

Prefabricated Construction - A Design and Cost Parameter Analysis

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Abstract - At whatever point we consider construction, it for the most part implies in the traditional sense. Wherein each progression that is built on site, should be finished and signed off before initiating on to the next stage. Prefabricated development varies as in the secluded units are produced in a plant and afterward conveyed to site as segments or all in all units and afterwards erected and assembled on site.

This paper will start with the prologue to the Prefabrication development and it's extension in the current day and time in both uprising and advanced nations then it will proceed onward to the various materials and their costing that are being utilized in construction.

It appears to us while talking about the similarities and contrasts in prefabricated versus conventional development techniques that prefab development is unrivaled and superior in terms of :-

- Cost Efficiency
- Sustainability
- Adaptability
- Resale and Quality control

This Paper centers around the contrasts among conventional and modular development in the case of design parameters and cost analysis.

Keywords - Cost-Benefit analysis framework, Modular construction, Prefabrication, Prefabricated construction, RCC Construction, Traditional Construction.

I. INTRODUCTION

Prefabricated Construction is a technique of manufacturing the various segments of a building design at a manufacturing plant and shipping them to an area of the building site where they are put together.

Pre-assembled development is getting more normal and is accessible in assortments of budgets. It has been demonstrated effective, harmless to the ecosystem, and labor-friendly. Prefab Construction is generally viewed as a sustainable way for the development industry. India is as yet in the underlying interaction of embracing and eliminating the limitations to the pre-assembled development practices and has directed a couple of studies till date on the requirements of prefabricated development up to the activity stage.

The role of prefabrication in architecture has been acknowledged for its capability of expanding profitability and effectiveness while keeping up the quality. The upsides

of better, quicker and less expensive development projects are applicable to advanced nations like the U.S.A, Japan, and UK, where the working class nobility keeps on requesting this condition in structures that goes from exceptional to standard. Developing countries such as China, India, Africa and some parts of South America, that are beginning to adapt on prefabrication have the advantages of realizing housing quickly and affordably; however, greater reliance on manufactured production has possibly shown more disadvantages than advantages for these cultures.[3]

Prefabrication has a positive upper hand over traditional innovation in development, however it has not actually been able to compete with the ordinary types of development. Pre-assembled materials have made development work simple and cut down the development time altogether by as much as 50%. In spite of the fact that utilizing such materials is more normal in far off nations, prefab construction is utilized in India in just huge development projects, in metropolitan urban communities like the raised interstate highways and

metro train tasks and huge structure and development organizations like Tata Housing and L&T have assembled private ventures in numerous parts of the country. Yet, it is as yet ailing in rural territories.

Types of Prefabrication

Four categories of prefabricated construction are divided into:-

- Pre Cut
- Panelized
- Modular
- Manufactured

The type of manufacturing, and the magnitude of offsite assembly are the fundamental differences between these four categories.

- **Pre-Cut:-** Pre-cuts are the building materials that are machined into a predetermined dimension, and are drilled in according to the use and specification. The unrefined materials are made and prepared to be transported in packets or ready-to-use construction kits. The least amount of offsite assembly is done in this type of prefabrication.
- **Panelized:-** The next kind of prefabrication is the panelized construction. It imparts similarities to pre-cut assembling however the panelized construction measures crude materials into usable pieces, also in addition gathers the sections into panel units. This strategy for development essentially utilizes similar materials as convention development like plywood, situated strand board, timber, insulation and drywall.[8]
- **Modular:-** Modular, the third sort of prefabrication, takes the panelized type and improves it further for assembling. Now, the primary states of the house become more self-evident. Now and again, particular homes are partitioned dependent on units, for example, the kitchen, room, restroom, and parlor. Much regularly, the modules are underlying parts, quarters, and different shapes for simpler transportation from the site of production.

- **Manufactured:-** The most intricate sort of prefabrication is manufactured, regularly known as mobile homes. Unlike some other pre-assembled lodgings, manufactured structures are completely amassed before shipment. Mobile homes commonly come in two sizes:- single-wide and double wide. Single-wide are houses built with a width which isn't more extensive than 5.5 meters, and length not longer than 27 meters. Double-wide homes, on the other hand, are houses with width greater than 6 meters and so they must be broken down and transported in units.[1]

Materials used for casting Prefabricated components

There are different materials utilized in a pre-assembled fabricating, like concrete, steel, and wood. The sort of material relies upon the underlying project plan and the kind of development. Some are listed below:-

Wood is commonly used in prefabrication building. As it is light and very easy to transport, it allows builders to get entire modular single or multiple story structures to the construction sites.

Steel and R.C.C were presented in prefabrication a couple of years prior. Pre-constructed buildings usually have a steel frame, steel wall panels, steel, and concrete floor decks.

Galvalume is also used in prefab construction and it is a form of Steel coated with aluminum Zinc.

II. METHODOLOGY

- Step 1 :Design Finalisation and dimension finalization of residential building.
- Step 2 : Costing of material used.
- Step 3 : Cost Calculation of construction through traditional methods.
- Step 4 :Designing of prefabricated Design of a building.
- Step 5 :Calculations of cost of Sections for building.
- Step 6 : Assembling Calculations.
- Step 7 :Finalisation of Cost of Residential building through Prefabricated Construction Method.
- Step 8 : Comparing Cost of Both methods of construction.
- Step 9 : Checking errors in calculations before conclusion.
- Step 10 : Concluded Cost benefit Analysis.

III. DATA ANALYSIS

3.1 R.C.C HOME

Total Area of the R.C.C home is 169 meter sq. and it's total cost of construction is Rs 2,213,706 .

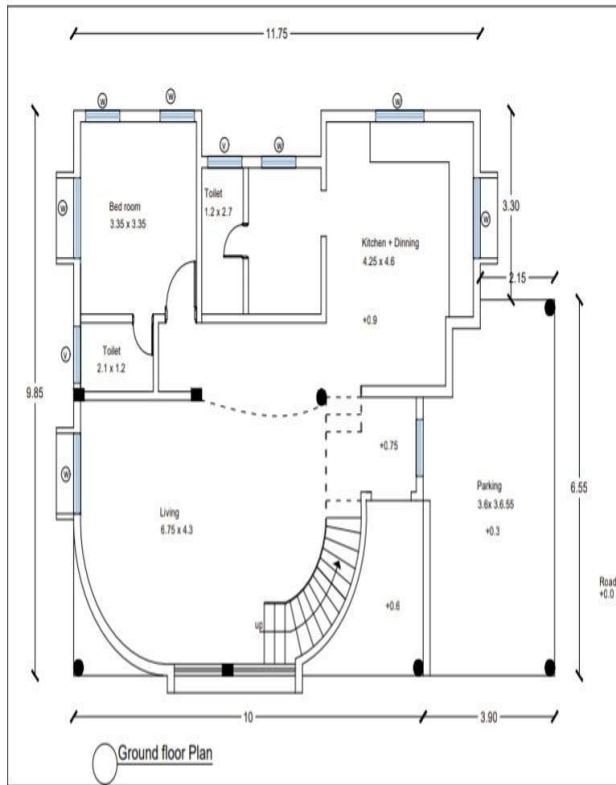


Fig.3.1.1 Line plan of R.C.C home ground floor

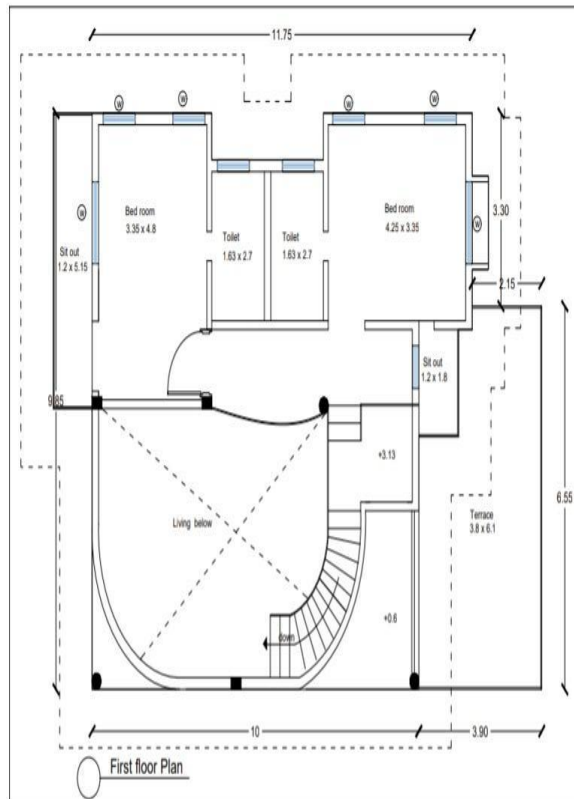


Fig 3.1.2 Line plan of R.C.C home first floor

Definition of R.C.C home and its advantages

RCC is essentially known as supported Reinforced cement concrete innovation that is utilized to develop solid structures with gigantic strength and malleability and this is a principal improvement technique used to develop private houses or condos to withstand regular cataclysms like tremors, wave ,twisters and so on

Next are a few benefits of R.C.C home :

- R.C.C has a high compressive strength contrasted with other structure materials.
- With the assistance of given steel support, built up cement can likewise withstand a decent measure of pliable burdens.
- R.C.C gives Fire and climate protection from the design partly.
- The built up solid structure is more strong than some other sort of building.

For working out the money saving advantage, assessment between the two strategies for development ,i.e., prefabrication based and conventional based procedure, the rules that were crucial was the evaluation of the amount and cost of services and materials which are to be used in these two circumstances.[7]

Table 1 - Costing of R.C.C home

Costing of RCC Home					
S No	Quantity	Description	Rate	Per (Unit)	Amount
1	192.6	Earth Work excavation & preparing bed for foundation, rubble soling in situ concreting	₹747.99	Meter Cube	₹144,063.00
2	24.1	RCC WORK IN FOUNDATION	₹4,700.00	Meter Cube	₹113,270.00
3	51.52	Filling in plinth & floors with soil	₹250.00	Meter Cube	₹12,880.00
4	66.28	RCC for column, plinth beam,slabs lofts,lintels	₹4,491.00	Meter Cube	₹297,664.00

5	177.69	Stone masonry	₹2,700.00	Meter Square	₹479,763.00
6	33.32	Doors & Windows	₹2,445.24	Meter Square	₹81,476.00
7	2.92	RCC Waist slab parapet	₹6,200.00	Meter Cube	₹18,104.00
8	7	M S steel & Tor Steel used for RCC	₹49,168.00	M T	₹344,176.00
9	912.29	Plaster	₹175.21	Meter Square	₹159,843.00
10	343.69	Flooring	₹674.61	Meter Square	₹231,857.00
11	3.26	Kadapa Tiles	₹6,200.00	Meter Square	₹20,212.00
12	17.82	Grill Work For Windows	₹1,000.00	Meter Square	₹17,820.00
13	64	Plumbing	₹703.43	Per Unit	₹45,020.00
14	15	C.I vent Pipe,bib to brass Socket	₹345.00	Per Unit	₹5,175.00
15	912.2	Painting and White Wash	₹25.88	Meter Square	₹23,608.00
16	24.1	Water Proofing	₹600.00	Meter Square	₹14,460.00
17		Electrical Work		4% of whole bungalow costing	₹70,584.00
18	65	Glazed Tile Work and Sand Filling	₹700.00	Meter Square	₹45,500.00
19		Miscellaneous		5 % of Whole bungalow costing	₹88,231.00
			Total	Cost	₹2,213,706.00

3.2 PREFABRICATED HOME

Total Area of the R.C.C home is 151 meter sq. and it's total cost of construction is Rs 3,371,351.

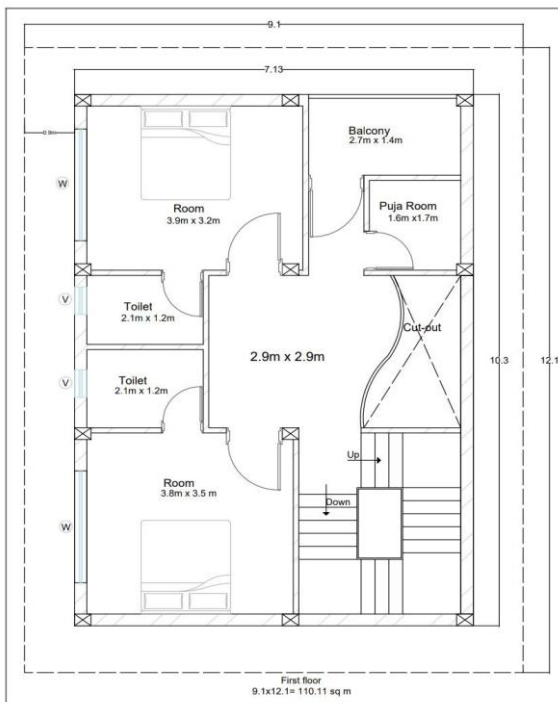


Fig. 3.2.1 Line plan of modular home ground floor

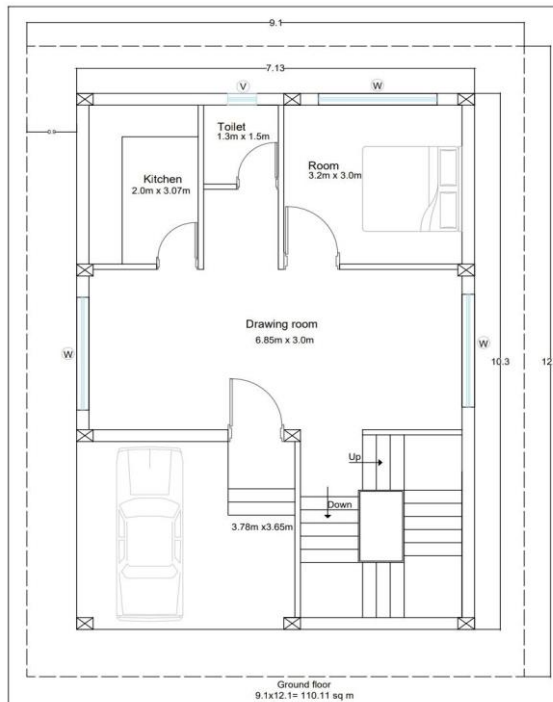


Fig. 3.2.1 Line plan of modular home first floor

Advantages of prefabrication

- Self supporting readymade segments are utilized so the requirement for formwork covering and scaffolding is significantly decreased.
- Development time is decreased and structures are finished sooner permitting on before return of the capital contributed.
- On location construction and blockage is limited.
- Quality control can be simpler in a processing plant mechanical production system setting than a building site setting.
- Prefabrication can be found where skillful labor, materials space and overheads are limited.
- Fewer expansion joints required.
- Materials for Scaffolding are put away somewhat in parts or in full and utilized.
- Availability of precise structure and expert workmanship.
- Interruptions in connecting can be omitted.
- Work is done with better technology. · Less workers are needed.
- Members can be used again.[4]

Table 2 - Costing of modular home

COSTING OF MODULAR HOME					
S NO	QUANTITY	DESCRIPTION	RATE	PER (UNIT)	AMOUNT
1	953	Modular Material aluminium composite panels	₹2,000.00	Meter Square	₹1,906,000.00
2	70.481	Delivery of All products	₹1,000.00	MT	₹70,481.00
3	Lumpsum	Installation of all products on site	lumpsum		₹409,000.00
4	1080	Flooring	₹160.00	Meter Square	₹172,800.00
5	17	Windows	₹3,750.00	Per Unit	₹63,750.00
6	11	Doors	₹9,040.00	Per Unit	₹99,440.00
7	Lumpsum	Module Connections	Lumpsum	Per Unit	₹90,000.00
8	Lumpsum	Shipping Damages , Shortage	Lumpsum		₹50,000.00
9	Lumpsum	INTERIOR FINISHING	Lumpsum		₹120,000.00
10		ELECTRICAL WORK	1.5 % OF WHOLE BUNGALOW COST		₹55,000.00
11		Mechanical Work	> 1% of Bungalow Cost		₹15,000.00
12		Plumbing Work	> 1.5% of Bungalow Cost		₹51,680.00
13	7	Foundations For the home by excavation preparing bed	₹15,000.00	Meter Square	₹105,000.00
14		Miscellaneous	5% of bungalow Cost		₹163,200.00
			Total	Cost	₹3,371,351.00

IV. RESULTS AND CONCLUSIONS

1. After cost analysis of the g+1 bungalow of R.C.C and prefabricated modular lodging it is presumed that R.C.C

construction is cheaper than prefabricated modular construction .

2. The cost difference as an exact value between the two methods comes out to be Rs.1,157,645.00

3. The cost difference in percentage comes out to be 41.551% which means that the R.C.C home is around 40% more cheaper to construct than a prefabricated home in India as of now.
4. The one main reason for such drastic cost difference is that due to lack of industries in India the costing of composite aluminium panels are at a high premium as well as their installation cost is higher. If we look at the BOQ properly we can see that it is a major reason why a modular home of G+1 costs higher than a R.C.C home.
5. In context of foundation cost, R.C.C building cost comes around Rs.39,000 more than that of the prefab building which shows that prefabrication has its definite advantages in some areas of design and planning.
6. The development of industries producing more prefabricated building materials such as “HINDUSTAN PREFAB” will also help in promoting modular construction in our country.

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