



To examine and compare filler slab technique and rat trap bond as an alternative low-cost construction technology

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ABSTRACT

India is a developing country with only 20% of the highest paid group. Affordable housing can be considered affordable for a low- or middle-income person if the family can get a unit of housing for up to 30% of the family income. The low-income group of developing countries often do not have access to the housing market. Affordable housing is a related and closely related budget and seeks to reduce construction costs through better management, efficient use of local resources, skills and technologies without sacrificing the energy and health of the building. The "Rat Trap Mouse and Filler Slab" approach can be applied to a housing project to achieve cost effectiveness and structural stability without compromising the strength and durability of the system. In this project we work on Rat Trap Bond and Filler Slab Concept for alternative low-cost construction material. It was analyzed in this case study of Ajni in Nagpur district of Maharashtra.

Keywords:-Filler Slab Method, Rat Trap Bond, Brick Masonry, Low Cost Construction Technology

1. INTRODUCTION

Over the last five, or so decades, developing countries in particular have experienced phenomenal growth of urban areas partly due to policies that have tended to favor urbanization as an engine of rapid development. However, this trend has had worsening urban housing conditions and in particular, the sprawl of informal settlements and slums is the single-most manifestation of the urbanization phenomenon that has brought about human misery, poverty, insecurity and failures of

National policies, administration and economies (UN Habitat: 2008). Green building has taken off in recent year with many builders and new home owners looking for new and different methods of construction that can potentially offset energy cost. Construction of low cost housing by using the low cost building materials increases the access to buildings by low income group peoples. Low cost housing can be achieved by use of efficient planning and project management, low cost materials, economical construction technologies and use

of alternate construction methods available. The profit gained from use of such methods can decrease the cost of construction and make the low cost housing accessible to all. The use of low cost alternate building materials also prevents the rise of construction cost due to use of scarce building materials which eventually increase the cost of the project. Some alternative building material can be made out of natural materials, while others can help to lower energy costs of the occupant once built. Regardless of what the goal of the builder is, alternative building material and their use is on the rise. The need of alternative building technologies and materials has arisen in the past few years. Fortunately, there are many such options available at our disposal which when used in suitable combinations can save huge amounts of money and hence can result in affordable construction costs. One such building technique is the use of 'Rat-Trap Bond' masonry and Filler Slab method.

2. LITERATURE REVIEW

[1] **Application of RCC Filler slab Floors and Roofs (Dr BALASUBRAMANI N1 , Ar. VEDHAJANANI B2 , Dr PERUMALK3 , RAMAN P4)2017:** The RCC filler slabs are no longer inferior to conventional RCC slabs. RCC filler slab floors & roofs are very much feasible for vertical expansion of further floors above. They are also a boon for preservation of open land. The slabs consume lesser materials and they give room for air pockets within their cross section. Hence, apart from being economical, they are energy efficient and eco-friendly. The RCC filler slabs conserve natural resources at the same time.

[2] **RAT TRAP BOND MASONRY(Aditya Joshi1 , Krunal Rakholiya2 , Jay Rangani3 , Harshal Gangode4 , Mateen Khan5 , M. V. Rao6 , Gaurav Ahire7 , Kalyani Sarode8)2017:**Housing is the basic need and right of all human beings. During our ages, due to tremendous rise in property market rates, the dream of common middle class and lower income group people remains a dream, as the reality of nonaffordability is bitterly painful. Many efforts at governmental levels have failed to alleviate the problems of the common people's housing shortage which continues to grow at an alarming rate. The shortage we see today is not about housing itself, it's actually about 'Affordable Housing' Fortunately

enough, the solution to affordable housing shortage (especially urban) is within our reach. We cannot control the hikes in the land rates, but Endeavour to minimize the costs of construction by switching to some simple, cost-effective building materials and technologies. One such solution is the use of Rat-Trap Bond Masonry Technique. It's simple, and easy to construct and effects into an overall savings of about 23 % in the costs in comparison to conventional brick work, while also reducing its impact on the environment by achieving a huge saving in the embodied energy consumption.

[3] **Comparison of performance of rat trap brick bond with the conventional brick bond.(Zeeshanullah, Abdullah Khan)2018:**From study of different research paper, it has been found that Cavity produces thermal comfort. Its R-Value is 0.70 m²K/W which is twice in comparison with English & Flemish bond. The air cavity can be filled with some other insulating material to achieve even more thermal resistance. For analyzing the house for its cooling and heating load use the Ecotect software. This is an efficient way of analyzing which is provided with the ease of selection of weather data for which building is analyzed. There are number of options of materials that can be applied on building .The Rat Trap bond is not only good to save the electricity consumption but also very good in the thermal load reduction. The below figure shows the clear difference between the thermal loading of both types of brick bonds.

[4] **Sustainable Low-Cost Housing using Cost Effective Construction Technology "Rat Trap Bond Masonry" and "Filler Roof Slab" in Bihar(Subha Sinha1*, Shivangi Mishra2 , Pallav Kumar3 , ShashankSaurabh):** A filler slab roofing system is used which based on the principle that for roofs which are simply supported, the upper part of the slab is subjected to compressive forces and the lower part of the slab experience tensile forces. Concrete is very good in withstanding compressive forces and steel bears the load due to tensile forces. Thus, the low tensile region of the slab doesn't need any concrete except for holding steel reinforcement together. It has been observed that adoption of filler slab in place of conventional RC slab, the saving of about 17 to 26 percent in total cost results. In addition, the saving of 16 to 33 percent in cement and about 45 percent in steel. Rat trap bond technology has been used in this case study. It is an alternative brick

bonding system for English and Flemish Bond. The reduced number of joints can reduce mortar consumption. No plastering of the outside face is required and the wall usually is quite aesthetically pleasing and airgaps created within the wall help making the house thermally comfortable. In summer, the temperature inside the house is usually at least 5 degrees lower than the outside ambient temperature and vice versa in winter.

[5] Low Cost Housing By Using GFRG Panels (Sk. Subhan Alisha) (2016): Experts forecast that a building made of GFRG panels can have a life span of 60 years. The foundation cost comes about 10-15% of the total building. It is suggested to adopt arch foundation in ordinary soil for effecting construction cost up to 40%. The conventional R.C.C. lintels which are costly can be replaced by brick arches for small spans and saves construction cost up to 30-40%.

[6] Rapid Affordable Mass Housing Using Glass Fibre Reinforced Gypsum (GFRG) Panels (Devdas Menon) (2014): In order to express this technology, a two storey GFRG demo building was built inside the IIT Madras campus. This building, constructed within a span of 30 days housing a total area of 1981 sq. ft., has 4 flats, two having carpet area of 269 sq. ft. meant for EWS (economically weak section), and the other two with 497 sq. ft. carpet area each meant for LIG. The saving in cost was almost 35% when compared to conventional construction.

[7] Cost Model For Using Glass Fibre Reinforced System (GFRG) (Mohammad Said Meselhyel Saed) (2016): In this paper author study about GFRG system and design low cost model to analyse direct cost for the system during the design phase. The market price for this system is divided into two main components; cost and mark up. The mark up aspect is divided into contingency, which is mainly related to risk analysis and differs with respect to site, owner and project. The other aspect is profit margin, which depends upon market status and feasibility study for project.

[8] Development Of Building System Using Glass Fiber Reinforced Gypsum (GFRG) (A. Meher Prasad) (2013):

Focused on new building panel product, made of gypsum plaster reinforced with glass fiber. It is also known as rapid wall in the industry. GFRG is of particular relevance to India, where there is a

tremendous need for cost effective mass scale affordable housing, and where gypsum is abundantly available as an industrial by product waste. The product is not only eco-friendly or green, but also resistant to water and fire. The panel contains cavities that may be filled with concrete and reinforced with steel bars to impart additional strength and provide ductility.

[9] International Journal Of Humanities And Social Science Invention vol.5, Issue 11 november 2016 (Lokesh M. N & Dr. Mahesha M)

Development of infrastructure is imperative for agriculture and overall economic growth and improving quality of life. Rural road connectivity is one of the key component for rural development has its promotes access to economic and social services, generating increased agricultural income and productive employment.

[10] Alternative Low Cost Construction Materials & Techniques

Sudesh Bharsakhale (2020), This paper deals with Affordability is measured in terms of disposable income, In the context of housing, affordability means the financial capacity of an individual to buy or rent a house. In 2008, the High Level Task Force on Affordable Housing for All, setup by the Government of India, defined affordability as a measure of household gross annual income and the size of a housing unit. In this project we work on Rat Trap Bond and Filler Slab Concept for alternative low cost construction material. The need of alternative building technologies and materials has arisen in the past few years. Fortunately, there are many such options available at our disposal which when used in suitable combinations can save huge amounts of money and hence can result in affordable construction costs. Filler slab technology is a simple and a very innovative technology for a slab construction. The reason why, concrete and steel are used together to construct RCC slab, is in their individual properties as separate building materials and their individual limitation. Concrete is good in taking compression and steel is good in tension. Thus RCC slab is a product which resists both compressions as well as tensile. One such building technique is the use of RAT TRAP BOND' masonry. Contrary to other technologies, this amazing building technology is not new to us. RTB was first introduced in India in 1970, by renowned Architect Sir Laurie Baker. Since then, it has been used

in many Government buildings and small village panchayats. In this modern age, we have overlooked this extremely useful technology which, while providing the same strength to the walls also saves us time and labor and also material cost to the extent of about 23% when compared with a standard 230mm brick masonry wall. In this project we have outlined the importance of RTB technology along with the construction details and also provided some comparative calculations to highlight the savings that can be achieved against the conventional solid brickwork.

3. PROPOSEED METHODOLOGY

1. Construction of rat trap bond :-

- The bricks are placed in a vertical position so that 110 mm face is seen from front elevation,



2. Construction of filler slab :-Once the shuttering is done, the reinforcements are laid in grid form. The size of grid depends on structural design and size of filler material. For example, grid of 35cm X 50cm is used for magalore tile as filler material and grid of 45cm X 45cm is used for clay pots of 40cm diameter filler. The filler material to be soaked in water before casting so that it does not absorb water from concrete. Then the slab is cast with cement concrete similar to traditional concrete slabs.



- instead of the 75mm face (considering brick of standard size 230 X 110 X 75 mm).
- As the width of the wall is kept as 230mm, a cavity is created inside the wall.
- However, the first and the last layer of the masonry is constructed as the convention sold masonry.
- In the sill, lintel and sides of openings are made of solid masonry (without cavity) for fixing of frames.
- To strengthen the masonry, vertical and horizontal reinforcement bars are provided in the cavities.
- Electrical conduits and plumbing pipes, with prior planning, can be put inside the cavity for better aesthetics

5. RESULTS AND DISCUSSION

1. Developed Plan :-

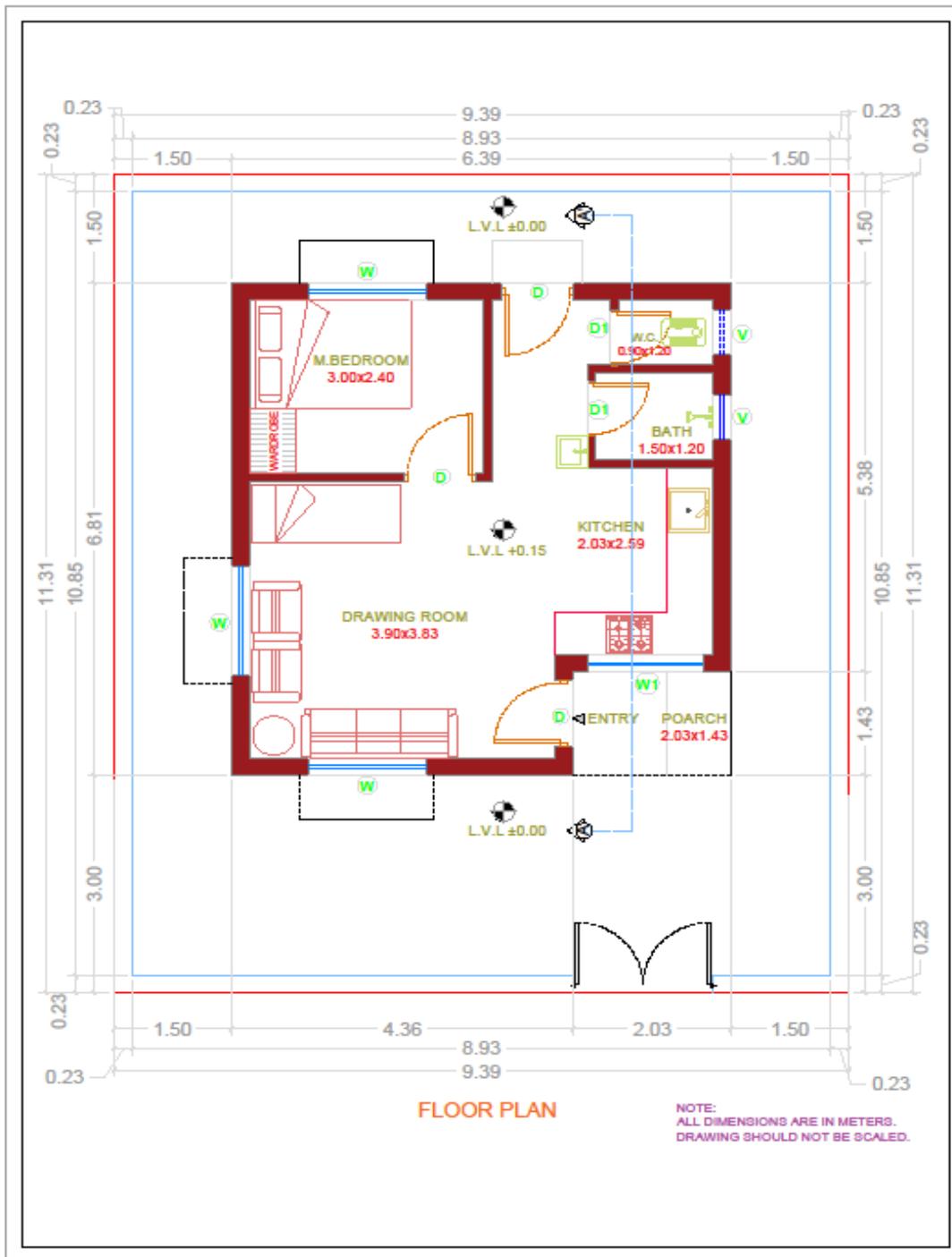


Figure.1-developed plan

SCHEDULE OF OPENINGS				
OPENING	SIZE	SILL L.V.L	LINTEL L.V.L	DISC.
D	0.9X2.1	0.00	2.10	FLUSH DR.
D1	0.75X2.1	0.00	2.10	UPVC DR.
W	1.5X1.2	0.90	2.10	AL. WND
W1	1.5X0.9	1.20	2.10	KITCHEN WND
V	0.6X0.6	2.25	2.85	M.S

2.Elevation :-



Figure.2-Elevation Of Proposed plan

3. Section A-A :-

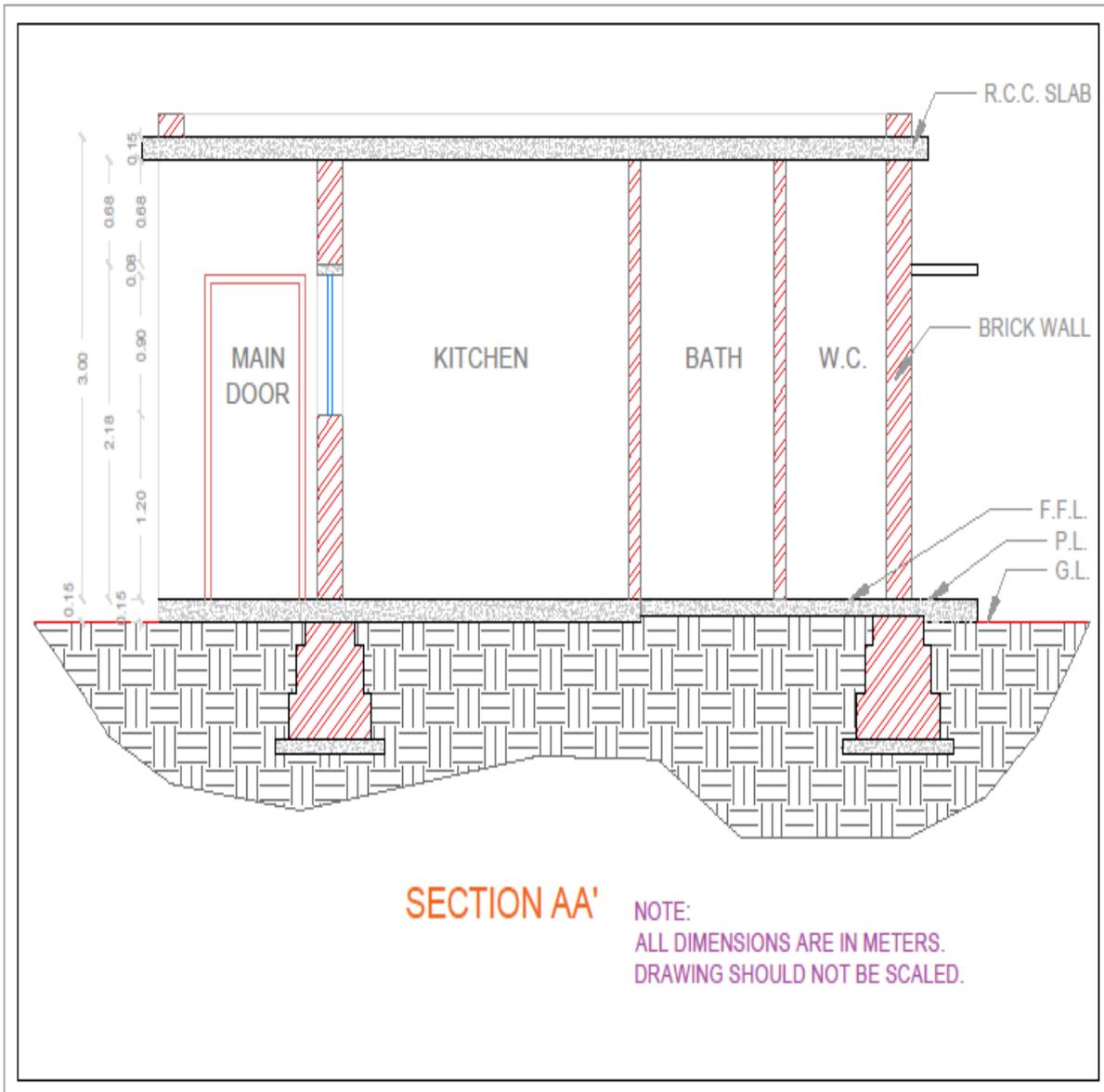


Figure.3-Section A-A

4.Site Plan :-

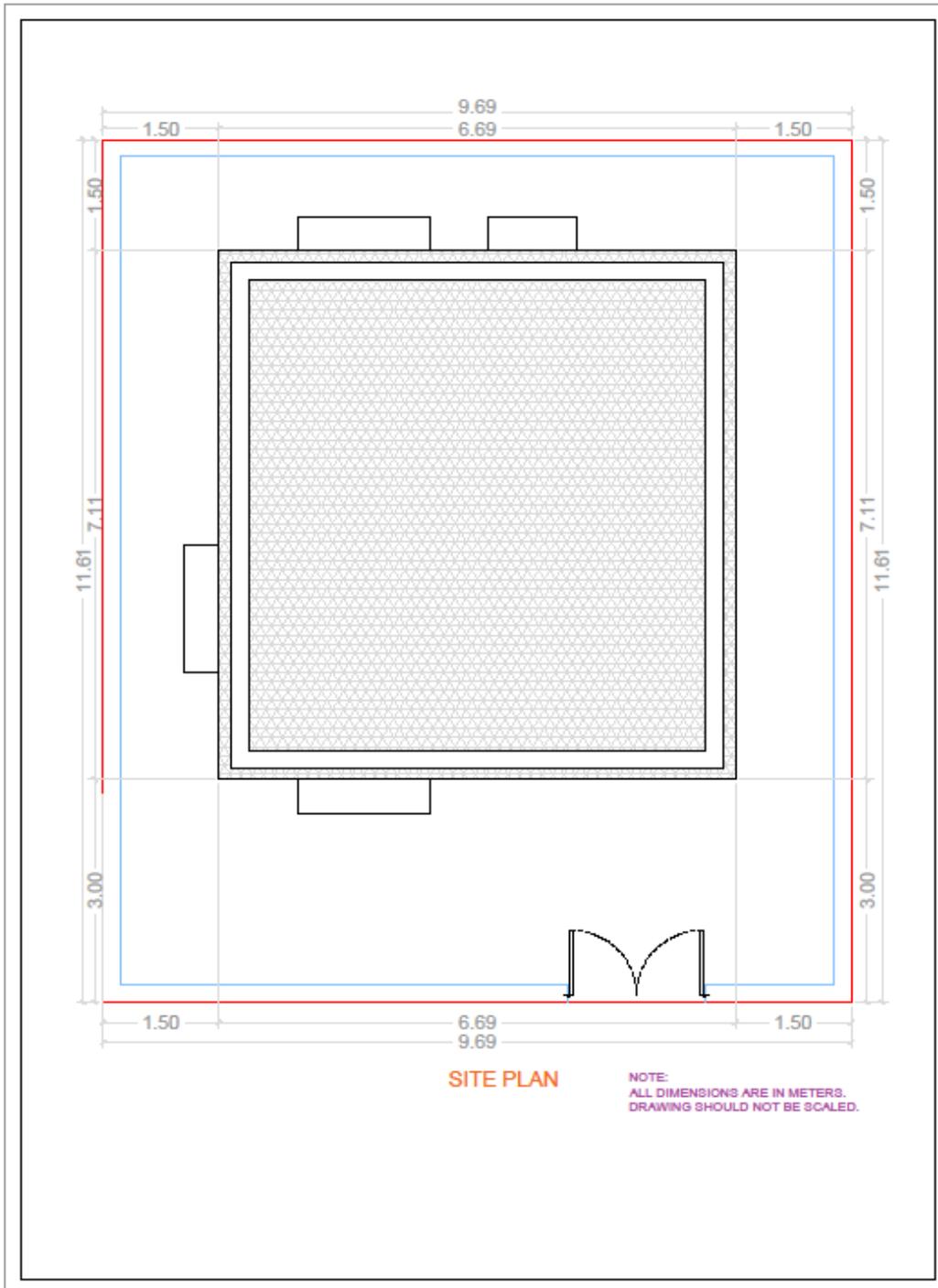


Figure.4.-Site Plan

4.3 DETAILED ESTIMATE

S.N	Description	Number	Length	Breadth	Height	Quantity	Total Quantity
1	Excavation	1	32.25	1	0.95	30.637	30.637m ³
2	PCC	1	32.25	1	0.2	6.45	6.45m ³
3	Brickwork In Foundation						
	1 st Step	1	33	0.75	0.3	7.425	
	2 nd Step	1	32.85	0.6	0.3	5.913	17.748m ³
	3 rd Step	1	32.7	0.45	0.3	4.41	
4	Brickwork In Super Structure						
	External	1	29.1	0.3	3	26.19	26.19m ³
	Deduction						
	D	3	0.9	0.23	2.1	1.304	
	W	4	1.5	0.23	1.2	1.656	3.075m ³
	V	2	0.5	0.23	0.5	0.115	
						Total	23.115m ³
	Internal	1	5.1	-	3	15.3	15.1m ²
	Deduction						
	D ₁	2	0.75	-	2.1	3.15	3.15m ²
						Total	12.15m ²
5	RCC Work						
	Slab	1	7.11	6.69	0.15	7.13	7.15m ³
	Lintel- D	3	1.15	0.23	0.23	0.182	
	W	4	1.8	0.23	0.23	0.380	0.672m ³
	D ₁	2	1.05	0.23	0.23	0.11	
6	Flooring						
	Living- L1	1	3.9	1.2	-	4.68	
	L2	1	3	1.8	-	5.4	
	Kitchen	1	2.4	1.8	-	4.32	
	Bed Room	1	3	2.4	-	7.2	26.64m ²
	WC	1	1.5	0.9	-	1.35	
	Bath	1	1.5	1.2	-	1.8	
	Passage	1	0.9	2.1	-	1.89	
7	DPC	1	32.25	0.23	-	7.41	7.41m ²

Table 1-Detailed Estimate

6. RESULTS

1. The overall cost of construction of one house by using rat- trap bond and filler slab is 16.25% less as compare to normal construction method.
2. Cost saving in brickwork in foundation by using rat trap bond method is up to 19.5%.
3. Cost saving in brickwork in superstructure by using rat-trap bond method is up to 19.5%.
4. The reduction in quantity of cement mortar between conventional bond and rat-trap bond comes as 0.0252m³
5. Cost saving in slab by using filler slab method is up to 18.06%.

7. CONCLUSION

Housing is a basic need and a right of all people. During our years, due to the huge rise in the real estate market rates, the dream of the average middle class and the low-income group remains a dream come true, as the reality of inefficiency is very painful. In this project we are working on the Rat Trap Bond and the Filler Slab Concept alternativeless expensive building material. Many attempts at government level have failed to alleviate the problemsthe housing shortage of ordinary people continues to grow at an alarming rate. Filler slab technology is simple and the newest slab construction technology. The reason why, concrete and steel are used

together to build. The RCC slab, is located in each of them as different building materials and their individual boundaries. Concrete is good for taking stress and iron is good for stress. The RCC slab is therefore a product of both pressures and durability. The shortage we see today is not about housing itself, it is actually about 'Affordable Housing. Fortunately enough, the solution to the shortage of affordable housing (especially in urban areas) can be achieved. We can not control inflation, but Try to reduce construction costs with a simple switch, inexpensive building materials and technology. One such solution is the use of the Rat-Trap Bond Masonry Technique. The construction cost, including material and labor cost, can be saved by using the low-cost housing technologies by using Rat trap bond Masonry and Filler Slab respectively if we compare it with traditional construction methods for walling and roofing respectively.

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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