used for external & internal walls, floor & roof applications in any type of buildings.

Integrated Hybrid Solution - One (IHS-One)



- IHS-ONE of M/s Aap Ka Awas LLP is an Intermediate Building System (IBS) having three main components namely, interlocking walling system, precast floor & roof system and ferrocement building elements i.e. stairs, shelves, etc. All three components are integrated to construct a building and hence named as “Integrated Hybrid Solution – ONE”.
- This system uses Hydraform prefabricated mortarless interlocking blocks, precast RC Planks & Joists system to build load bearing G+3 structures.
- Both roof/floor and walling system can also be bridged with RC framed structure as well as steel structure in multistoried structure providing a complete solution for a building structure.

3D Precast Volumetric Construction

- Replacing cast in situ RCC structural frame with factory made structural components – 3D
- Customized factory made volumetric construction i.e. the entire module (room)



Moducast® System



- The Moducast® System (Mooreliving India Building Solutions LLP) combines a series of modules to create the overall building, this provides complete flexibility in the layout.
- The structure is designed in splittable transportable modules. These panels are assembled on specially designed steel beds and floor concrete is done linking the panels to the floor reinforcement forming a monolithic structure.
- This module is moved to various stages to complete the secondary operations and finishing works just like in a car assembly line. Finished module is then transported to site and erected together to form the final structure. It is suited for low to medium rise mass housing projects.

3D MONOLITHIC VOLUMETRIC Construction



Typical Offsite construction facility

Robotics & Automation for Prefabricating Precision Components for Buildings

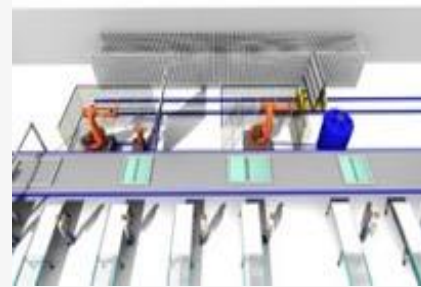
Precast Hollow Core Slabs,
Double Walls, Retaining Walls
Lift Cores and Mesh Welding



Prefabricated
Bathrooms + Modular
MEP



Sealant Injection for Aluminum
Glazing



Marble and granite
cutting and polishing



In-house
Design &
Engineering
Team with
Global
Expertise



Spraying Machine for Wood
Products



Integration and turnkey solution
including MEP and finishes
Manufacturing instead of
construction
Reduced labor on site
Complete coordination and
execution of full scope



BMTPC under Performance Appraisal Certification Scheme (PACS) Identified, Evaluated, Certified and Promoted New Emerging Technologies

(Gazette Notification No. I-16011/5/99 H-II in the Gazette of India No. 49 dated December 4, 1999)



PRECAST CONCRETE CONSTRUCTION SYSTEM – 3D PRECAST VOLUMETRIC		
1	Volumetric (3D) Concrete Printing Technology (VCPT)	1059-S/2022
PRECAST CONCRETE CONSTRUCTION SYSTEM – PRECAST COMPONENTS ASSEMBLED AT SITE		
2	SRPL Building System (Waffle-Crete)	1021-S/2015
3	Walltec Hollowcore Concrete Panel	1022-P/2015
4	Precast Large Concrete Panel System	1027-S/2016
5	Industrialized 3-S system using RCC precast with or without shear walls, columns, beams, Cellular Light Weight Concrete Slabs/Semi-Precast Solid Slab	-
6	Robomatic Hollowcore Concrete Wall Panels	1040-S/ 2018
7	K-Wall Panels	1043-S/2019
8	Urbanaac Precast Construction Technology	1046-S/2019
9	Integrated Hybrid Solution - One	1048-S/2020
10	Kon_Crete Reinforced Autoclaved Aerated Concrete Panels	1056-P/2021
LIGHT GAUGE STEEL STRUCTURAL SYSTEM & PRE-ENGINEERED STEEL STRUCTURAL SYSTEM		
11	Factory Made Fast Track Modular Building System	1011-S/2013
12	Speed Floor System	1013-S/2014
13	Light Gauge Steel Framed Structure (LGSF)	1014-S/2014
14	Light Gauge Steel Framed Structure with Infill Concrete Panel Technology	1028-S/2016
15	Continuous Sandwich (PUF) Panels With Steel Structure	1038-S/2018
16	PUF Sandwich Panel with Pre Engineered Building Structure	1060-S/2022
PREFABRICATED SANDWICH PANEL SYSTEM		
17	Advanced Building System – Emmedue	1010-S/2014
18	QuickBuild 3D Panels	1019-S/2015
19	Reinforced EPS Core Panel System	1020-S/2015
20	Rapid Panels	1026-S/2016

21	Prefabricated Fibre Reinforced Sandwich Panels	1030-S/2017
22	Concrewall Panel System	1031-S/2017
23	Rising EPS (Beads) Cement Panels	1032-S/2017
24	PIR Dry Wall Pre-Fab Panel System	1039-S/2018
25	Baupanel system	1041-S/2018
26	Flyash EPS (Beads) Cement Sandwich Panels	1042-S/2018
27	V-Infill Wall (Light Weight EPS Wall)	1045-S/2019
28	Nano Living System Technology	1047-S/2019
29	Factory Assembled Insulated Sandwich Panels using Mineral Wool	1057-P/2021
30	Factory Assembled Insulated Sandwich Panels using PUF	1058-P/2021
31	Everest Rapicon Panel / Solid Wall Panel	1061-S/2022
MONOLITHIC CONCRETE CONSTRUCTION		
32	Monolithic Concrete Construction System	1006-A/2011
33	Modular Tunnel Form	1018-S/2015
STAY IN PLACE FORMWORK SYSTEM		
34	Glass Fibre Reinforced Gypsum Panel System	1008-S/2011
35	Sismo Building Technology	1025-S/2016
36	Insulating Concrete Forms	1029-S/2017
37	Lost-in-place formwork system- Plasmolite Wall Panels	1033-S/2018
38	Lost-in-place formwork system- Plaswall Panel system	1034-S/2018
39	Structural Stay-in-place formwork system	1035-S/2018
40	Monolithic Insulated Concrete System	1036-S/2018
41	Stay-In-Place PVC Wall Forms	1044-S/2019
42	Permanent Wall Form (PVC)	1050-S/2020

A Novel initiative to Transplant Best Global Technologies for Indian Construction Sector



Ministry of Housing and Urban Affairs
Government of India

सबसे बेहतर आवास सबसे बेहतर तकनीक
Best Technology for Best Housing

15 YEARS OF CELEBRATING THE MAHATMA

सत्यमेव जयते

GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA

"To promote the use of new technologies in the housing sector, we have initiated the Global Housing Technology Challenge-India, so that new emerging technologies could be used for low cost housing."







-Narendra Modi

Global Housing Technology Challenge - India (GHTC-I)

Categories	Technology	Tech. Providers
1	<i>Precast Concrete Construction System - 3D Precast volumetric</i>	4
2	<i>Precast Concrete Construction System – Precast components assembled at site</i>	8
3	<i>Light Gauge Steel Structural System & Pre-engineered Steel Structural System</i>	16
4	<i>Prefabricated Sandwich Panel System</i>	9
5	<i>Monolithic Concrete Construction</i>	9
6	<i>Stay In Place Formwork System</i>	8
	Total	54



Light House Projects under GHTC-India

Location	Technology	Houses
 Indore	Prefabricated Sandwich Panel System	1,024
 Rajkot	Monolithic Concrete Construction System	1,144
 Chennai	Precast Concrete Construction System-Precast Components Assembled at Site	1,152
 Ranchi	Precast Concrete Construction System-3D Pre-Cast Volumetric	1,008
 Agartala	Light Gauge Steel Structural System & Pre-Engineered Steel Structural System	1,000
 Lucknow	Stay in-place Formwork System	1,040

- ❑ GHTC-India was launched to identify and mainstream innovative proven construction technologies from across the globe which are Cost-effective, Climate & Disaster Resilient, Sustainable and Green.
- ❑ Shortlisted Technologies will showcase 6 Light House Projects (LHPs) in 6 States through challenge process as **Live Laboratories**.
- ❑ **3S** Mantra of Skill, Scale & Speed for superior quality of construction

1

Precast Concrete Construction System – 3D Volumetric

1	Pre-cast concrete system with columns, beams, walls, slabs, hollow core slabs & also 3D Volumetric components	Katerra
2	Vertical structural modules cast in Plant/Casting yard are assembled together through casting of floor panel. The unit is transported & installed at site.	Moducast Pvt. Ltd
3	3D Modular casting using steel mould and high performance concrete of building modules in factory. These pods are transported to the construction site & assembled	Magicrete Building Solutions,
4	Modules with 3D Volumetric Precast concrete unit, various units make on house	Ultratech Cement Ltd,



2

Precast Concrete Construction System – Precast components assembled at site

1	Precast Large Concrete Panel (PLCP) System with structural members (wall, slab etc.) cast in a factory/ casting yard and brought to the building site for erection & assembling	Larsen & Toubro
2	Pre-cast Concrete Structural system comprising of pre-cast column, beam, precast concrete / light weight slab, AAC blocks/ infill concrete walls.	B.G. Shirke Construction Technology Pvt. Ltd
3	Optimal Pre-cast concrete System through structural Analysis, design & equipment support	Elematic India,
4	Precast concrete construction system using precast walls with precast plank floor	PG Setty Construction Technology Pvt Ltd,
5	Precast components comprising of beams, columns, staircase, slab, hollow core slab etc. manufactured in plant & erected on site	Teemage
6	Pre-cast sandwich panel system & Light weight Pre cast Light Weight concrete slab	Nordicflex
7	Prefabricated Interlocking Technology (without mortar) with Roofing as Mechanized Precast R.C. Plank & Joist system	Adalakra Associates Pvt. Ltd
8	Large Hollow wall prefab concrete Panel (lightweight, interlocking, concrete panel) using factory produced large standard hollow interlocking concrete block	William Ling,



3

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

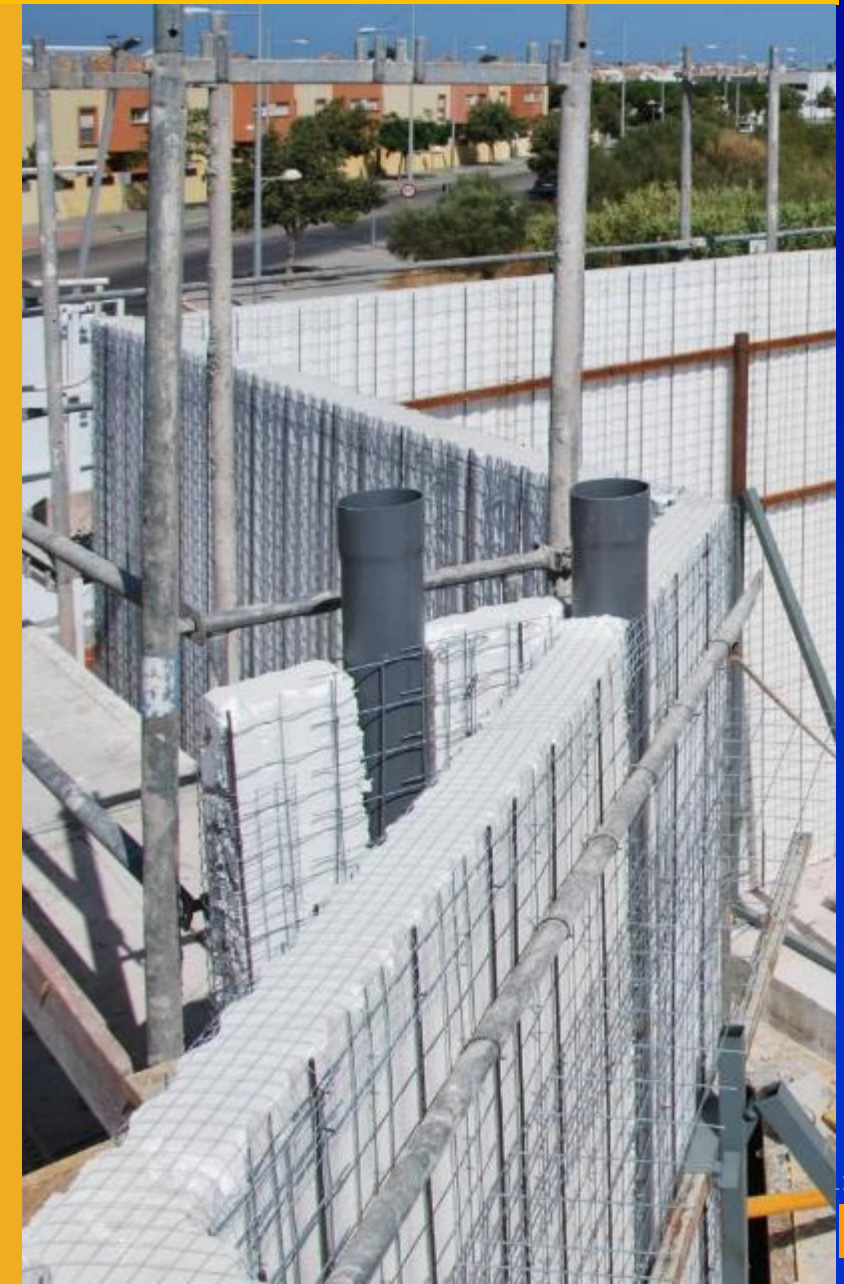
1	LGS Framing with various walling & roofing options	Mitsumi Housing Pvt. Ltd,
2	LGS Framing with various walling & roofing options	Everest Industries Ltd,
3	LGS Framing with various walling & roofing options	JSW Steel Ltd.,
4	LGS Framing with various walling & roofing options	Society for Development of Composites
5	LGS Framing with various walling & roofing options	Elemente Designer Homes
6	LGS Framing with various walling & roofing options	MGI Infra Pvt. Ltd.,
7	LGS Framing with various walling & roofing options	RCM Prefab Pvt. Ltd,
8	LGS Framing with various walling & roofing options	Nipani Infra and Industries Pvt. Ltd.,
9	LGS Framing with various walling & roofing options	Strawcture Eco
10	LGS Framing with various walling & roofing actions	Visakha Industries Ltd.
11	Prefabricated steel structural system with Dry wall system as AAC panels, PUF panels etc	RCC Infra Ventures Ltd.
12	Hot rolled steel frame with speed floor	Jindal Steel & Power Ltd.
13	Hot rolled steel section with AAC Panels as floor & slab	HIL Ltd.
14	AAC wall and roof panel system to provide integrated solution. AAC products are reinforced and used in both load and non-load bearing applications	Biltech Building Elements Ltd
15	AAC Panels are Wire mesh/ steel reinforced for use as wall & slab. Appears to be non load bearing panels to be used with structural framing.	SCG International India Pvt Ltd
16	Precast Light Weight Hollow-core wall Panel is a non-structural construction material with framed structures.	Pioneer Precast Solutions Private Limited



4

Prefabricated Sandwich Panel System

1	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Worldhaus
2	EPS Cement sandwich Panel: wall & slab with EPS Cement sandwich Panel to be used with RCC or Steel structural frame. Load bearing upto G+1 storey	Bhargav Infrastructure Pvt.Ltd
3	EPS Cement sandwich Panel: wall & slab with EPS Cement sandwich Panel to be used with RCC or Steel structural frame. Load bearing upto G+1 storey	Rising Japan Infra Private Limited
4	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Bau Panel Systems India Pvt Ltd,
5	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	BK Chemtech Engineering
6	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	MSN Construction
7	Reinforced Expanded Polystyrene sheet core Panel with sprayed concrete as wall & slab	Beardshell Ltd.
8	Pre-fab PIR (Poly-isocyanurate) based Dry Wall Panel System" as non-load bearing wall	Covestro India Pvt. Ltd.,
9	Sandwich panels as wall & slab	Project Etopia Group



5

Monolithic Concrete Construction

1	Aluminium formwork system for Monolithic Concrete construction	Maini Scaffold Systems
2	Aluminium formwork system for Monolithic Concrete construction	KumkangKind India Pvt. Ltd
3	Aluminium formwork system for Monolithic Concrete construction	S-form India Pvt. Ltd.,
4	Aluminium formwork system for Monolithic Concrete construction	ATS Infrastructure Ltd.
5	Aluminium formwork system for Monolithic Concrete construction	Innovative housing & Infrastructure Pvt. Ltd
6	Aluminium formwork system for Monolithic Concrete construction	MFS formwork Systems Pvt. Ltd.
7	Aluminium formwork system for Monolithic Concrete construction	Knest Manufacturers LLP
8	'Tunnel form' construction technology, an cast in situ RCC system, based on the use of high-precision, re-usable, room-sized, steel forms or moulds for monolithic concrete construction	Outinord Formworks Pvt. Ltd.
9	Aluminium formwork system for Monolithic Concrete construction	Brilliant Etoile



6

Stay In Place Formwork System

1	Expanded-Steel Panel reinforced with all- galvanised Steel Wire-Struts serving both as the load- bearing steel structure and as the stay-in-place steel formwork filled with EPS- alleviated concrete	JK Structure
2	Factory made prefab Glass fibre reinforced Gypsum cage panels suitable for wall & slab with reinforcement & concrete as infill as per the requirement	FACT-RCF Building Products Limited
3	Structural Stay In Place Galvanized Steel formwork system for walling with the same bottom single layer formwork for slabs/ in-situ slab	Coffor Construction Technology Pvt.Ltd
4	Factory produced PVC Stay in place formwork with concrete & reinforcement in walling units with cast insitu RCC Slab	Joseph Jebastin (Novel Assembler)
5	Fully load bearing walls with 150 mm monolithic concrete core sandwiched inside two layers of EPS as walling The forms are open ended hollow polystyrene interlocking blocks which fits together to form shuttering system	Reliable Insupack
6	Ready to use Stay in place polymer formwork, light weight, with flooring slab (combination of ferro cement and natural stone) placed on RCC precast joists)	Kalzen Realty Pvt. Ltd
7	Fast Bloc, Insulated Concrete Form (ICF), acts as formwork for concrete and rebar, Co1oumn/post and beam construction, creating an strong skeleton in the walls.	Fastbloc Building Systems
8	Formwork system "Plaswall with Two fibre cement boards (FCB) & HIMI (High Impact Molded Inserts) bonded between two sheets of FCB in situ and erected to produce a straight-to finish wall with in-situ concrete	FTS Buildtech Pvt.Ltd





**GLOBAL
HOUSING
TECHNOLOGY
CHALLENGE INDIA**

Light House Projects

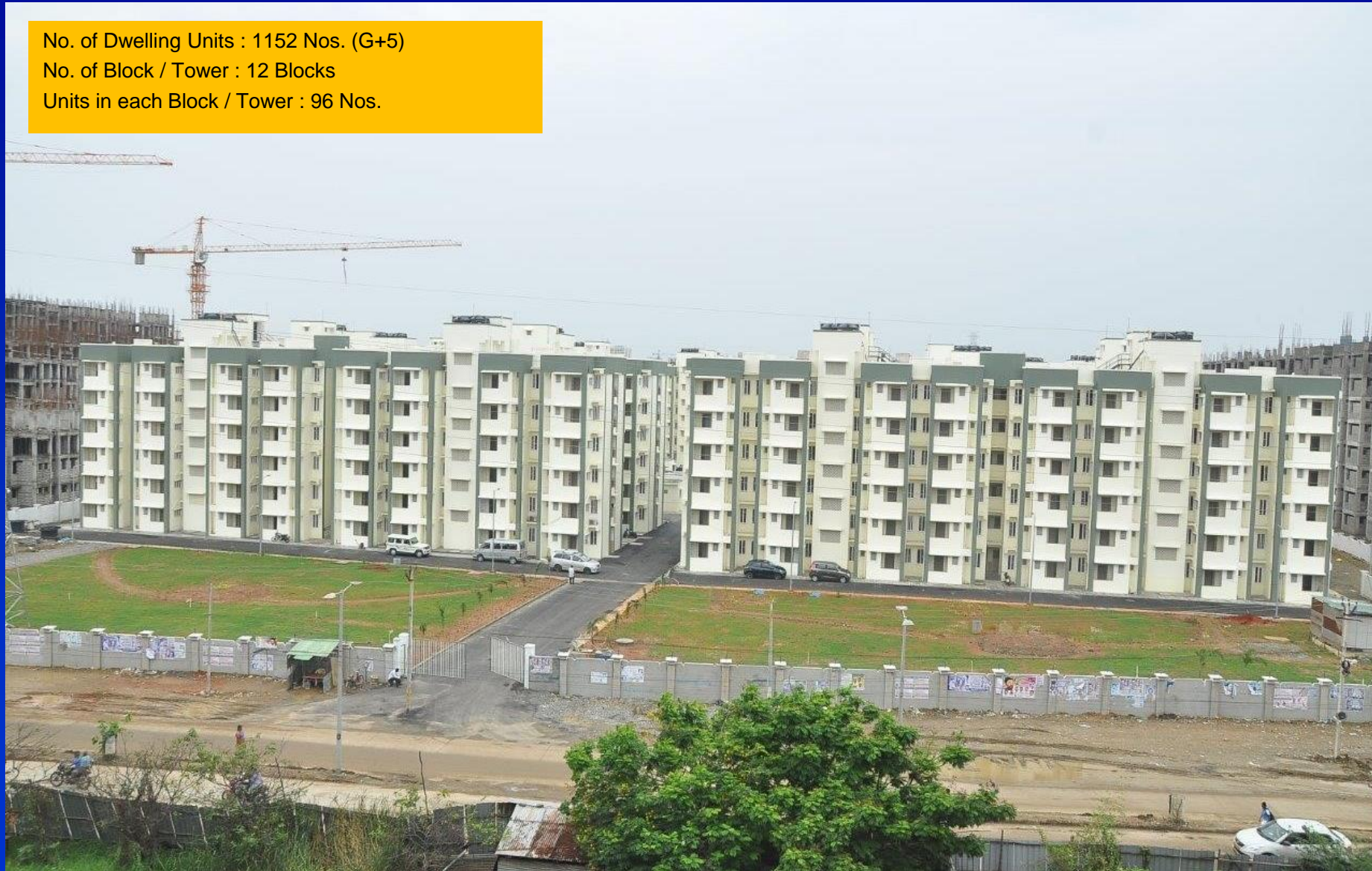


Hon'ble Prime Minister laid the foundation stone of six LHPs on 01.01.2021

Light House Project (LHP) at Chennai, Tamil Nadu

(Technology: Precast Concrete Construction System-Precast Components)

No. of Dwelling Units : 1152 Nos. (G+5)
No. of Block / Tower : 12 Blocks
Units in each Block / Tower : 96 Nos.



Light House Project: Chennai, Tamil Nadu

Construction Process

Construction Agency	M/s B.G. Shirke Constriction Private Ltd.
Technology Used	Precast Concrete Construction System - Precast Components Assembled at Site
No. of Houses	1,152
No. of Towers	12 (G+5)
Technology Brief	<ul style="list-style-type: none">• Individual precast building components (columns & beams, slabs, stairs etc.) are manufactured in the casting yard under controlled conditions.• Finished components are then transported to site, erected & assembled through in-situ concreting (wet jointing).

1 **Manufacturing** of Pre-cast building components (columns & beams, slabs, stairs etc.) in casting yard



2 **Transportation & Erection** of Pre-cast beams & columns at site



3 **Placement** of pre-cast slabs & **Assembly** through in-situ concreting (wet jointing) with beam and columns



4 **Infill walls** constructed using Autoclaved Aerated Concrete (AAC) Block masonry along with **services** (electricity, plumbing) followed by plastering



Light House Project (LHP) at Rajkot, Gujarat

(Technology: Monolithic Concrete Construction System)

No. of Dwelling Units : 1144 Nos. (S+13)
No. of Block / Tower : 11 Blocks
Units in each Block / Tower : 104 Nos.



Light House Project: Rajkot, Gujarat

Construction Agency	M/s Malani Construction Co.
Technology Used	Monolithic Concrete Construction using Tunnel Formwork
No. of Houses	1,144
No. of Towers	11 (S+13)
Technology brief	<ul style="list-style-type: none">• Reinforced Concrete walls and slabs are cast monolithically in single pour (one go) using Tunnel Form work.• It is a customized engineered steel formwork consisting of two half shells which are placed together and then concreting is done to form a room size module. Several such modules make a house.

Construction Process

- 1 Customised Tunnel Formwork** (mould) of steel manufactured in the factory



- 2 Placement of Tunnel formwork** in already erected reinforcement cage for walls at site



- 3 Placement of slab reinforcement & Concreting** of walls & slabs together in one go along with **services** (electricity, plumbing)



- 4 Infill walls** constructed using Autoclaved Aerated Concrete (AAC) Block followed by plastering



Light House Project (LHP) at Indore, M.P.

(Technology: Prefabricated Sandwich Panel System & Pre-Engineered Steel Structural System)

No. of Dwelling Units : 1024 Nos. (S+8)
No. of Block / Tower : 8 Blocks
Units in each Block / Tower : 128 Nos.



Light House Project: Indore, Madhya Pradesh

Construction Process

Construction Agency	M/s KPR Construction Pvt. Ltd
Technology Used	Prefabricated Sandwich Panel System with Pre-Engineered Steel Structural System
No. of Houses	1,024
No of Towers	08 (S+8)
Technology brief	<ul style="list-style-type: none">• The factory-made Prefabricated Sandwich Panel System comprises of core cement mortar with EPS granules balls sandwiched between calcium silicate boards on both sides.• These panels are being used in combination with pre-engineered steel structural system as a dry wall construction in this project.

1

Customised steel columns & beams manufactured in the factory are erected at site



2

Deck slab installation in already erected steel structure



3

Concreting of deck slabs with reinforcement along with services



4

Factory made Prefabricated sandwich panels are installed as infilled walls along with services



Light House Project (LHP) at Lucknow, U.P.

(Technology: Stay in-place Formwork System & Pre-Engineered Steel Structural System)

No. of Dwelling Units : 1040 Nos. (S+13)
No. of Block / Tower : 4 Blocks
Units in each Block / Tower : A(494), B(130), C(208) & D(208)



Light House Project: Lucknow, Uttar Pradesh

Construction Process

Construction Agency	M/s Jam Sustainable LLP
Technology Used	Stay in Place PVC Formwork with Pre-Engineered Steel Structural System
No. of Houses	1,040
No. of Towers	04 (S+13)
Technology brief	<ul style="list-style-type: none">• Poly-vinyl Chloride (PVC) based permanent stay-in-place form work acting as pre finished walls filled with concrete which requires no plaster and paint• These pre finished walls are used in combination with Pre-Engineered Steel Structural System

1

Customised steel columns & beams manufactured in the factory are erected at site



2

Deck slab installation in already erected steel structure & **Concreting with services**



3

Factory made prefinished PVC Wall forms are installed as infilled walls along with services



4

Filling of infill walls with concrete



Light House Project (LHP) at Agartala, Tripura

(Technology: Light Gauge Steel Structural System & Pre-Engineered Steel Structural System)

No. of Dwelling Units : 1000 Nos. (G+6)
No. of Block / Tower : 7 Blocks
Units in each Block / Tower : A(112), B(154), C(118),
D(168), E(168), F(168) & G(112)



Light House Project: Agartala, Tripura

Construction Process

Construction Agency	M/s Mitsumi Housing Pvt. Ltd
Technology Used	Light Gauge Steel Framed (LGSF) System with Pre-engineered Steel Structural System
No. of Houses	1,000
No. of Towers	07 (G+6)
Technology brief	<ul style="list-style-type: none">• This system uses factory made galvanized Light Gauge Steel wall components in combination with pre-engineered steel structural system for structure• The light gauge steel wall sections are assembled at site which are then cladded with concrete panels on both sides and filled with light weight concrete.

1

Customised steel columns & beams manufactured in the factory are erected at site



3

Filling of light weight concrete between the wall panels



2

Erection of factory made LGSF panels and **Fixing** of Precast concrete panels for walling



4

Deck slab installation in already erected steel structure & **Concreting with services**



Light House Project (LHP) at Ranchi, Jharkhand

(Technology: Precast Concrete Construction – 3D Volumetric Construction)

No. of Dwelling Units : 1008 Nos. (G+8)
No. of Block / Tower : 7 Blocks
Units in each Block / Tower : 144 Nos.



Light House Project: Ranchi, Jharkhand

Construction Process

Construction Agency	M/s SGC Magicrete LLP
Technology Used	Precast Concrete Construction System – 3D Volumetric
No. of Houses	1,008
No. of Towers	07 (G+8)
Technology brief	<ul style="list-style-type: none">• A latest technology where precast concrete structural modules like room, toilet, kitchen, bathroom, stairs etc. & any combination of these are cast monolithically in casting yard under controlled condition.• These Modules are transported and installed using cranes & push-pull jacks and integrated together at site to form a complete building unit.

1

Casting of structural modules & slabs in the casting yard



2

Placement of modules at site using cranes



3

Placement of pre cast floors on already erected structured modules



4

Step 2 & 3 are repeated like Lego Blocks to complete a Tower



"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. I urge all such universities and all engineering colleges across the country that professors involved in this field, faculty and students should make groups of 10-15 people who should go to these six sites for a week and study it thoroughly. The people of our universities across the country should visit these pilot projects which are in a way incubators and study about the technology."

Hon'ble Prime Minister,
01.01.2021



LIGHT HOUSE PROJECTS : LIVE LABORATORIES

[Click to enrol](#)

Light House Projects (LHPs) being constructed at Agartala, Ranchi, Lucknow, Indore, Rajkot and Chennai are first of its kind in the country to demonstrate use of globally available proven innovative technologies in mass housing. These technologies are new to the country with limited use in construction sector.

Ministry of Housing and Urban Affairs (MoHUA) is promoting these LHPs as Live Laboratories for different aspects of transfer of technology to the field which includes planning, design, production of components, construction practices and testing.

The primary goal of making these LHPs as Live Laboratories is to encourage large scale citizen participation and create technical awareness for on-site learning, multistakeholders consultation, find ideas for solutions, learning by doing, experimentation and encouraging innovation, thereby mainstreaming the globally identified proven innovative technologies under GHTC-India in Indian context.

PRINCIPLES





GLOBAL
HOUSING
TECHNOLOGY
CHALLENGE INDIA

TECHNOGRAPHS

Change Agents of Innovative and
Sustainable Construction Technologies

Scan and enrol:



Target Group :-



Faculty & Research Students



Technical Professionals



Central/States/ULB Officials



Construction Agencies



Builders/ Developers



Startup/Innovators/Entrepreneurs

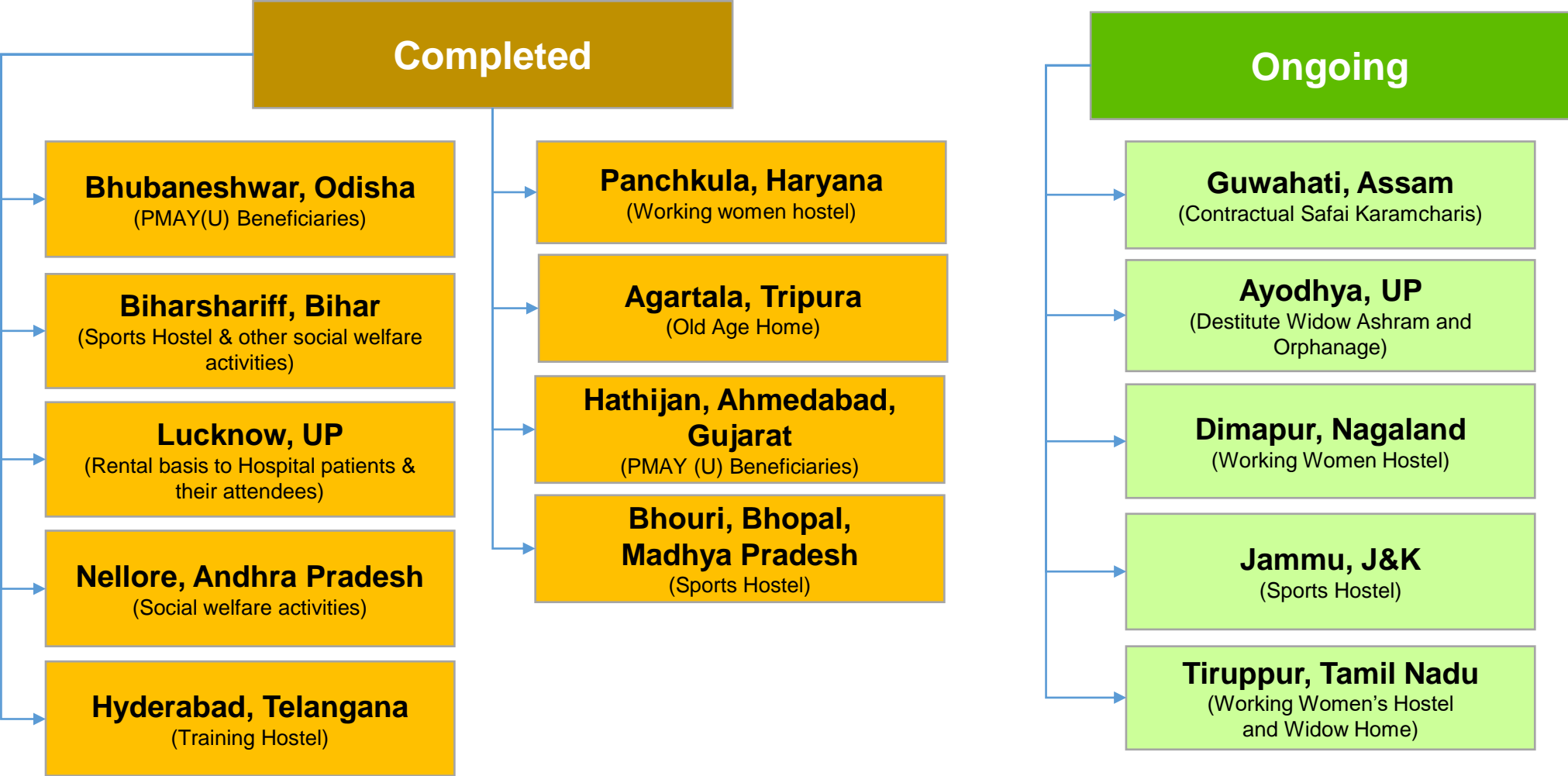


Other Concerned Stakeholders



[https://ghc-
india.gov.in/userhome/index](https://ghc-india.gov.in/userhome/index)

Demonstration Housing Projects (DHPs)



Completed Demonstration Housing Projects (DHPs)

Model housing projects containing up to **40 Houses each** with sustainable, cost and time effective emerging alternate housing construction technologies suitable to the geo-climatic and hazardous conditions of the region.



Nellore, Andhra Pradesh

Glass Fibre Reinforced Gypsum Panel System



Hyderabad, Telangana

Light Gauge Steel Frame System & Stay-in-place formwork - Coffor



Bihar Sharif, Bihar

Stay in Place - CR Steel Formwork System



Lucknow, Uttar Pradesh

Stay in Place - EPS Double Walled Panel System



Bhubaneswar, Odisha

EPS Core Panel Technology



Panchkula, Haryana

Light Gauge Steel Framed Structure with fibre cement board and infill of rockwool



Agartala, Tripura

Stay-in-Place Formwork System- Coffor

Completed Demonstration Housing Projects (DHPs) during the Year

Bhopal- Sports Hostel



Insulated Concrete Forms (ICF)

Ahmedabad - PMAY (U) Beneficiaries



Integrated Hybrid Solution-ONE

Ongoing Demonstration Housing Projects (DHPs)

Guwahati- Contractual Safai karamcharis



Light Gauge Steel Frame Structure with V-infill concrete wall

Jammu- Sports Hostel



EPS core panel using Quikbuild Panels

Ayodhya - Destitute Widow Ashram & Orphanage



Light Gauge Steel Frame structure with cement fiber board

Tiruppur - Working Women Hostel & Widow Home



Precast Concrete Construction System

Dimapur - Working Women Hostel



Flyash EPS Cement Sandwich Panels with steel structure



Activities at DHP sites:

- Dissemination of innovative technologies
- Periodic Training programs for students/ Professional on use of new technologies in DHPs
- Capacity building of local Artisans
- Knowledge dissemination through Webinars

Adoption of New Technologies by States



AHP houses in Pune, Maharashtra using Precast Construction Technology

- More than **16 Lakh houses** are being built using innovative technologies under PMAY(U) & other state schemes.

State	Technology
Andhra Pradesh	EPS, Monolithic and Steel Technology
Chhattisgarh	Monolithic and Precast Technology
Gujarat	Monolithic, Precast (Waffle-crete)
Kerala	Glass Fibre Reinforced Gypsum (GFRG)
Maharashtra	Precast (3S) & Monolithic Technology
Odisha	Precast concrete construction
Jharkhand	Global Tender floated
Tamil Nadu	Precast Concrete Technology
States like Assam, Karnataka, Madhya Pradesh, Telangana & Uttarakhand have also expressed interest in Technology neutral bidding process	

54

Alternate technologies Identified

54

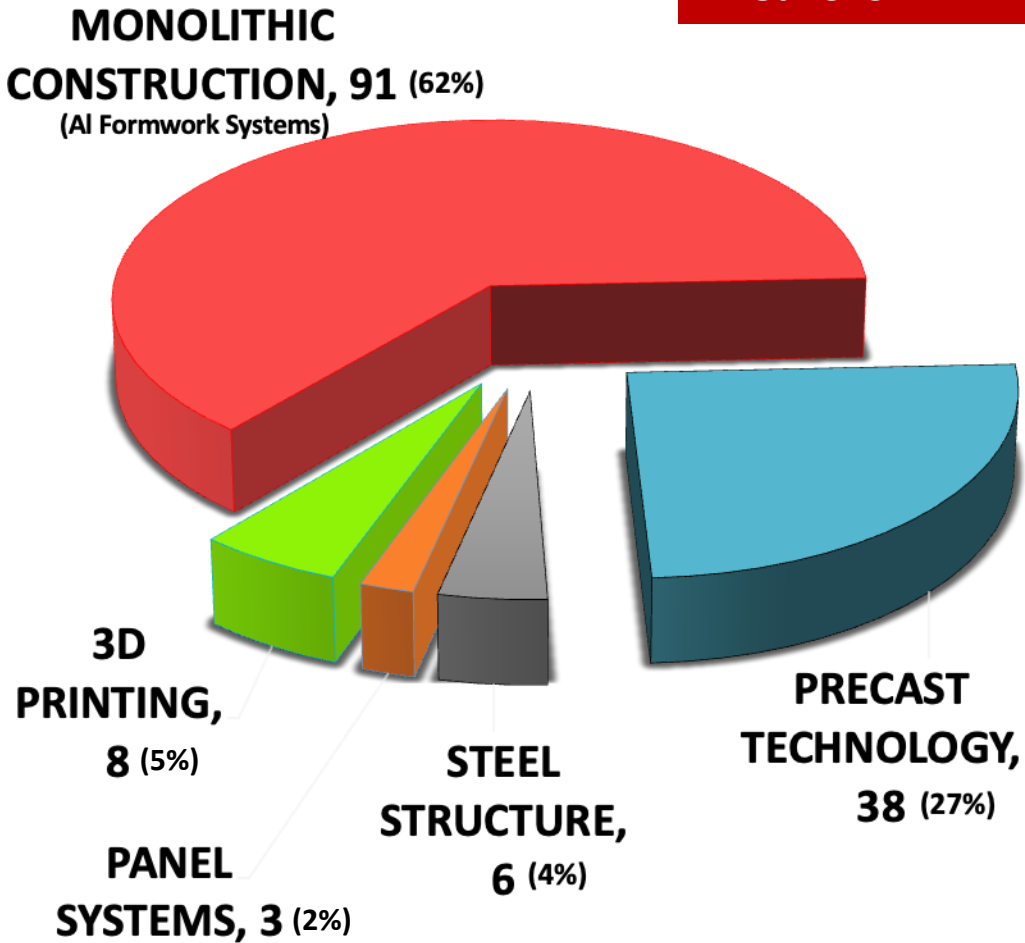
technologies approved by CPWD

34

SoRs issued for alternate technologies by CPWD (27+7)

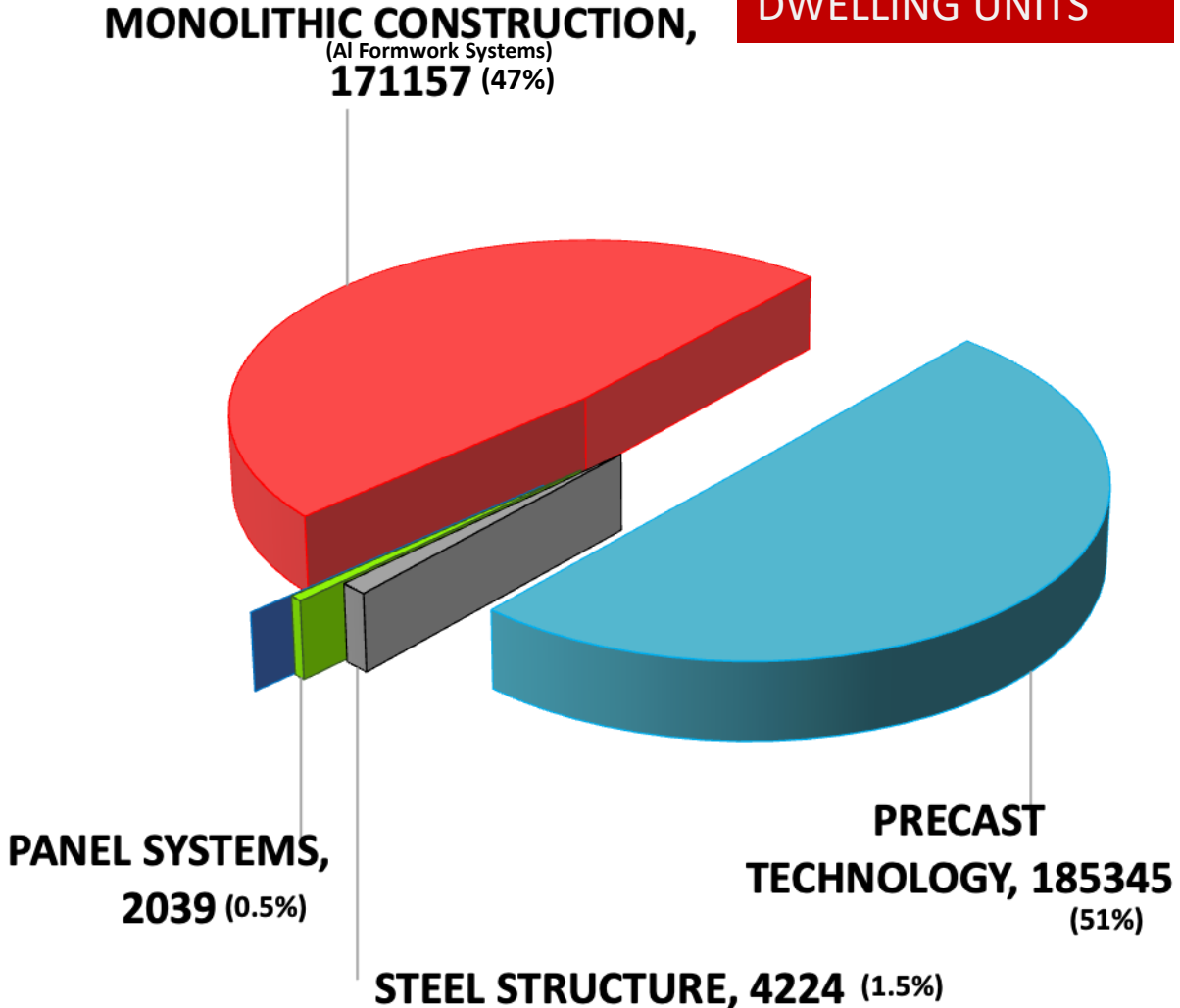
DISTRIBUTION OF USE OF INNOVATIVE TECHNOLOGIES

BY NUMBER OF PROJECTS



Total Projects: 146

BY NUMBER OF DWELLING UNITS



Total Units: 3,62,765

Certificate Course on Innovative Construction Technologies

Target Group

- Any person who has successfully completed and in possession of a minimum qualification of B.E. / B.Tech (Civil) or B.Arch. (or equivalent) or Diploma in Civil with 5 years' experience.

Objectives

- **Familiarise** the professionals with the latest materials and technologies being used worldwide for housing.
- Provide an **awareness** of the state of art of materials and technologies in terms of properties, specifications, performance, design and construction methodologies so that professionals can successfully employ these in their day to day practice.
- Provide **exposure** to executed projects where such materials and technologies have been implemented.

नवरीति: (NAVARITIH)

(New, Affordable, Validated, Research Innovation Technologies for Indian Housing)

Certificate Course on Innovative Construction Technologies



Hon'ble Prime Minister of India launched NAVARITIH
during Foundation Stone Laying ceremony of six Light House Projects (LHPs) on 1.1.2021

नवरीति: (NAVARITIH)

(New, Affordable, Validated, Research Innovation Technologies for Indian Housing)

Certificate Course on Innovative Construction Technologies

Salient Features

1

Online Classes through video conferencing

2

Course Fee : Rs.2,500 per participant

3

MCQ based Online Examination

4

Three Attempts Permissible in 45 days

5

Field visits for hands-on exposure

Way Forward

- **Need to mainstream these technologies into construction industry**
- **Sensitization, dissemination at Pan India level**
- **Capacity building, skill development**
- **Publication of manuals, guidelines, codes, SOR**
- **Demonstration buildings**
- **Information, Education and Communication**

Let us be part of India's growth story of
Reform, Perform & Transform



You can reach us at ska@bmtpc.org; info@bmtpc.org;



[@bmtpcdelhi](https://twitter.com/bmtpcdelhi)



[bmtpc.bmtpc](https://www.facebook.com/bmtpc.bmtpc)

“Creating Enabling Environment for Affordable Housing for All”

