

# Affordable Housing Construction in Andhra Pradesh State – Monolithic Construction using Aluminum Formwork-Alternative Option of Precast Construction



**C A Prasad**  
Director, Metey Engineering & consultancy Pvt. Ltd.

Under the PMAY scheme, affordable housing scheme is being taken up by the state Govt's adopting the modern technologies of construction. Conventional construction is also continued by the state Govt's in the rural sector, as the contractors are not available for construction using the modern Technologies. One of the technologies being adopted by the State Govt. are Monolithic construction technology and is also called as shear wall technology. This paper presents the possibility of using the precast technology also for the affordable houses.

In the case of conventional construction, the bricks used for construction are of inferior quality. They are more porous and absorb water. Thereby, the wet wall condition is observed, and very soon, the structures look dilapidated and people are leaving the houses within no time, even though, they are given free of cost to the people, and are thus named as Ghost houses. The Govt. purpose of giving an affordable house for the Economically weaker section of the society is not served and money spent is not effective too.

Considering the above, the PMAY scheme envisages for adoption of Modern innovative and green Technologies and building materials for faster and quality construction of houses in place of conventional construction and emphasis is also laid on the durability aspect very much.

Considering the various technologies available, the Govt. of Andhra Pradesh has taken the initiative to demonstrate these technologies and they have built the individual houses through A.P.Housing Corporation, at Kethanakonda village, near Ibrahimpatnam, Vijayawada, such that the various contractors and Developers can have a glimpse of it, and adopt the new technologies into their construction. Some of them are left unfinished, such that the visitors can understand the Technology adopted. The photos of the buildings at Kethanakonda are as shown below. The author is the designer for those buildings built at Kethanakonda.



**Amongst the various technologies available, viz.,**

1. Monolithic construction using Aluminum Form work
2. Insulated wall construction
3. Composite construction
4. Precast construction

the Govt. of Andhra Pradesh has chosen and adopted the Monolithic construction using the Aluminium form work for all the houses taken up under the PMAY scheme.

By adopting to this, the existing contractors can switch over from their conventional construction to this new type of technology with a bit of ease

**Monolithic construction:**

Capex is involved in buying the Aluminium formwork. If the



number of repetitions achieved is more, then the cost put on it is retrieved, and contractors will be at ease for moving forward thus.

The Monolithic construction involves the construction of walls and slab together and it consists of RCC walls and slab, and no brick work is used in the construction.

The Aluminum formwork is light and easy to handle. 600mm wide panels is the standard width and height could be of any size which could be fabricated and the standard height for residential units being 2900/3000mm. Panels of lesser widths like 300mm, 200mm and 100mm for filling up gaps in walls are also available in standard formats and thus made construction easier.

The construction involves the M30 grade Self Compacted concrete and after deshuttering of formwork, it gives a smooth surface and does not require the plastering on top of it.

Being a concrete surface, it is impervious, and no cracks will develop in the walls. Water ingress into the wall is arrested, and thus, the walls are dry, and durability of wall and the structure is improved, and maintenance issues hardly arise. These buildings are more durable, have least maintenance and generations will live in it, instead of the inferior quality of buildings built earlier as per conventional type of construction

Some of the Unit plans adopted by them are as follows:

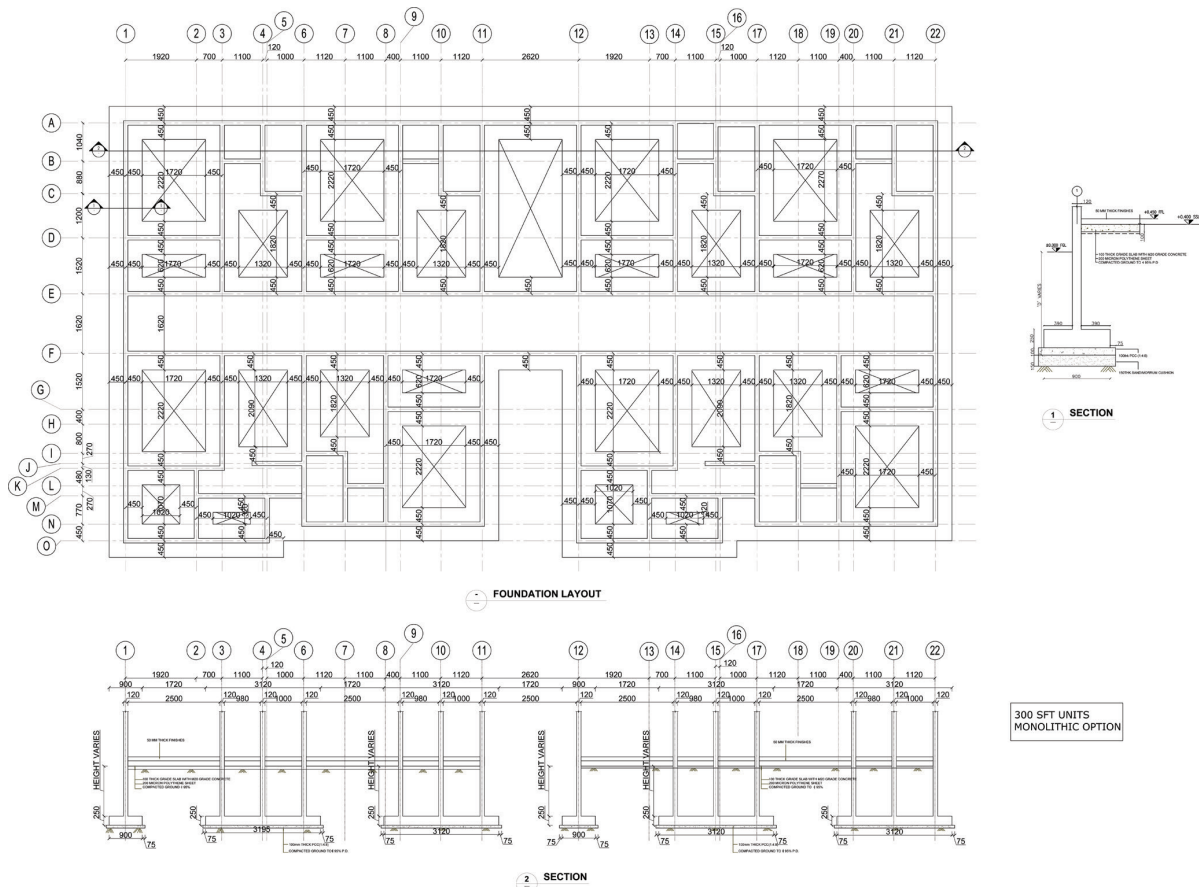
300-SFT unit plans – 1 BHK

365-SFT Unit plans- 1 BHK

430-SFT Unit plans – 2 BHK



Monolithic type construction using formwork





### Fire resistance:

The buildings are all four storeyed blocks. The Tender conditions stipulate that the buildings to be designed to resist One-hour Fire period. BDA for similar buildings in Bangalore have stipulated 1.5 hour fire resistance.

Corresponding to the 1.0 hour fire resistance, the IS 456:2000 code and NBC 2016 code stipulates the wall thicknesses and reinforcement percentages as follows:

The above table prescribes  $>1\%$  vertical reinforcement for 100mm thick walls, and  $0.4\% < P < 1\%$ , for 120mm thick walls

Horizontal reinforcement to walls is to be provided as 0.25% as per IS code 13920 :2016

Structurally, the 120mm thk wall demands only 0.25% vertical reinforcement, when designed for an Earth quake zone III condition. However, 0.4% vertical reinforcement is to be provided for the 120mm thk wall from Fire considerations and is provided. Horizontal reinforcement of 0.25% is to be provided in addition to the vertical reinforcement.

If 100mm thick wall is to be provided, then, 1% vertical reinforcement is to be provided from Fire considerations in addition to the 0.25% Horizontal reinforcement. Typical buildings under construction are shown in image 2.



Typical buildings using monolithic and formwork style construction

Fire Resistance h	Minimum beam width b	Rib width of slabs bw	Minimum thickness of floors D	Column Dimension (b or D)			Minimum wall thickness		
				Fully exposed	50% Exposed	One face exposed	P<0.4%	0.4%≤p≤1%	P>1%
	mm	mm	mm	mm	mm	mm	mm	mm	mm
0.5	200	125	75	150	125	100	150	100	100
1	200	125	95	200	160	120	150	120	100
1.5	200	125	110	250	200	140	175	140	100
2	200	125	125	300	200	160	-	160	100
3	240	150	150	400	300	200	-	200	150
4	280	175	170	450	350	240	-	240	180

### NOTES

1. These Minimum dimensions relate specifically to the covers given in the table 16A

2. p is the percentage of steel reinforcement.

Fig. 1 Minimum dimensions of reinforced concrete members for Fire resistance



This paper presents the possibility of using the precast Technology to the above plans and list the details herewith

## Precast:

The unit plans adopted for monolithic construction technology could be made to suit for the precast construction as per the details mentioned below:

Precast walls could be used for external walls and these are load bearing elements

Prestressed precast Hollow core slab could be used as Flooring units, and these could span for longer lengths and can support the Light weight partition walls over it.

Typical construction using the Precast walls and HCS will be as follows:

1. Cast In situ Foundation
2. Precast Walls from foundation level to plinth level, and thereafter, for each floor height
3. Prestressed Precast HCS as floor slabs plus structural topping
4. All internal walls could be constructed using light weight AAC blocks or Non load bearing hollowcore precast walls of 600mm in width as shown in image 3.



Image 3: Non-load bearing hollow core precast walls of 600mm width

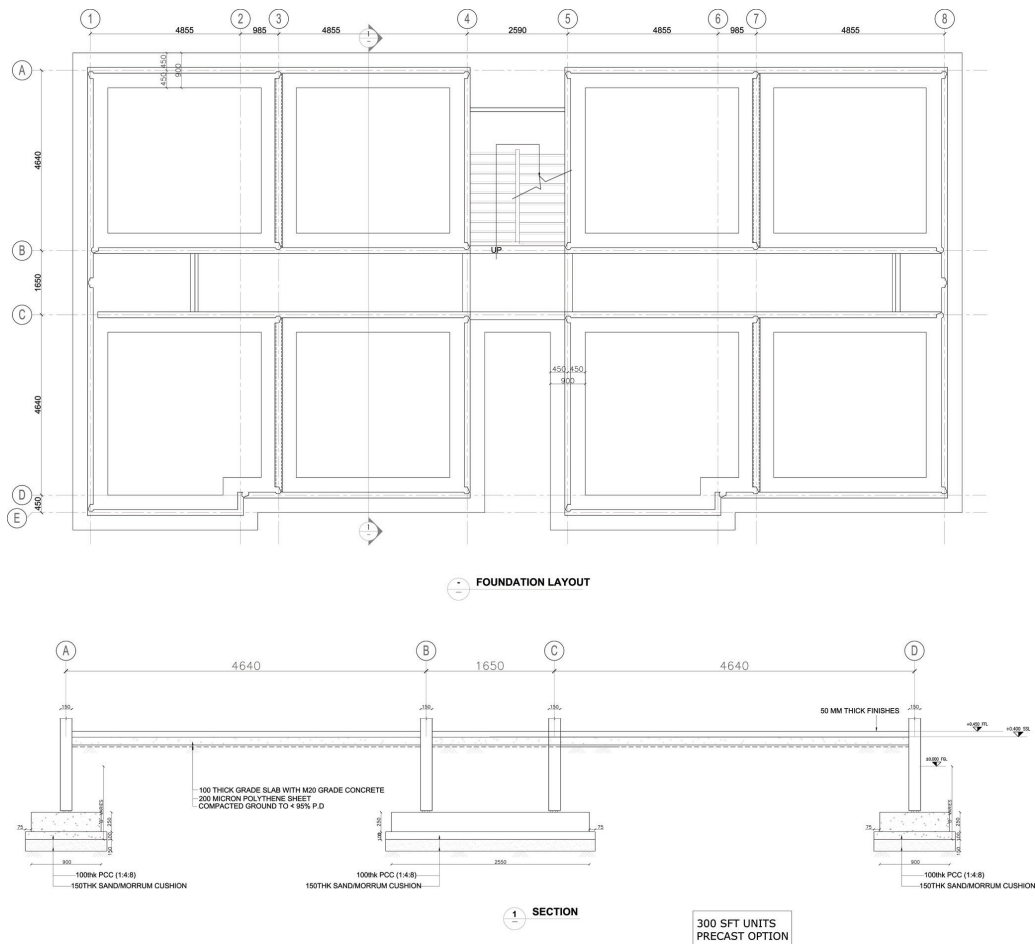
5. Precast stairs are easy to cast in a mould, and to lift and erect them



Image 4: Precast stairs erection and mould equipment

The drawing details for the precast construction are as indicated below,

300-SFT unit plans – 1 BHK / 365-SFT Unit plans- 1 BHK / 430-SFT Unit plans – 2 BHK





## PRECAST CONSTRUCTION

The precast wall thicknesses are kept as 150mm, such that they carry the loads and the HCS slabs will have sufficient bearing width to rest

### Manufacturing:

#### 1.Fixed / Tilting tables:

These can be used for manufacturing of Precast walls at the site itself. Depending on the number of walls to be cast, Prefabricated Tables of size 8m x 4m or 12m x 4m could be ordered. Bianchi from Mumbai and Elematic from Rajasthan are supplying the Prefabricated tables of any size to order. They will range between ₹ 15 lakhs to ₹ 25 lakhs depending on the size and type of table as Fixed table or Tilting Table along with the vibrators fixed underneath the tables as seen in image 5.



Image 5: Fixed/Tilting table with vibrators fixed underneath for manufacturing of precast walls at site

#### 2) Prestressed Precast Hollow core slabs:

Prestressed wires along with concrete grade strength of M45 and above is used. The strength of Precast Hollow core slabs is high and can easily support the non-load bearing walls

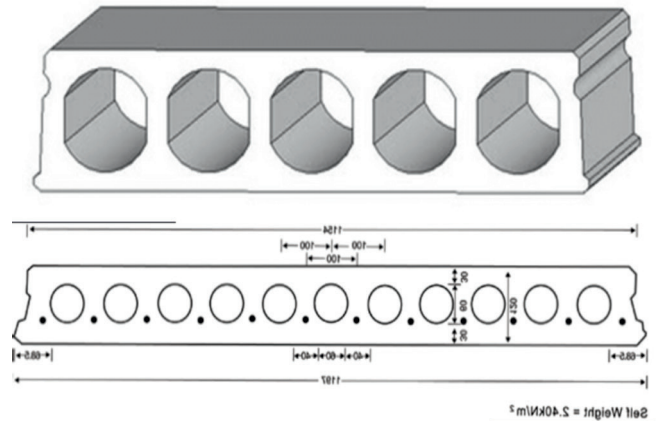


Image 6: Prestressed precast hollow core slabs manufactured off-site

These are manufactured in a precast company and they could be sourced from the precast manufacturers at a price. Precast products are available from sources like Inventaa (Hyderabad, Keesara(Vijayawada), PRECA and PSV precast in Hyderabad, Kanera (Bangalore), Precast India (Pune), VME Precast (Chennai), Teemage (Coimbatore and Nlagonda), Supercast (Noida), etc.,

3) If precast Industry is not in the near by area, then Precast RCC slabs could be done using the Tables. Details of them are as shown below:

#### Advantages of going for precast construction:

All internal walls could be non-load bearing walls and they could be constructed of the following, viz.,

AAC BLOCKS with 2 to 3mm paste as glue to bond the blocks  
PRECAST HOLLOWCORE Light weight WALL PANELS

The above products being light in weight, can be loaded on the floor slabs and they can take the loads and they are of drywall construction.

Being Internal walls, Putty can be applied on top of them, and paint application can be done, thus saving on plastering and curing.

For precast slabs of Prestressed precast HCS or precast RCC slabs, plastering to the ceiling need not be carried out, as they are already Table / bed mould surfaces, and smooth enough. Thereby, plastering and curing to ceilings is not necessary. Of course, ceilings of Monolithic wall construction type is also similar and need not require plastering. Painting to them is a direct application.

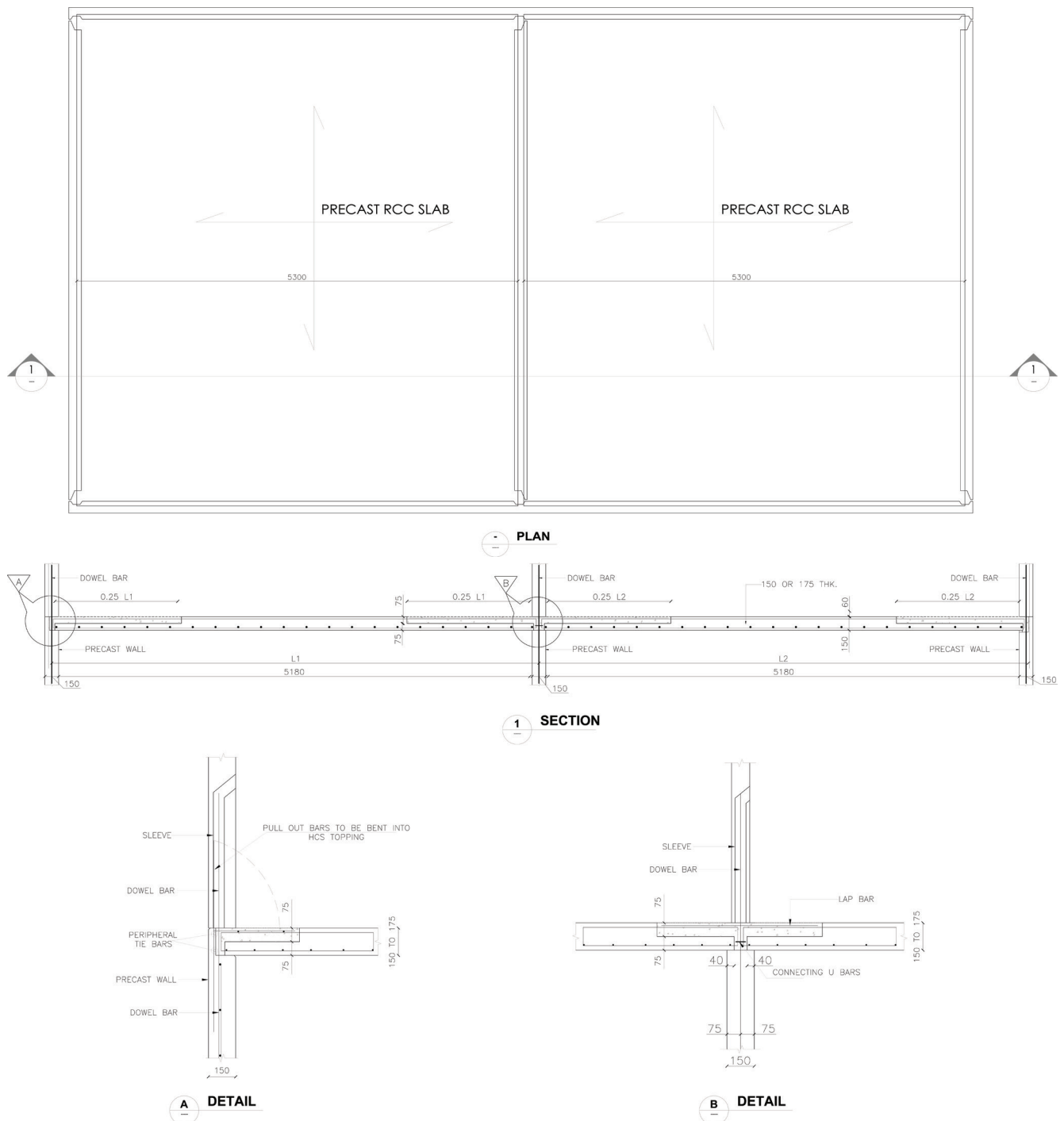
Foundations are provided only to the external/peripheral load bearing walls only unlike the foundation for all walls in Monolithic construction, thus saving in foundation quantities

Quality control is controlled at one location, i.e at site batching plant itself

The wall panel could be lifted out from the table, the next day by using High strength concrete, quick setting and early strength gain admixtures

Wall panel could be cured for the next four days, and then erected on the site





#### Construction Process:

1. Foundations to be cast insitu
2. Walls to be precast on Tables
3. Erection of Precast walls on to the foundation and grout the dowels/sleeves
4. Fill soil up to plinth level and compact
5. Cast grade slab
6. Erect GF walls and grout the Dowels/sleeves
7. Precast the wall junctions
8. Erect the Precast HCS
9. Place the topping reinforcement and concrete it
10. Steps 6 to 9 to be continued for typical floors
11. Internal walls can be built simultaneously as each of the floor slabs are erected and completed
12. Interior works and MEP



### Cycle period:

Foundation and work up to plinth levels, will take one-month time to complete. Thereafter, one-week cycle per each floor of structural work is easily achievable

By adopting to the Precast work, the work will be less labour oriented, which is another major advantage

No form work to the slabs is required

### Machinery requirement:

For a four story blocks as shown in the drawings, a 20 MT Mobile crane will suffice for the work for lifting of panels and HCS units, in addition to the Hydra requirement for initial usages for lifting wall panels up to the GF.

A movable Tower Crane on rails will also be good, based on the quantum of work and position of units in a row to be studied as an alternative

For keeping the walls in stable position till they are grouted and hardened, adjustable jacks will be required to fix to the wall panels

### Conclusion:

Precast to the affordable houses could be adopted with ease,

and it will result in faster construction, and they are durable too. It will be cost effective too, and on par with the Monolithic construction

In the cities and urban areas, number of precast companies have come up, and developers/ contractors can make use of them in taking the products from them and build the houses with speed. In the rural areas too, Precast can be taken up, as per the details mentioned above.

In the case of precast construction, Labour is required for cast insitu works of foundation, Grade slab and structural topping in the floors, and thus less dependence on labour, and construction delays will not be there on account of shortage of labour in the market

Investment on form work will be on the Tables only, and it is very minimal investment unlike the investment on Aluminum formwork which will be high.

The author recommends for Precast construction technology for the affordable housing units taken up under the PMAY scheme

It can also be used for the residential unit buildings of S + 5 units built by the developers in the cities and for those too, the external wall only could be load bearing type and all the internal walls could be light weight partition walls. Prestressed precast HCS could be used as floor slabs and details would be given in the next article ■