



GLOBAL HOUSING TECHNOLOGY CHALLENGE INDIA



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







USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PRADHAN MANTRI AWAS YOJANA (URBAN)

# PREFACE

The raison d'être for bringing paradigm shift in the construction practices in vogue stems out of the clarion call given by Hon'ble Prime Minister for establishing a New India by 2022, the platinum jubilee year of our Independence.

BMTPC under Ministry of Housing & Urban Affairs, Govt. of India has been promoting innovative housing technologies for field level applications which are suitable for affordable mass housing specially in urban areas. These housing technologies offer a basket of appropriate structural systems which are not only superior than the existing RCC/load bearing construction practices but also deliver quality, safe & sustainable houses at a much faster rate with much improved structural and functional performance.

These systems are being used world over successfully and now most of the States along with Govt. agencies & departments, construction agencies, development authorities & housing boards have shown interest & are willing to adopt them. About 1.5 million houses are being constructed with innovative housing technologies in India under PMAY(U) and other state-run schemes. It is high time that construction fraternity in India pole-vault to Modular Construction & Prefabrication as the way to construct whereby worksite productivity is maximised, project delivery time is optimised, construction site wastage is minimised and overall sustainability is achieved.

BMTPC under Ministry of Housing & Urban Affairs, is operationalizing Performance Appraisal Certification Scheme (PACS) through which 39 innovative construction systems have been certified so far. Also, MoHUA recently conducted Global Housing Technology Challenge – India on 2-3 March 2019 which was inaugurated by Hon'ble Prime Minister of India. Through GHTC-India, 54 innovative technologies have been shortlisted which have been broadly divided into six broad categories namely, (1) Precast Concrete Construction System – Precast components assembled at site, (2) Light Gauge Steel Structural System & Pre-engineered Steel Structural System, (3) Prefabricated Sandwich Panel System, (4) Monolithic Concrete Construction, (5) Stay In Place Formwork System, and (6) Precast Concrete Construction System - 3D Precast volumetric. At present, six Light House Projects comprising of 1000+ houses in different States are being constructed using six distinct technologies shortlisted under GHTC-India. Also, Demonstration Housing Projects (DHPs) using Innovative technologies are being taken up in different parts of the country.

The booklet gives snapshots of housing projects under Pradhan Mantri Awas Yojana (Urban) which are using innovative construction technologies along with Light House Projects and **Demonstration Housing Projects.** 

> Dr.Shailesh Kr.Agrawal **Executive Director**

BMTPC



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# CONVENTIONAL CONSTRUCTION SYSTEMS



The ubiquitous construction systems around the globe 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-place system commonly known as load bearing system as load of structure is transferred to foundation and then to ground through load bearing walls.

#### **RCC Framed Structure**

- yes

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.



# INNOVATIVE CONSTRUCTION SYSTEMS



The conventional construction systems are primarily cast in-situ slow pace construction systems and can not meet the present requirement of housing shortage. Therefore, it is judicious to adopt new construction systems which are fast track and deliver quality construction without compromising functional and structural requirements.

These innovative systems are precast concrete construction, hot and cold form steel construction, engineered formwork systems, sandwich panel construction, factory made prefabricated systems etc. These systems are being practiced world over and some of the developing countries have successfully met the huge housing demand using them.

These systems employ technologies which are environmentally-responsible and resource-efficient through the life span of building.

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#### SRPL BUILDING SYSTEM (WAFFLE-CRETE)

Large structural ribbed panels of reinforced precast concrete, bolted together and the joints between the panels are caulked to form the walls, floor and pitched or flat roofs of buildings.





#### PRECAST LARGE CONCRETE PANEL SYSTEM

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 pre-stressed concrete elements, prefabricated in a precast yard or site.





#### INDUSTRIALIZED 3-S SYSTEM

using RCC precast with or without shear walls, columns, beams, Cellular Light Weight Concrete Slabs/Semi-Precast Solid Slab

Industrialized total open prefab construction technology based on factory mass manufactured structural prefab components.



#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



#### WALLTEC HOLLOWCORE CONCRETE PANEL

Factory produced extruded non-load bearing concrete hollowcore wall panels using light weight concrete made of river sand, crushed stone aggregate, light weight aggregate and Ordinary Portland cement.



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#### ROBOMATIC HOLLOWCORE CONCRETE WALL PANELS

Fully automated machines factory produced extruded non-load bearing concrete hollowcore wall panels using light weight concrete made of river sand, crushed stone aggregate, light weight aggregate and Ordinary Portland cement.



#### **K-WALL PANELS**

K-Wall panels are factory produced nonload 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.

PRECAST CONCRETE CONSTRUCTION SYSTE - PRECAST COMPONENTS ASSEMBLED AT SIT





#### URBANAAC PRECAST CONSTRUCTION

Urbanaac precast construction technology 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.

**INTEGRATED HYBRID** 

**SOLUTION - ONE** 

This 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.





BHT GAUGE STEEL STRUCTUR SYSTEMS & PRE-ENGINEERED STEEL STRUCURAL SYSTEM



## LIGHT GAUGE STEEL FRAMED STRUCTURE (LGS<u>F</u>)

Factory made galvanized light gauge steel components assembled as panels at site with infill walls of fibre cement board / cement particle board filled with ensulation materials e.g. rockwool.



#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



# LIGHT GAUGE STEEL FRAMED STRUCTURE WITH INFILL CONCRETE PANELS (LGSF-ICP)

Factory made Light Gauge Steel Framed Structure with infill wall of factory made precast panels filled with light weight concrete at site.







#### FACTORY MADE FAST TRACK BUILDING SYSTEM

Factory Made Fast Track Modular Building construction system is hot rolled steel frame structure with different walling components, manufactured and fabricated in a controlled factory environment.

SPEED FLOOR SYSTEM

Suspended concrete flooring system using

hybrid concrete/steel tee-beam in one direction and an integrated continuous

one-way slab in other direction.



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#### PREFABRICATED FIBRE REINFORCED SANDWICH PANELS

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 & are fully cured at the factory itself and used as filler walls.





#### CONTINUOUS SANDWICH (PUF) PANELS WITH STEEL STRUCTURE

Prefabricated, modular, factory made panels consisting of an insulating layer of rigid polyurethane foam (PUF) between two layers of precoated metal sheets.





## 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.





#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



# 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.





#### FACTORY ASSEMBLED INSULATED SANDWICH PANELS USING MINERAL WOOL

These factory assembled insulated sandwich panels consist of an insulating layer 'sandwiched' between two layers of metal sheets and manufactured using mineral wool bonded between pre-coated steel sheets to produce profiled finish panels.





#### FACTORY ASSEMBLED INSULATED SANDWICH PANELS USING PUF

These factory assembled insulated sandwich panels consist of an insulating layer 'sandwiched' between two layers of metal sheets and manufactured using rigid Polyurethane Foam (PUF) bonded between pre-coated steel sheets to produce profiled finish panels.



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#### ADVANCED BUILDING SYSTEM – EMMEDUE

Factory made panels consisting of selfextinguishing EPS core sandwiched between two welded wire fabric mesh made of high strength galvanized wire and finished at site using shotcrete of mix of cement and coarse aggregate on both sides.





#### **RAPID PANELS**

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.







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.



#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



#### **QUICKBUILD 3D PANELS**

Consists of a welded wire space frame integrated with expanded polystyrene insulation core. The panels are placed in position and a wythe of concrete of required thickness is applied to both sides.



# Σ SYST **REFABRICATED SANDWICH PANEL**



#### **CONCREWALL PANEL SYSTEM**

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 and sprayed on both sides with shotcrete to form a sandwich type construction.



#### BAUPANEL SYSTEM

Panels of Expanded polystyrene (EPS) and steel wire mesh which are applied with shotcrete to form a sandwich panel type construction at site.





#### RISING EPS (BEADS) CEMENT PANELS

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.





#### FLYASH EPS (BEADS) CEMENT SANDWICH PANELS

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.





#### PIR DRY WALL PRE-FAB PANEL SYSTEM

A system where two fibre cement boards of 10 mm thickness are filled with insulation material namely Poly Isocyanurate (PIR) in-situ and erected to produce straight to finish walls. Used for non-load bearing applications.





#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



#### 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.



PREFABRICATED SANDWICH PANEL SYSTE



#### MONOLITHIC CONCRETE CONSTRUCTION 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/composites, for the entire modular unit.



MONOLITHIC CONCRETE CONSTRUCTION

#### MODULAR TUNNEL FORM

Mechanized system for cellular structures 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 together.





#### GLASS FIBRE REINFORCED GYPSUM (GFRG) PANEL SYSTEM

Integrated composite building system using factory made prefab load bearing cage panels using GFRG and monolithic cast in-situ RC infilled for walling and floor/roof slabs.





#### SISMO BUILDING TECHNOLOGY

Insulating shuttering kit for whole building unit based on doubled walled EPS panel and a three-dimensional lattice made of galvanized steel wire. The lattice is filled with materials of different nature to serve as formwork.





#### STRUCTURAL STAY-IN-PLACE FORMWORK SYSTEM (COFFOR)

Structural stay-in-place formwork system to build load bearing monolithic concrete wall structures based on shear wall concept.









#### CERTIFIED INNOVATIVE CONSTRUCTION TECHNOLOGIES UNDER PACS



#### INSULATING CONCRETE FORMS (ICF)

Sacrificial formwork systems which are left in the structure after concreting and act as insulation. It comprises of a panel of two walls of Expandable Polystyrene (EPS) separated by a nominal distance of 150mm by hard plastic ties.





#### MONOLITHIC INSULATED CONCRETE SYSTEM (MICS)

Formwork system with a rigid thermal insulation that stays in place as a permanent interior and exterior substrate for walls, floors and roofs, comprises of two layers of EPS connected by plastic ties.





#### LOST-IN-PLACE FORMWORK SYSTEM – PLASWALL PANEL SYSTEM

Lost in place formwork, where two fiber 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.



# STAY IN PLACE FORMWORK SYSTEM



#### LOST-IN-PLACE FORMWORK SYSTEM – PLASMOLITE WALL PANELS

Lost in place formwork system, where two fibre cement boards of 6 mm thickness are bonded together through High Impact Molded Inserts spacers and erected in situ to produce straight to finish panels which are filled with light weight foam concrete.





#### STAY-IN-PLACE PVC WALL FORMS

This is a prefinished wall formwork 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 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" 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. Wall components are erected and filled with concrete, in situ, to provide a monolithic concrete wall.





# PERFORMANCE APPRAISAL CERTIFICATION SCHEME (PACS)

A Tool to Propagate Innovative and New Building Materials & Technologies

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

#### **Performance Appraisal Certificates Issued on Innovative Technologies/Systems**

S. No.	Product	Name of Firm	PAC No.
1	Formwork for Monolithic	Sintex Industries Ltd, Kalol Guiarat	1006-A/2011
2	Glass Fibre Reinforced	Rashtriya Chemicals & Fertilizers Ltd. Mumbai	1008-S/2011
2	Gypsum Panel System	FACT-RCF Building Products Ltd, Kochi	1009-S/2012
3	Factory Made Fast Track Modular Building System	Synergy Thrislington, Mohali	1011-S/2013
4	Advanced Building System Emmedue	BK Chemtech (I) Pvt Ltd, Italy/ Bangalore	1010-S/2014
5	Speedfloor System	Jindal Steel & Power Ltd., New Delhi	1013-S/2014
6	Light Gauge Framed Steel Structure	JB Fabinfra Pvt. Ltd., Gurgaon	1014-S/2014
7	Quick Build 3D Panels	Beardsell Ltd., Chennai	1019-S/2015
8	Modular Tunnelform	Outinord Formworks Pvt. Ltd., Pune	1018-S/2015
9	Reinforced EPS Core Panel System	Jindal Steel & Power Ltd., Gurgaon	1020-S/2015
10	SRPL Building System (Waffle- Crete)	Shaival Reality Pvt. Ltd., Ahmedabad	1021-S/2015
11	Industrialized 3-S system using RCC precast with or without shear walls, columns, beams, Cellular Light Weight Concrete Slabs/Semi-Precast Solid Slab	B.G. Shirke Construction Technology Pvt. Ltd., Pune	-
12	Walltec Hollowcore Panel System	B N Precast Pvt. Ltd., Gandhinagar	1022-P/2015
13	Sismo Building Technology	M K S Infosolutions Pvt. Ltd., Manesar	1025-S/2016
14	Rapid panels	Worldhaus Construction Pvt. Ltd., Bangaluru	1026-S/2016
15	Precast Large Concrete panel System	Larsen & Toubro Ltd., Mumbai	1027-S/2016
16	LGSFS-ICP Technology	Society for Development of Composites, Bangaluru	1028-S/2016
17	Insulating Concrete Forms	Reliable Insupacks (P) Ltd,Greater Noida	1029-S/2017
18	Prefabricated Fibre Reinforced Sandwich Panels	HIL Ltd., Hyderabad	1030-S/2017
19	Concrewall System	Schnell Home, Italy	1031-S/2017
20	Rising EPS (Beads) Cement Panels	Rising Japan Infra Pvt.Ltd., New Delhi	1032-S/2017

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5. INO.	Product	Name of Firm	PAC NO.
21	Lost-in-Place Formwork system – Plasmolite Wall Panels (For Partition Walls)	M/s FTS Buildtech Pvt. Ltd., Mumbai	1033- S/2018
22	Lost-in-Place Formwork system –Plaswall Panel System (For Structural Applications)	M/s FTS Buildtech Pvt. Ltd., Mumbai	1034-S/2018
23	Structural Stay-in-Place Formwork System	M/s Coffor Construction Technology Pvt. Ltd., Vadodara	1035-S/ 2018
24	Monolithic Insulated Concrete System (MICS)	M/s Maiwir Ecotech Pvt. Ltd., Khammam	1036-S/2018
25	Continuous Sandwich (PUF) Panel with Steel Structure	M/s Kingspan Jindal Pvt. Ltd., Gurugram	1038-S/2018
26	PIR Dry Wall Prefab Panel System	M/s Covestro (India) Pvt. Ltd., Thane (West)	1039-S/2018
27	Robomatic Hollowcore Concrete Wall panels	M/s Robomatic Precon Pvt. Ltd., Hyderabad	1040-S/2018
28	Baupanel System	M/s Bau Panel System India Pvt. Ltd., Pune	1041-S/2018
29	Flyash EPS (Beads) Cement Sandwich Panels	M/s Bhargav Infrastructure Pvt. Ltd., Surat	1042-S/2018
30	K-Wall Panels	M/s Pioneer Precast Solutions Pvt. Ltd., Chennai	1043-S/2019
31	Stay-In-Place PVC Wall Forms	M/s Novel Assembler Pvt. Ltd., Mumbai	1044-S/2019
32	V-Infill Wall (Light Weight EPS Wall)	M/s Visaka Industries Limited, Secunderabad	1045-S/2019
33	Precast Construction Technology	M/s Urbanaac Infrastructures Pvt.Ltd., Ahmedabad	1046-S/2019
34	Nano Living System Technology	M/s Nano Living System Pvt. Ltd., New Delhi	1047-S/2019
35	Integrated Hybrid Solution - One	M/s Aap Ka Awas LLP, New Delhi	1048-S/2020
36	Permanent Wall Forms	M/s Kalzen Realty Pvt. Ltd., Hyderabad	1050-S/2020
37	Kon_Crete Reinforced Autoclaved Aerated Concrete Panels	M/s UAL Industries Ltd., UAL-KON-CRETE, Howrah, West Bengal	1056-P/2021
38	Factory Assemble Insulated Sandwich Panels using Mineral Wool	M/s Metecno (India) Pvt. Ltd., Chennai	1057-P/2021
39	Factory Assembled Insulated Sandwich Panels using PUF	M/s Metecno (India) Pvt. Ltd., Chennai	1058-P/2021

# EAST GODAVARI ANDHRA PRADESH

PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

26,802 DUs

#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)



KURNOOL ANDHRA PRADESH





PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

36,563 DUs

#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)





4,7047 DUs

10-3

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ANDHRA PRADESH

GUNTUR



VIZIANAGARAM ANDHRA PRADESH

> PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

11,837 DUs

-TI-I Feiler

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# VISAKHAPATNAM ANDHRA PRADESH

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The series of the series of the series

PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

57,499 DUs





#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)





BILASPUR CHHATTISGARH

> PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

.

1,981 DUs



# BHILAI CHHATTISGARH

TT



PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

696 DUs

# RAIPUR CHHATTISGARH



PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

1,136 DUs



181

DESSA

GUJARAT

# BHARUCH GUJARAT

PMAY(U) Project using PRECAST CONCRETE TECHNOLOGY (Waffle-crete)

512 DUs



#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)



12

PMAY(U) Project using PRECAST CONCRETE TECHNOLOGY (Waffle-crete)

1,776 DUs

22

#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)









#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)

Light House Project (LHP) under PMAY(U) using PRECAST CONCRETE CONSTRUCTION SYSTEM - 3D PRE-CAST VOLUMETRIC

1,008 DUs



#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)

147



XE

1,200 DUs













PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM

and a set of the set

2,112 DUs



CHENNAI TAMIL NADU

> PMAY(U) Project using PRECAST CONCRETE TECHNOLOGY

480 DUs

#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)

# HYDERABAD TELANGANA

PMAY(U) Project using MONOLITHIC CONCRETE CONSTRUCTION SYSTEM (TUNNEL FORMWORK)

har below and a second

14,040 DUs





#### USE OF INNOVATIVE HOUSING TECHNOLOGIES UNDER PMAY(U)



40 DUs











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