



ANALYTICAL AND PROTOTYPE MODELLING OF MIVAN FORMWORK

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ABSTRACT

Construction is one of the significant sectors of Indian economy and is an integral part of the development. Today India's urban population is the second largest in the world and its future development leads to increased demand for housing to cope with this problem India should desperately need to plan for acquisition of land and rapid creation of dwelling units. One of the most important factors in determining the success of a construction project in terms of speed, quality cost and safety of work is the formwork used in the project as it accounts about 35 to 40 percent of the total project cost of the structure. When considering a construction projects both the client and contractor want to finish the job early as the client wants to use the building for the intended purpose as soon as possible. The contractor wants to finish the construction as soon as possible to gain a higher profit. The most efficient way to speed up the work in mass housing construction is by achieving a very short floor cycle. The floor cycle of a building mainly depend on the formwork type, as it is the main time factor of a building project. The aim of our study is to present about the existing formwork system used in mass housing construction in Tamil nadu and to show how each one will affect the project duration, project cost and the quality of the work. For that, a research has been carried out and the results will present in this paper.

Key words: Aluminium System, Aluform System, Block Work and Plastering, Construction, Deck Panel, Formwork, Wall Panel.

1. INTRODUCTION

Construction is one of the significant sectors of Indian economy and is an integral part of the development. Today India's urban population is the second largest in the world and its future development leads to increased demand for housing. To cope with this problem India should desperately need to plan for acquisition of land and rapid creation of dwelling units. Construction is a complex process involving basically the areas of Architectural planning, Engineering and Construction. According to the Federation of Indian Chamber of Commerce and Industries (FICCI), keeping in view the existing housing crisis, the country shall need addition of more 2.5 million new dwelling units annually" (Kulkarni, 2001). The recent years voiced the active participation of private sectors in finding the solution over the prevailing situation on housing front. Keeping in view the gigantic task of providing affordable shelter to masses, adoption of a cost – effective technology assumes greater significance. The present strain on Indian economy and the overgrowing demands for housing calls for adoptions of appropriate building technology which could lead to economy and speed in construction. As a result of experimentation of innovate construction techniques and modern construction management it is now possible to achieve an overall saving to the extent of 10 percent in the total cost of housing construction compared to the cost of traditional housing. There is growing realization today that speed of construction needs to be given greater importance especially for large housing

projects. This is not only essential for the faster turnover of equipment and investment also leading possible to the reduction in the housing cost – but also for achieving the national objective of creating a large stock to overcome shortest possible time.

2. OBJECTIVE OF STUDY

Our study aims to prove, for mass housing low-rise constructions, Aluminium Formwork System will be the best suitable formwork system in terms of Safety, Quality, Cost and Duration over the conventional formwork system, by analyzing the on- going projects in TamilNadu and referencing the completed projects all over India.

3. METHDOLOGY

The disparity between the supply and demand for affordable housing is tremendous. Rapid urbanization has resulted in a geometric increase in the housing demand, which cannot be fulfilled using conventional materials and methods of construction. The traditional or conventional method of construction for mass housing is comparatively, a slow process and has limited quality control, particularly when a large size project is involved. It is therefore obligatory to work out a method or a scheme where the speed and quality of construction are controlled automatically by a systematic approach. Therefore Aluminium Formwork System (AFS) identified to be suitable for Indian conditions for mass housing construction where quality and speed can be maintained at a reasonably high level. It is adoptable for any design of a building and establishes a kind of assembly line production.

The methodology of using aluminium formwork takes in to consideration on the following important parameters such as the number of housing units and the time that is available and works out the component of input as formwork. The whole structure is constructed with cast- in-situ load bearing walls by using pre-engineered aluminium forms with form-finished concrete and no plaster on any face.

4. FORM WORK

Formwork is a die or a mould including all supporting structures, used to shape and support the concrete until it attains sufficient strength to carry its own weight. It should be capable of carrying all imposed dead and live loads apart from its own weight. Formwork has been in use since the beginning of concrete construction. New materials such as steel, plastics, fiber glass and Aluminium are used in formwork. Greater attention is being given to the design, fabrication, erection and dismantling of formwork as a temporary structure. Form work includes the surface in contact with the concrete and all necessary supporting structure.

5. ALUMINIUM FORMWORK

The panels of aluminium formwork are made from high strength aluminium alloy, with the face or contact surface of the panel, made up of 4mm thick plate, which is welded to a formwork of specially designed extruded sections, to form a robust component

The panels are held in position by a simple pin and wedge arrangement system that passes through holes in the outside rib of each panel. The panel fits precisely, securely and requires no bracing. The walls are held together with high strength wall ties, while the decks are supported by beams and props. Since the equipment is made of aluminium, it has sections that are large enough to be effective, yet light enough in the weight to be handled by a single worker. Individual workers can handle all the elements necessary for forming the system with no requirement for heavy lifting equipment or skilled labor. By ensuring repetition of work task on daily basis it is possible for the system to bring assembly line techniques to construction site and to ensure quality work, by unskilled or semi-skilled workers.

Trial erection of the formwork is carried out in factory conditions which ensure that all components are correctly manufactured and no components are missed out. Also, they are numbered and packed in such a manner so as to enable easy site



Figure 1 Aluminium formwork (Larsen & Toubro Limited, Malad, Mumbai, 2016)

Merits of Aluminium Formwork

- In contrast to most of the modern construction systems, which are machine and equipment oriented, the formwork does not depend upon heavy lifting equipment and can be handled by unskilled laborers.
- Fast construction is assured and is particularly suitable for large magnitude construction of respective nature at one project site.
- Construction carried out by this system has exceptionally good quality with accurate dimensions for all openings to receive windows and doors, right angles at meeting points of wall to wall, wall to floor, wall to ceiling, etc, concrete surface finishes are good to receive painting directly without plaster.
- System components are durable and can be used several times without sacrificing the quality or correctness of dimensions and surface.
- Monolithic construction of load bearing walls and slabs in concrete produces structurally superior quality with very few constructions joined compared to the conventional column and beam slabs construction combined with filter brick work or block work subsequently covered by plaster.
- In view of the four – day cycle of casting the floor together with all slabs as against 14 to 20 – day cycle in the conventional method, completed RCC structure is available for subsequent finish trades much faster, resulting in a saving of 10 to 15 days per floor in the overall completion period.
- As all the walls are cast monolithic and simultaneously with floor slabs requiring no further plaster finish. Therefore the time required in the conventional method for construction of walls and plastering is saved.
- As fully completed structural frame is made available in one stretch for subsequent – finishing items, uninterrupted progress can be planned ensuring, continuity in each trade, thereby providing a scope for employing increased labor force on finishing items.
- As the system establishes a kind of “Assembly line production” phase – wise completion in desired groups of buildings can be planned to achieve early utilization of the buildings.

Limitation of Aluminium Formwork

- High initial investment cost.
- More number of components.

- High repair cost of Aluminium forms.
- Probability of theft is more.
- Segregation and stocking required more space.

6. COMPONENTS OF ALUMINIUM FORMWORK

The basic element of the formwork is the panel, which is an extruded aluminium rail section, welded to an aluminium sheet and other components are extruded section. This produces a lightweight component with an excellent stiffness to weight ratio, yielding minimal deflection under concrete loading. Panels and extrusions are manufactured in the size and shape to suit the requirements of specific projects. Following are the components that are regularly used in the construction.

Slab Components

- Slab Panel (SP)
- Slab Prop Head (SPH)
- Mid / End Beam (MB / EB)
- Slab Corner (SC)
- Beam Splice Bar (BSB)
- Prop Length (PL)

Wall Components

- Wall Panel (WP)
- External Corner (EC)
- Rocker (RK)
- Internal Corner (IC)
- Kicker (K)
- Pin and Wedge

Beam Components

- Beam Panel (BP)
- Bulk Head Horizontal (BHH)
- Beam Prop Head (BPH)
- Soffit Corner Internal (SCI)
- Beam Soffit Panel (BSP)
- Soffit Corner External (SCE)



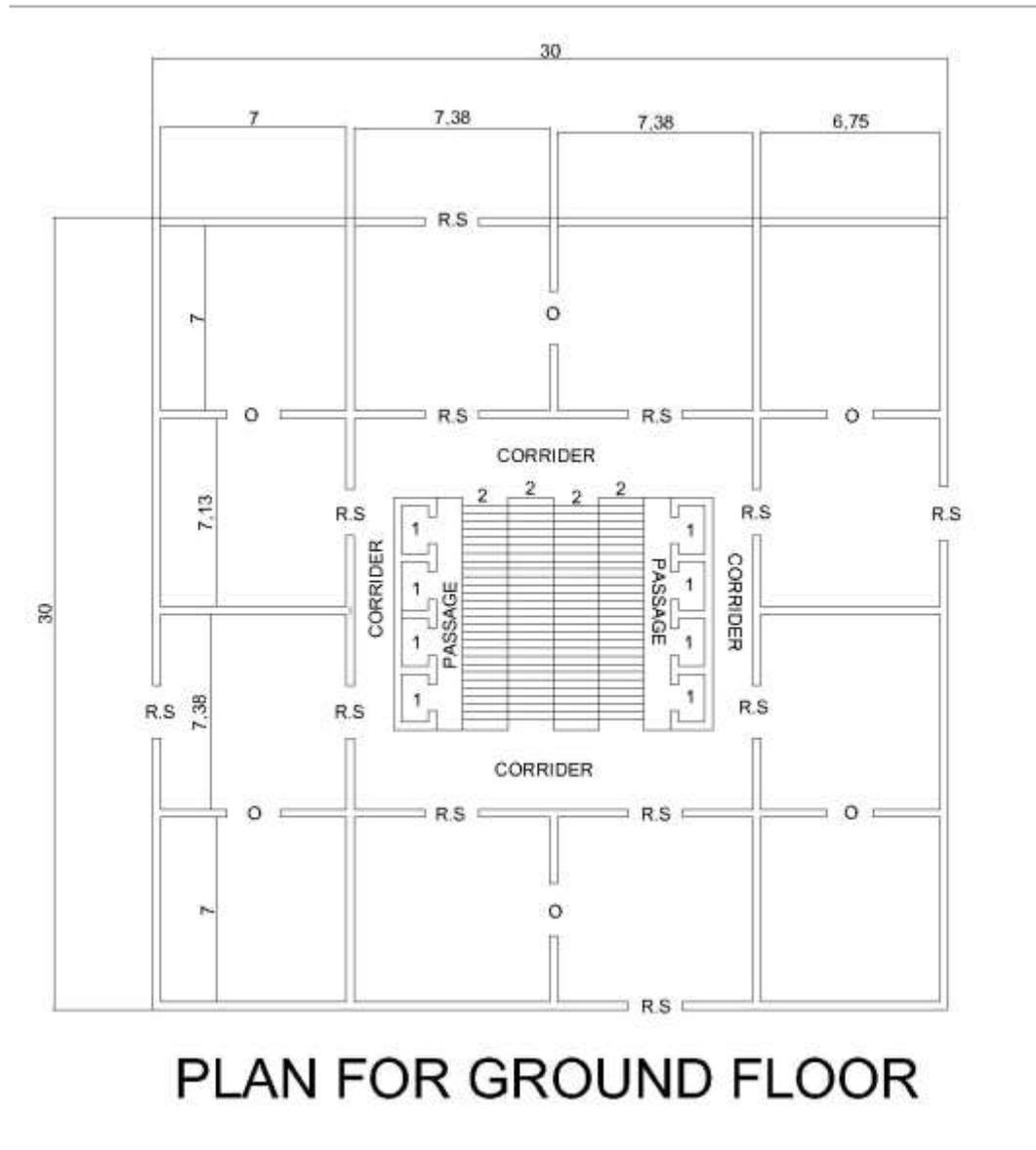


Figure 2 Drawing –Plan for Aluminium frame work

COST COMPARISON BETWEEN CONVENTIONAL AND ALUMINIUM FORMWORK SYSTEM

In typical floor construction, around 20 percent of cost saving is possible in box type structure over framed structure. Almost 40 percent savings in project duration in Box type structure over framed structure. Construction cost escalation, Labor rates increases every year at the percent of 2 to 5. Cement and steel price increases every year at the percent of 10 to 15. Around 5 to 8 percent Savings in project cost is possible on reducing over heads by early completion of projects. High return on investment is possible.

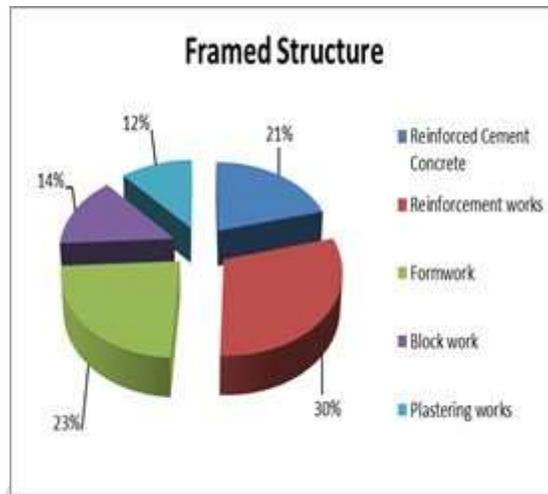


Figure 3 Pie Chart for Framed Structure

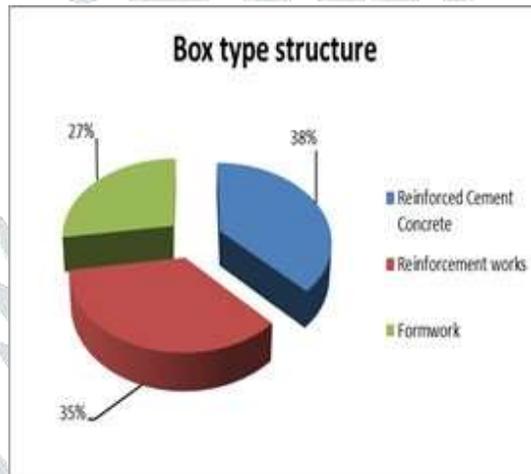


Figure 4 Pie Chart for Box type Structure

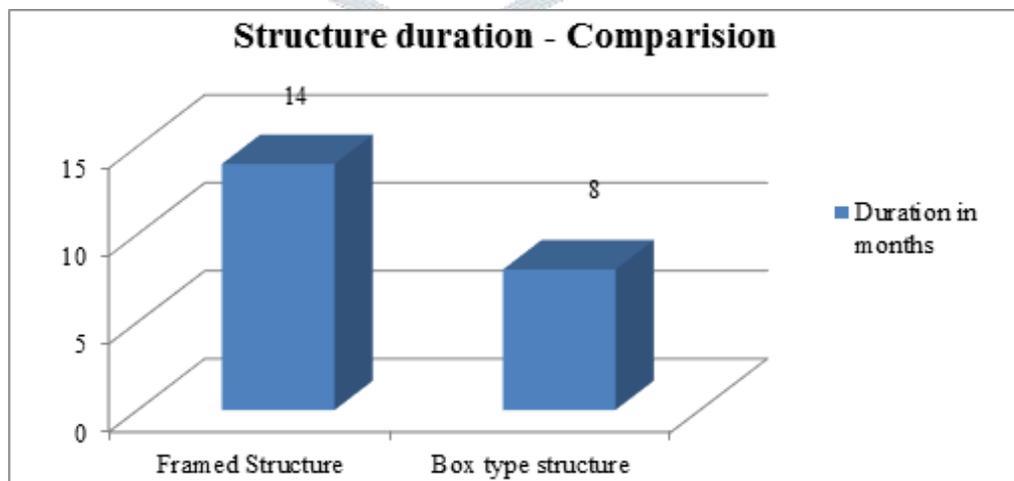


Figure 5 Construction duration

7. CONCLUSIONS

The task of housing due to the rising population of the country is becoming increasingly monumental. In terms of technical capabilities to face this challenge, the potential is enormous; it only needs to be judiciously exploited.

- Traditionally, construction firms all over the world have been slow to adopt the innovation and changes. Contractors are a conservative lot. It is the need of time to analyze the depth of the problem and find effective solutions. Aluminium formwork serves as a cost effective and efficient tool to solve the problems of the mass housing project all over the world. Aluminium formwork aims to maximize the use of modern construction techniques and equipment on its entire project.
- From the results obtained we can come to a conclusion that when the Aluminium formwork is used in the construction project, the total project cost and the duration of the project is lesser than the Conventional formwork system.
- The floor cycle will be 7 to 10 days when the Aluminium formwork used in typical floors, and hence the structure duration will be reduced by 35 to 40 percent over the conventional method of construction. At the same time, there will not be any additional activities such as block work and plastering, which further reduces the overall project duration in the tune of 3 to 4 months.
- The Aluminium Formwork System can achieve not only faster rate of construction but can also bring down the structural cost by 20 to 25 percent over the conventional method with lesser labour inputs.
- Not only the direct benefits, there are many indirect benefits of using aluminium formwork system in the mass housing construction projects. For example Aluminium is the 100 percent recyclable materials, which saves our environments from the extraction of natural resources such as mining of bauxite, reduces tree cutting.

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