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Low Cost Housing

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ABSTRACT
The majority of rural population migrates to the urban areas seeking a job and higher income for their survival. This creates a huge demand for housing and infrastructure in the urban areas. This is a phase where low cost housing comes into action. There is an urgent need to access to alternative building materials and techniques that are both affordable and sustainable. A literature review method was adopted in this article to investigate the economic benefit of low cost housing compared to conventional brick and concrete construction.

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I. INTRODUCTION

Low cost housing is regarded as affordable for low and middle income earners. It can be achieved by higher efficiencies of workers and by minimizing the cost asthetic of the building.

Time and cost are two main concerns with increase importance of cost reduction techniques. There is a myth in minds of many people, they think that whenever construction is done with low cost the materials used will always be a low-grade quality. Low cost construction has much to do with proper budgeting and look for reducing construction cost through proper management, right use of local materials, skills and technology without surrendering the strength and life of the structure

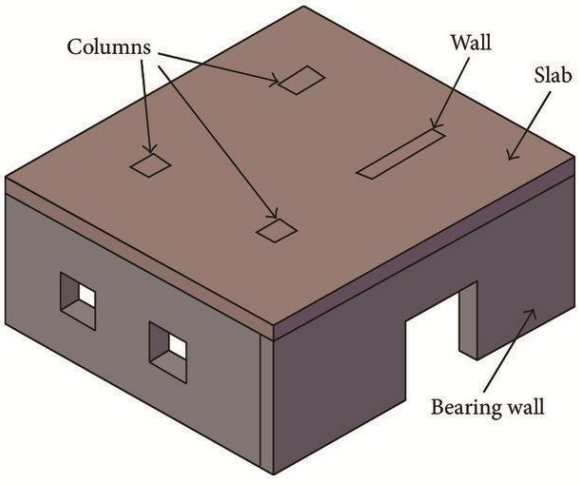
OBJECTIVES:

- Reduction of construction cost
- Make suitable plans and estimations to identify the best
- Make a residential drawing plan
- Take the estimate for ordinary and cost efficient hosuing and compare both

TECHNIQUES

1)LOAD BEARING STRUCTURE : Load bearing structure is one in which a brick masonary wall is the major structural element in the foundation as well as in the building framework. All the above load is carried by a wall and also transfer to the ground through the foundation which is also made up of brick masonary . There is no framework of column, beam and foundation which is made from concrete.

When we layout our plans for construction we should always concentrate primarily on the structure we are going to use . It should preferably be load bearing structure instead of using frame structure



2) MATERIAL MANAGEMENT : To manage productivity and cost efficiency material management is essential. It contributes the major portion of expenses in construction
Study of low cost construction materials from projects under construction and recently completed
Finding new construction techniques to implement them in construction of building
3)INTERLOCKING MUD BRICKS: Interlocking bricks are the enhanced form of conventional clay bricks. Each brick is constructively designed to lock itself to the other bricks around without the use of mortar. The self-locking is achieved using shear-key and lock mechanism. Based on the design, the shape of shear-key will vary and a complimentary lock is provided on the opposite side of brick. Load transfer is achieved by shear transfer and gravity
High quality interlocking bricks are made of cement, sand and Stone dust mixed together in appropriate proportions. The required materials are batched and mixed proportionately. Once the required mix is prepared, it is then compressed to form bricks with desirable interlocking patterns. The compression is achieved by using hydraulic compression system. The bricks are then subjected to curing for about **7 days**.


Benefits of Inter-locking Bricks

Earthquake resistant

During earthquakes, there are various stresses acting on the structure. Conventional bricks are not fully equipped to transfer the seismic loads throughout the structure since the only medium of load transfer is the mortar. If the mortar fails then the whole structure fails under seismic forces. Interlocking bricks are an effective and proven Seismic resistant construction materials. The self locking pattern of the bricks enables the seismic forces to travel across the whole structure equivalently.

Plastering can be time consuming and costly in case of conventional wall construction. Plastering of walls can be completely eliminated by using fair faced bricks of your choice available in the market. If required the walls can be given a smooth finish by applying a thin layer of paint. Since these bricks are self-designed that gives a neat finish, the maintenance cost is minimized.
No Plasterwork required.

Provides cooler interior

High compacted bricks generally result in higher density, which in turn converts itself into high thermal mass. Henceforth, the walls made of high compacted bricks typically furnish warm interiors. Interlocking bricks are less heat intensive. The tests have shown that interlocking bricks provides a much cooler interior ($3^oC - 5^oC$). This enables lesser/no use of air conditioners resulting in minimized energy consumption and more cost saving.
cool.

Unskilled labour

In case of Conventional brick laying, skilled labour is required for checking water level, spirit level and various other operations. Therefore a layman or an unskilled labour may find it difficult to learn the conventional methods of construction. Whereas interlocking bricks construction enables an unskilled labour to easily follow up on the construction procedure. It also provides various opportunities for an entrepreneur.

Minimizes cost

Since there is no use of mortar in the construction process, the cost of buying cement, sand, mortar and stone dust can be neglected. Also the cost for transportation can also be immensely reduced along with the cost on skilled labour. It does not require plasterwork, minor bar bending work, lesser cement and fewer labourers hence contributing to the overall cost reduction of the construction project.

Time Efficient

It is proved as the most time efficient way of construction. The normal conventional bricks has to be cured for about 21 days whereas the self-locking bricks require only 7 days of curing. In addition to that, time required for setting and curing of the structure can be diminished completely. By eliminating all the time consuming tasks, the project can be completed faster.

Disadvantages of Inter-locking Masonry

There are a few disadvantages as well to this method of construction. Since there is no plasterwork provided, rain water might into the lines making it a hostage for insects and other undesired things. Due to the action of weather, disintegration of the bricks might also occur (especially in the corners). The colour of the brick changes if the rain water enters through the gaps.

As the interlocking bricks alone are not enough to hold all the forces acting on the structure, it is not advised for building having more than two storeys.

Compression test of Interlocking Blocks

Sl.No	**Load(N)**	**Area(mm^2)**	**Compressive Strength(N/mm^2)**
1	147150	22000	6.69
2	161865	22660	7.14
3	137340	22440	6.12

Water Absorption test of Interlocking Blocks

Sl.No	Dry weight of interlocking block	Wet weight of Interlocking block	Water absorption (%) by mass
	M1(gm)	M2(gm)	[(M2-M1)/M1]x100
1	12110	12950	6.93
2	12234	13100	7.07
3	12902	13920	7.89

Average Water Absorption	**=7.29%**

4)STAIRCASE FOR LOW COST HOUSING : We have been using the cast-in-situ construction. But it is more expensive. Alternatively we can use an effective and efficient method which is called Precast staircase system

-Its construction is cheap and quick

-It can be simply supported and can be supported with a cantilever

5)DOORS AND WINDOWS : We can make sure that we do not spend so much on the doors and windows and just look for the maximum durability of a design which is provided to you at less cost. instead of following the conventional carpenting procedures we should always go by the frames for doors. These save cost up to 30% and saves time

6) RCC FILLER SLAB : It is basically a normal RCC slab where concrete in the tension zone i.e the bottom of the slab ,is replaced by light weighed filler materials such as bricks and tiles . These filler materials do not compromise with the strength of the structure

- Consumes less steel and concrete due to reduced weight of the slab achieved by replacing the portion of concrete by light weight materials

-Reduces the entry of heat into the building through the roof due to heat resistant properties of the filler materials

- Cost saving of about 23% in comparision with normal RCC slab

5.6 DESIGN OF FILLER SLAB

Length =7.92m
Breadth =9.14m
The beam is simply supported on four edges with corners are free to lift
Span ⁄depth =25
For two way slab span/depth =35
For Fe415 steel multiply by 0.8
For shorter span and live load less than 3 span/depth = 0.8 x 35
We have live load =4 KN/m^3
Span/depth =28
Depth (d) =7920/28
Effective depth = 280mm
Assume a 14 mm cover
Then total depth D = 86 + 20 + 10/2= 305mm
Effective span,
l_x=clear span + effective depth
=7.92 + 0.305 = 8.23 m
L_y= clear span + effective depth
=9.14 + 0.305 = 9.45m

5.6.1 Load

Self weight = 19 x 1 x 0.305= 5.795 KN/m
Live load = 4 x 1 = 4 KN/m

Total load W = 9.8 KN/m
Factored load =9.8 x 1.5 = 14.69 KN/m

5.6.2 Ultimate Moment and Shear Force

Since it is a two-way slab, the Bending moment is developed in both X and Y direction
ly / lx = 1.3
Co efficient in x direction α_x = 0.074
Co efficient in y direction α_y = 0.061
Factored moment in x direction Mux
= $\alpha_x w l_x^2$
= 0.074 × 14.69 × 7.92^2
= 68.19 KN/m
Factored moment t in y direction Muy
= α_yWu l_x^2
= 0.061 x 14.69 x 7.92^2
=56.21 KN/m

5.6.3 Reinforcement [short span direction]

Mux=0.87 f_yAst d {1- (Astf_y/ bdf_{ck})}
Ast = 712 mm^2
Using 8 mm diameter bars
Spacing = (2 x 1000 x π/4 x 8^2)/Ast
=110 mm

5.6.4 Check

3d = 300mm
Spacing < 300 mm
Provide 8 mm bars at 110 mm center to center in short span direction

5.6.5 Reinforcement in Long Span Direction

Effective depth = 100 -8 = 92 mm
Using 8 mm diameter bar
Ast = 604 mm^2
Spacing = (2 x1000 x π/4 x 8^2) / Ast
=556mm
Provide 8 mm diameter bar at 140 mm center to centre

5.6.7 Check for Shear

Shear strength of concrete
τ_c =0.22 N/mm^2
Neutral axis depth factor
k = 1
$k\tau_c$ =1 x 0.22 =0.22
V_u = $W_u$lx/2 = 14.69x7.92/2 = 58.17 kN
τ_v = V_u/bd = 58.17x10^3/ 1000x280=0.20N/mm^2
pt = 100Ast/bd = 100x712/1000 x 280 = 0.25% and M20

$\tau_v < k\tau_c$

Hence, shear design is not required and slab is safe against shear.

5.6.8 Check for Deflection

$(l/d)_{actual}$ = 28.29
Fs = 0.58xfyxAst$_{req}$ / Ast$_{prov}$
=0.58x415x1
= 240.7 N/mm^2
pt = 100Ast/bd = 100x712/1000 x 280 = 0.25% and M20
MF_1 = 1.3
MF_2 = 1
MF_3 =1
MF_1 X MF_2 X MF_3 X 25 = 32.5

$(l/d)_{allowable}$ = 32.5
$(l/d)_{actual} < (l/d)_{allowable}$

Hence deflection control is satisfactory.

COST ESTIMATE OF COST EFFECTIVE BUILDING 112 SQUARE METER LAND

Sl. No.	PARTICULARS	QUANTITY	UNIT	RATES	AMOUNT (Rs)
1	**Ground Floor**				
1.1	Site clearance tree cutting and yard filling with Anti-termite treatment				15000
1.2	Earth work excavation in ordinary Soil for foundation	18.04	1 m^3	353.35	6374.434
1.3	PCC 1:4:8 using 40mm for foundation	12	1 m^3	5477	65724
1.4	RR masonry in CM 1:8 for foundation	12	1 m^3	4700	56400
1.5	SSM masonry in CM 1:8 for basement	35	1 m^3	25000	875000
1.6	Providing and laying cement concrete M20 (1:1.5:3) using 20 mm down size Granite jelly for RCC belt laid in thick And well compacted by vibrating and Curing Including all cost and labour charges	12	1 m^3	3200	38400
1.7	Supplying and filling of earth inside basement including consolidation by ramming including all cost and labour charges	22	1 m^3	700	15400
2	**SuperStructure**				0
2.1	Brick masonry using Interlocking bricks for super structure for **outside walls** including centering, centering, scaffolding , Curing ,material and labour charges etc complete	37	m^3	600	22200
2.2	Brick masonry using Interlocking bricks for super structure for **inside walls** including centering, centering, scaffolding , Curing ,material and labour charges etc complete	6	1 m^3	500	3000
3	**Wood work doors and windows**				0
3.1	Supplying and fixing of country woods with fully paneled shutters including all cost and labour charges etc complete	9	1 m^2	700	6300
3.2	Supplying and fixing of PVC doors with fully paneled shuttering including all cost and labour charges etc complete	1.8	1m2	450	810
4	**Windows and ventilations**				0
4.1	Supplying and fixing steel window and ventilators including material and labour cost etc complete	17	Number	4800	81600
5	**RCC concrete**				
5.1	Providing and laying cement concreteM15 (1:2:4) using 20mm and downsize Granite jelly for RCC beamlaid in layers and well compacted by vibrating curing including necessary steel and or plywood or plank centeringand form work etc (exclusive of the cost of steel and fabrication charges) with all Lead and lift as directed by the Engineer –in-charge. lintel	9.42	m^3	3700	34854
5.2	Providing and laying cement concrete M15 (1:2:4) using 20mm and down size Granite jelly for filler slab laid in layers and well compacted by vibrating curing including necessary steel and or plywood or plank centering	10.92	m^3	3700	40404
5.3	Proving and fabricating for steel reinforcement 1ncluding all straightening cutting bending hooking lapping placing in position tying with binding wire of approved quality and gauge including all cost of binding wire and anchoring to the adjoining member where ever necessary etc including all laps and wastage etc complete as per design and specification and direction with all lead and lift	65	1kg	90	5850
6	Plastering in CM 1:3 ,12 mm thick under roof slab sunshade bottom of beam etc floated hard and trowelled smooth including watering curing provision of grooves and scaffolding to any height cost and conveyance of all material and labour charges for scaffolding etc complete	20.42	1 m^2	451	9209.42
7	**For inside walls**				0

7.1	Inside pointing for inner wall including watering curing cost and conveyance of all material and labour charges etc complete	175	1 m²	65	11375
8	**Outer wall**				0
8.1	Outside pointing for outer wall including watering curing cost and conveyance of all material and labour charges etc complete	170	1 m²	65	11050
9	**Floor finishing**				0
9.1	Floor finishing with red oxide including all cost and labour charge etc complete	97	m²	240	23280
9.2	Floor finishing with ceramic tiles including all cost and labour charge etc complete				
9.2.1	flooring	9	m²	380	3420
9.4	Supplying and providing ceramic slab black colour 20 mm (60 cm wide) for kitchen slab including material and labour charge for laying polishing and providing edge with round nosing etc complete	7.3	m²	370	2701
10	**Painting and white washing**				0
10.1	White washing to the inner side of the wall and ceiling using white cement including all cost and labour charges etc complete	463	1 m²	250	115750
10.2	Colour washing to the inner side of the wall using distember including all cost and labour charges etc complete (if)	346	1 m²	180	62280
10.3	Enamel painting in doors windows including all cost and labour charges etc complete	26	m²	280	7280
	TOTAL				1513661.854
11	Electrification including all cost and labour charges etc complete			10%	151366.1854
12	Water supplying and sanitary fitting including all cost and labour charges etc complete			9%	136229.5669
13	Water proofing				20000
				Total	1821257.606

ADVANTAGES • Less use of cement and steel for any given section compared with rcc with a corresponding reduction in self weight.

- A major cutting in cost expenses in cost expenses compared to rcc.
- An easy manufacturing process requiring only semi skilled labour

. • The technique & cheaper installation practice compared to rcc.

- The technique requires neither scaffolding, a shuttering, a concrete mixer nor a vibrator.
- They have a high degree of permeability& resistance to cracking.
- They require minimal maintenance.
- They are economical compared to components built with steel, concrete, or brick walls.

DISADVANTAGES • The need of a casting & working area to prefabricated the element & cure them. This may be hard or expensive especially in an urban setting.

- The need for a control for ensuring quality products.
- The need for a proper applied curing method usually overlooked in any building construction activities.
- If the element are not manufactured on the site they will have to be carried which may add to the cost. Care should be taken not to damage the elements during transportation.

II. CONCLUSION

Adoption of any alternative technology on large scale needs a guaranteed market to function and this cannot be established unless a product is effective and economical

The key lies in the systematic approach in building technology or methodology and not necessarily particular construction type or design

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