

Design and construction of prefabrication houses for flood victims in Kerala, India

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Abstract—Kerala, a state in India recently devastated by serve monsoon rains. They found a vulnerable population that will soon face fresh landslide risks as a new monsoon approaches. Since the onset of south-west monsoon on May 29, Wayanad district in Kerala has experienced 247 landslides. So we choose a village called Panamaram in Wayanad district, where we carried out our revival tasks. In order to complete the project in time we selected fiber cement board as the principle building material. We have opted the idea of prefabrication structures for fast construction.

Index Terms—Aesthetics, Budget, construction, design, fiber, cement board, F lood, Plot, Prefabrication houses.

1 INTRODUCTION

PREFABRICATION is the practice of assembling components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located. The term is used to distinguish this process from the more conventional construction practice of transporting the basic materials to the construction site where all assembly is carried out. Moving partial assemblies from a factory often costs less than moving pre-production resources to each site.

Housing colony concept will make a unity among the victims for their whole life. It also has a benefit in economic sense too. Prefabrication process can simply assemble the components of a structure in a factory or other manufacturing site, and transporting complete assemblies or sub-assemblies to the construction site where the structure is to be located. This is one of the most important modern building techniques.

Every design is influenced by the land topography. This influences the design process as it affects how the building will be built and whether it can be on the plot of land. Before a build is begun the land must be inspected too see if it is on a flood plain, if it is the build can be postponed or cancelled because of the possibility of flooding the build. The water tables must be acquired to see how deep the foundations can be dug and if there is a large amount of water in the soil. The existing services can also affect the build as digging might not be possible on the area because of the utilities and services crossing the site, they may need to be diverted or the building avoid the pipes.

2 DESIGN PHASE

The design phase is divided into three:-

1. Interrogation
2. Scheduling
3. Designing

2.1 Interrogation

The interrogation part is meant for asking questions to the victims in order to get to know about their needs about the revival project. These are the few points we kept our attention during our interrogation session.

1. Plot
2. Design factors
3. Basic needs

4. Time of completion
5. Other suggestions

In case of selecting a plot we have consider many things. These are the thing that we studied and kept in mind before getting into the session. Geometry of the plot for any kind of construction is very important which can largely affect the appearance of your structure. Shape of the plot should be such that the construction can be easily made with cost low as possible. And also in the future you can further expand it. A plot with more routes will be considered a good one. The surround area of the residential plot is very important. It affects the price and the beauty of the plot. Plot should be taken in the area provided with a lot of services and in a suitable environment free from all kind of pollutions.

Community services such as police and fire protection, clearing of waste and street cleaning Utility services such as water supply, gas, electricity, and drainage Amenities such as schools, hospitals, libraries, recreation, telephone, etc. Shopping facilities and means of transportation. A site which comes within the limits of an area where the by-laws of the local authority enforce restrictions regarding proportions of plots to be built up, vacant spaces to be left in front and sides, heights of buildings, etc., should be preferred. Area of the plot of land should be such that the house constructed, keeping in view the restrictions of the local authority, would meet the requirements of the owner, preferably with possibilities of future extensions. The site should not be irregular in shape or having any sharp corners.

2.2 Scheduling

The term 'Construction' does not only denotes physical activities involving men, materials and machinery but also covers the entire gamut of activities from conception to realization of a construction project. Thus, management of resources such as men, materials, machinery requires effective planning and scheduling of each activity. Management is the science and art of planning, organizing, leading and controlling the work of organization members and of using all available organization resources to reach stated organizational goals. Construction management deals with economical consumption of the resources available in the least possible time for successful completion of construction project. 'Men', 'materials', 'machinery'

and 'money' are termed as resources in construction Management.

The main objectives of construction management are, Completing the work within estimated budget and specified time, Maintaining a reputation for high quality workmanship, Taking sound decisions and delegation of authority, Developing an organization that works as a team. The functions of construction Management are: planning, scheduling, Organizing, Staffing, Directing, Controlling and Coordinating. Planning is the process of selecting a particular method and the order of work to be adopted for a project from all the possible ways and sequences in which it could be done. It essentially covers the aspects of 'What to do' and 'How to do it'. Planning helps to minimize the cost by optimum utilization of available resources. Planning reduces irrational approaches, duplication of works and inter departmental conflicts. Planning encourages innovation and creativity among the construction managers. Planning imparts competitive strength to the enterprise. Scheduling is the fitting of the final work plan to a time scale. It shows the duration and order of various construction activities. It deals with the aspect of 'when to do it'.

2.3 Designing

These are the main factors considered by our design team:

1. Plot
2. Human design factors
3. Housing colony model
4. Basic requirement
5. Budget
6. Time of completion
7. Aesthetics

2.3.1. Plot

Topography OF Panamaram site is located in Mananthavady taluk of Wayanad district. Latitude:11°43'59.99"N and longitude:76°05'60'.00E. Topography of Wayanad can be defined as the one has High ranges with rugged topography include hill ranges, mixed jungles and is having rugged topography with steep slopes and narrow valley. Panamaram site comes under very narrow hill category. Average slope of the plot is 11:1 meter. Area of the plot is 2843 meter square. The plot is almost a rectangular in shape.

2.3.2. Human Design Factors

The plot is almost a rectangular in shape

1. Climate responsive design and site specific variables
2. Orientation
3. Cool breeze access
4. Solar access
5. Views
6. Overshadowing by landforms, trees and buildings (site survey)
7. Slope (site survey)
8. Storm water drainage
9. Access and transport
10. Services (power, gas, phone, water, sewer).

Sustainability of the design is also a large factor that affects the design process. If the building is not environmentally friendly or if the building will not last very long then the design would need to be changed, prolong the buildings lifespan and also to make the building better for the environment.

2.3.3. Housing Colony Model

Social housing is an umbrella term referring to rental housing which may be owned and managed by the state, by non-profit organizations, or by a combination of the two, usually with the aim of providing affordable housing. Social housing can also be seen as a potential remedy to housing inequality. Although the common goal of public housing is to provide affordable housing, the details, terminology, definitions of poverty and other criteria for allocation vary within different contexts.

2.3.4. Basic Requirements

Before considering the designing of house it is described to study the basic requirement in house designing.

1. Climate responsive design and site specific variables
2. Orientation
3. Strength and stability
4. Comfort and convenience
5. Protection
6. Resistance to moisture penetration
7. Durability
8. Thermal insulation
9. Safety against fire

2.3.5. Budget

The costs of a constructed facility to the owner include both the initial capital cost and the subsequent operation and maintenance costs. Each of these major cost categories consists of a number of cost components. The capital cost for a construction project includes the expenses related to the initial establishment of the facility: Land acquisition, including assembly, holding and improvement, Planning and feasibility studies, Architectural and engineering design, Construction, including materials, equipment and labour, Field supervision of construction, Construction financing, Insurance and taxes during construction, Equipment and furnishings not included in construction, Inspection and testing.

Cost of the materials used is listed out in table 1.

Table 1. Cost of materials

Fiber Cement Board for flooring	23400.00
Partition wall (Fiber cement panel 3 rd exterior and 2 nd interior)	93700.00
Joinery (UPVC and Aluminium fabrication)	3900.00
Roofing(Tile)	26500.00
Ceiling (Fiber cement board)	7500.00

2.3.6. Time of Completion

These are some of the important reasons that can affect the time of completion of a construction project:

1. Contractor's improper planning
2. Contractor's poor site management
3. Inadequate contractor experience
4. Inadequate client's finance and payments for com-

pleted work

5. Problems with subcontractors
6. Shortage in material
7. Labour supply
8. Equipment availability and failure
9. Lack of communication between parties
10. Mistakes during the construction stage
11. Financial difficulties and economic problems
12. Contractor financial problems
13. Supervision too late and slowness in making decisions
14. Material shortages
15. Poor site management
16. Construction mistakes and defective work
17. Delay in delivery of materials to site
18. Lack of consultant's experience

2.3.7. Aesthetics

In case of small residents comfortable temperature and plenty of daylight are among the most attractive benefits commercial building owners can offer occupants. In addition to energy savings, solar shading solutions provide these essential benefits and contribute to a pleasant work atmosphere for those who spend their days working indoors.

Advantages of light shade colours:

1. Preserve natural light and reduce the need for artificial lighting. Reflect a higher percentage of solar energy.
2. Reduce interior heat gain, resulting in lower energy expenditures for cooling.
3. Increase privacy levels due to visible light reflectance (Rv) properties.

Disadvantages of light shade colours:

1. High visible light transmission (Tv) values can add to visual discomfort or glare.
2. Depending on glazing selection, may be highly visible from exterior and interfere with street-side aesthetics, causing unintended visual noise.

Advantages of dark shade colours:

1. Significantly reduce Tv values and enhance glare control.
2. Provide superior view-through for enhanced connection to the outdoors.
3. Often virtually invisible to the street-side, providing exterior continuity to building aesthetics.

Disadvantages of dark shade colours:

1. Absorb more solar heat than light colours
2. Can be less energy efficient when compared to light colours

3 CONSTRUCTION PHASE

After the completion of documentation work, the actual construction on plot begins. Following are the steps;

Earth Work

Generally excavation is carried out for the construction of wall foundations. Excavation should be carried out as per the drawings defined lengths & widths. After excavation, layout the foundation and backfill the remaining excavated area around foundation with soil.

Floor levels of residential buildings are higher than the natural ground level. Fill the area with soil up to floor levels and compact the soil. Now earth work of residential building is finished.

The preparation was carried out by without disturbing the natural gradient of the plot.

Vegetation was retained as much as possible.

3.1. Concrete Work in Foundation

It is very necessary to check the levels of foundation before concrete work. There are patches where excavated depth slightly exceeds and vice versa. Level the foundation base to same level. Now pour the concrete as per drawing specs. Generally concrete of ratio 1:4:8 is used for foundation. Sometimes it is even 1:5:10 or 1:6:20.

3.2. Trench

1. Depth of trench=65cm
2. Pcc=7.5cm

3.3. Footing

1. Depth of footing=60cm
2. Size of footing=60x60cm
3. Steel details=10mm dia,18cm c/c

3.4. Short Column

1. Size of short column=20x20cm
2. Steel details=8mm dia 4 no.s
3. 20 m of the total height of the plnth is located under the ground level,it provide firm support.

3.5. Base plate

1. Above the concrete pillar base plate is connected
2. Size of base plate is 20x20cm
3. L shaped channels is used to track on which v boards are gripped at the bottom.

3.6. Masonry

1. 7.5cm v panels are placed on channels so called as tracks.
2. V panes are placed close to each other without any gap.

3.7. Ceiling

For ceiling 6mm v boards are used.

3.8. Truss work

1. All truss works are made of steel.
2. V panels are placed in front view of the truss work.
3. Above the truss roof tiles are placed.

3.9. Doors & Windows

Traditionally, doors and windows of woods are used. But, steel & aluminum is also not a bad choice. In case of wooden doors & windows, frames are fixed in walls during masonry work. Panels are then fixed with hinges after plaster work. Steel and aluminum doors are fixed after completion of paint work. we used aluminium doors in wayanad site.

3.10. Services

Services are very important for every single house. Different types of services are provided during construction. These are Electricity supply, gas supply, water supply, sanitary etc. Conduits for electric supply are fixed in walls before plastering. Similarly water supply and sanitary lines are also laid before pouring of building floor. All these services are ensured in wayanad site.

4 CONCLUSION

This work was done to help the flood victims to get back to their normal life by providing a good shelter to them. All we have to look after is time of completion. Since the construction method we selected was innovative we finished the work in time. Prefabrication was the method of construction used here. The principle construction material was fiber cement board.

ACKNOWLEDGMENT

I wish to thank all my class mates in my institution. This work was supported in part by a grant from my teachers of our institute.

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