

# Innovative Green Technology & Building Materials for Pradhan Mantri Awas Yojana Scheme



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## Review of HFA policy in briefly Scope

'Housing for All' Mission for urban area will be implemented during 2015-2022 and this Mission will provide central assistance to implementing agencies through States and UTs for providing houses to all eligible families/beneficiaries by 2022.

Mission will be implemented as Centrally Sponsored Scheme (CSS) except for the component of credit linked subsidy which will be implemented as a Central Sector Scheme.

A beneficiary family will comprise husband, wife, unmarried sons and/or unmarried daughters. The beneficiary family should not own a pucca house either in his/her name or in the name of any member of his/her family in any part of India to be eligible to receive central assistance under the mission.

States/UTs, at their discretion, may decide a cut-off date on which beneficiaries need to be resident of that urban area for being eligible to take benefits under the scheme.

Mission with all its component has become effective from the date 17.06.2015 and will be implemented upto 31.03.2022.

## Coverage and Duration

All 4041 statutory towns as per Census 2011 with focus on 500 Class I cities would be covered in three phases as follows:

- Phase I (April 2015 - March 2017) to cover 100 Cities selected from States/UTs as per their willingness.
- Phase II (April 2017 - March 2019) to cover additional 200 Cities
- Phase III (April 2019 - March 2022) to cover all other remaining Cities

Ministry, however, will have flexibility regarding inclusion of additional cities in earlier phases in case there is a resource backed demand from States/UTs.

The mission will support construction of houses upto 30 square meter carpet area with basic civic infrastructure. States/UTs will have flexibility in terms of determining the size of house and other facilities at the state level in consultation with the Ministry but without any enhanced financial assistance from Centre. Slum redevelopment projects and Affordable Housing projects in partnership should have basic civic infrastructure like water, sanitation, sewerage, road, electricity etc.

ULB should ensure that individual houses under credit linked interest subsidy and beneficiary led construction should have provision for these basic civic services.

The minimum size of houses constructed under the mission under each component should conform to the standards provided in National Building Code (NBC). If available area of land, however, does not permit building of such minimum size of houses as per NBC and if beneficiary consent is available for reduced size of house, a suitable decision on area may be taken by State/UTs with the approval of SLSC. All houses built or expanded under the Mission should essentially have toilet facility.

The houses under the mission should be designed and constructed to meet the requirements of structural safety against earthquake, flood, cyclone, landslides etc. conforming to the National Building Code and other relevant Bureau of Indian Standards (BIS) codes.

The houses constructed/acquired with central assistance under the mission should be in the name of the female head of the household or in the joint name of the male head of the household and his wife, and only in cases when there is no adult female member in the family, the house can be in the name of male member of the household.

State/UT Government and implementing agencies should encourage formation of associations of beneficiaries under the scheme like RWA etc. to take care of maintenance of houses being built under the mission.

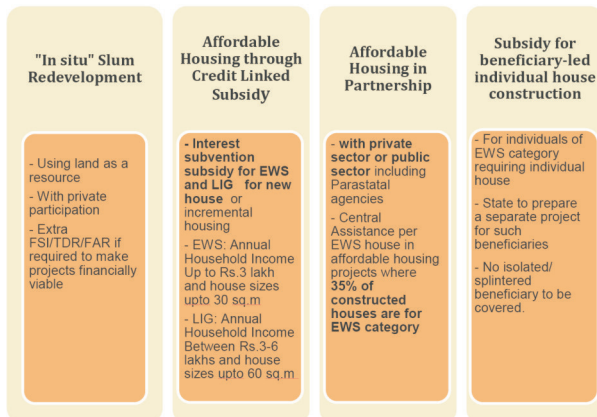
## Implementation Methodology

The Mission will be implemented through four verticals giving option to beneficiaries, ULBs and State Governments. These four verticals are as below:

## Details of Technology Sub-mission as listed in HFA policy

A Technology Sub-mission under the Mission would be set up to facilitate adoption of modern, innovative and green technologies and building material for faster and quality construction of houses.

Technology Sub-Mission will also facilitate preparation and adoption of layout designs and building plans suitable for various geo-climatic zones. It will also assist States/Cities in deploying disaster resistant and environment friendly technology.



ogies.

The Sub-mission will coordinate with various regulatory and administrative bodies for main-streaming and up scaling the deployment of modern construction technologies and material in place of conventional construction. Technology sub-mission will also coordinate with other agencies working in green and energy efficient technologies, climate changes etc.

The Sub-Mission will work on following aspects: i) Design & Planning ii) Innovative technologies & materials iii) Green buildings using natural resources and iv) Earthquake and other disaster resistant technologies and designs. Simple concept of designs ensuring adequate sunlight and air should be adopted.

Centre and State would also partner with willing IITs, NITs and Planning & Architecture institutes for developing technical solutions, capacity building and handholding of States and Cities.

State or region specific needs of technologies and designs would also be supported under this Sub-Mission.

#### The Scenario so far and Observations on the Built Houses for EWS

The houses so far built for EWS sector are like ghost houses and turning into dilapidated houses and are beyond maintenance conditions too.

This shows that the built structures are not durable and is in a went dilapidated stage within few years of construction. This shows that the quality of materials used are sub – standard.

The govt. also did not earmark sufficient funds for these houses, even though various schemes were launched and asked states to take it further. The Govt., has always looked at how cheaply it can be built, and in large numbers, instead of giving priority to quality and durability in construction.

In some States, the house for EWS sector are built far away from the Cities, and without basic Infrastructure and transportation facilities too and thereby, they are not even occupied by the beneficiaries in some locations

In the latest, HFA policy, the GOI have clearly outlined the principles of construction stating that adoption of modern, innovative and green technologies and building material for faster and quality construction of houses is to be considered and in addition stressed the need for basic Infrastructural facilities to be provided.

GOI have also stated clearly that up scaling the deployment of modern construction technologies and material in place of conventional construction is the desired intent.

Conventional construction predominantly used bricks as

filler walls or load bearing walls. By giving up the bricks, excavation of top soil from the agricultural fields will stop and does lot of good to the agricultural fields

Considering the above, the author reviews the following technologies suitable for construction of affordable houses, such that they are durable, strong and stable against the earthquake forces and list the advantages and disadvantages of each system along with its costing details

#### Precast

EPS Insulated

Monolithic Casting

Composite Structure

Light gauge Steel Structures

Referring to Precast, Various Options are Available, viz.,

1. Precast walls + Hollow core slabs
2. Precast walls + Precast Composite Slabs
3. Precast walls + Precast slabs

#### Precast Walls Could be Made of Using

1. the battery mould type unit for Mass Housing of units
2. Tilting type Tables and Stationery Fixed Table moulds could be used to construct units between 3 to 5 lakh units easily duly taking the required tables thereby, capex will be lesser. With Tilting type tables, walls and even precast slabs could be cast and thus is cost effective too
3. Pallet or corrousel system also used for Mass Construction  
Brief information about Precasting of walls using battery moulds, Tilting / Fixed tables and Pallet or corrousel system is presented herewith, viz.,

#### Battery Mould



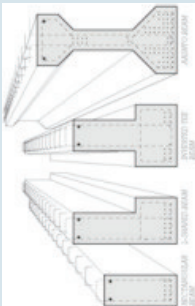


Battery moulds are designed for the vertical manufacture of single layer, large area reinforced precast elements of varying dimensions. They consist of bulkheads between which several concrete products can be simultaneously formed. The number of bulkheads determines the number of pouring bays – variably adjustable to suit the desired production capacity. The bulkhead groups are confined by the tensioning walls with integrated hydraulic clamping units. These walls clamp the entire group during production. Vibrators are fitted to the bulkheads to assure the effectiveness of the freshly poured concrete when compacted. Battery moulds can be supplied in customized sizes, number of pouring bays and as single or double battery moulds.



Tilting table

Tilting tables are designed for the manufacture of large area reinforced concrete elements, like walls and slabs. The surface of the steel plate is ultra flat and guarantees a high-quality concrete surface.

## Various Types of Technologies for Construction of EWS Mass Housing

Technology	Methodology	Merits	Demerits	Remarks
Monolithic shear wall construction using Aluminum shuttering	"The elements like walls, beams and slabs made of RCC are cast together at one go by using aluminum form work. Panels of 2' (0.6m) wide X 10' (3m), floor height are connected together with connectors.	Construction speeds can be achieved faster due to light weight of forms and less labor required for carrying the form work.  Quality of finish achieved is very good to receive painting directly without plaster.  "Formwork components are durable and can be used for 100 repetitions.  "5 to 7 days cycle is easily achieved in most of the constructions and construction for overall project is dramatically reduced.	"Initial investment on formwork is higher at the rate of Rs.10,000/sqm  About 50 repetitions are easy to achieve and there after maintenance is required to be done for correctness of shape such that another 50 repetitions could be completed.  No. of sets of formwork to be decided based on time of construction and the repetitions to be achieved.	
Insulated wall panel construction using shotcreting of concrete.	"System is conceived with insulated wall and roof panels of corrugated expanded polystyrene(EPS), which consists of zinc coated square mesh on either sides of it connected by a shear connectors	Light weight, seismic resistant, sound and thermal resistant.	Shotcreting means insitu work and needs to be closely monitored and inspected.	
Precast concrete	Prefabrication of structural concrete elements like beams, columns, walls, slabs and stairs under factory conditions and joining them together at site using dry and wet connections.	Production at factory conditions All weather working Better quality, finish and accuracy. Less labour, wastage, cost Faster cycle time Scalability and repeatability Offsite working - parallel working Standardisation - Design, engineering and execution.	Suitable for certain applications Cost and viability depends on volumns Logistics (production, handling and erection) because of urban infrastructure. Flexibility - Opening and cutouts Connection detail / method - Design integration. High equipment intensity Damage or breakage during handling / placement Tax?Duty structure - centralized facility	
Composite construction	Structural Steel columns and beams with Deck slab + Concrete or Insitu concrete with shuttering is a method of construction  Steel columns could be encased to get additional strength in addition to steel.	Very faster construction Concrete encasement makes the steel fire resistant and protects from corrosion/ durability	Cost is higher by about 20 to 30% compared to RCC type of construction Fire resistant paint to be applied to structural steel elements is very prohibitive	
Light gauge steel structures/Light gauge steel or cold formed steel construction	"Light weight cold formed steel sections for speedy low rise building construction.  External and internal walls are to be covered with plaster boards duly putting the rock wool in between them, which will give the thermal insulation.  These could be used in industrial townships, residential and commercial buildings, hospitals and schools etc.,  Gauge thickness from 0.7-2.0mm.	"Light weight, Seismic resistance, Thermal and acoustic insulation. With rock wool insulation inside, Air conditioning loads will be lesser.	Spacing of studs and joists will have an effect on internal and external planning of structure Plaster boards are required to be fire resistant and should be durable against the external environment, thereby, its cost is prohibitive compared to conventional systems	

## FOCUS: HOUSING FOR ALL

Details of costing of each system based on its production and area development

System	Delivery per annum		COST (Rs Cr)		Total cost (Rs cr)	Rate /sft(Rs.)		Remarks	Availability in India
	AREA (sft)	UNITS (No's) (350 sft plinth area)	Main cost (Rs Cr)	Infrastructure		Based on plinth area	Form work cost based on actual usage of walls and slabs area casting		
Tilting and fixed tables- of size 4mx12m. (7+3 no's) with accessories	3,00,000 (20 lakh sft of wall and slab area)	860	3	1	4	133/sft	20	A portal frame shed with sides open, gantry crane or Hydra, Truck for transport, storing &, Mini Batching plant	Indian Manufacturing exists and could be sourced locally
Battery Mould with 10 no. chambers with dual casting	5,00,000 sft of plinth area (33.50 lakh sft of wall and slab area)	1430	4	3	7	140 /sft	21	Steam curing is a must. Batching plant of 30 cum/hr is req	By tying up with factories from abroad, these could be easily manufactured in India. One company in India by name BIANCHI (Italian branch) is about to start its manufacturing in India
Pallet or carousel system with accessories (20 tables)	10,000sft (67 lakh sft includes walls and slabs)		5	5	10	100 /sft	15	Totally computerized system. Plotting on table is an option. Concrete from batching plant automatically on suspended rail system. Separate curing chamber. Batching plant of 30 cum/hr capacity required	These could be easily manufactured in India, with little transfer of technology of rail movement system from abroad
Hollow core slab with 8 beds of 120m long and two cassettes	Floor slabs casting. 148.75lakh sft in 5 years		9	8	17		11.5	Automatic system. Batching plant of size 30cum/hr is a necessity based on requirement. Heating system below the bed is a necessity	Except for the cassette system costing Rs 50.00 lakhs each, other things could be manufactured duly forming tie-up with manufacturer's from abroad
Hollow core slabs with two beds of 120m long and two cassettes	37.20 lakh sft in 5 years		3	3	6		16	Automatic system. Batching plant of size 30cum/hr is a necessity based on requirement. Heating system below the bed is a necessity	Except for the cassette system costing Rs 50.00 lakhs each, other things could be manufactured duly forming tie-up with manufacturers from abroad

Type of construction	Elements	Equipment	Costing of equipment	Remarks
Precast	Precast walls	Tilting and fixed Table moulds	Fixed table will cost Rs 12.00 lakhsapprox	Preferred option 1
	Precast slab	Mini Batching plant	Tilting table with hydraulic costs Rs 18.00 lakhs	Durability is good. Depending upon number of units to be built
	Insitu foundations		Hydraulic aggregate, form moulds, Magnets for fixing forms, etc.,	
Monolithic construction using Aluminum Formwork	Walls and slab cast together	Aluminum formwork	Rs 8000 per sqm as initial Investment and its cost comes down with greater repetitions	Preferred Option2, and also on par with Option 1
	For Wall thickness of 100/120mm, Self compacted concrete(SCC) is a necessity.	Mini Batching plant		Aluminum formwork is now available in India too. 50 to 100 repetitions is possible, depending upon handling
	Where SCC is not possible, to provide 150 thk wall with M25 concrete and needle vibrators			Durability is good, and structurally stable
Insulated wall technology				Preferred Option 3
	EPS panels with mesh on both sides and inter connected to be bought over from supplier	Shotcreting gun is a must and a necessity for effective shotcreting works	Rs 12 to Rs 14 lakhs for 1 no. shotcrete gun	Shotcreting of minimum 50mm thick on either side is a must. Reinforcement of 0.12 % - 0.4% - 1% vertical as per Design requirement, and 0.20% horizontal - Cover to reinforcement is to be maintained
				Durability depends upon cover to reinforcement and good shotcreting

