

SELECTION OF FORMWORKS FOR BUILDING CONSTRUCTION

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Abstract – In the developing country like India construction work plays an important role to increase the economy of the country. Also with the growing population urbanization is being the need of time. A good construction project has to focus on saving both time and money without losing the quality of work. One of the factor influencing the project time and economy is formwork. Different types of formworks are available in terms of material and function, so it becomes necessary to select a suitable formwork for a particular project. In Indian construction mostly aluminum (MIVAN technology) and conventional formworks are being used among which aluminum formwork is considered to save time and money for mass housing projects and large scale construction whereas, conventional formworks are found cheaper for small scale projects. For speedy construction MIVAN technology is best suited as it is easy to install and gives better finish. Apart other formwork systems like prefabricated, tunnel formwork etc. aluminum and timber formworks are commonly used as these are easily available almost all over India.

Key Words: formwork, MIVAN technology, conventional formwork system, aluminum formwork, mass housing

1. INTRODUCTION

Formwork is defined as a temporary structure which acts as support and mould for fresh concrete until it can take its own weight[1]. The structural system of temporary supports that holds formwork in position is termed as false work[2]. When concrete member gains sufficient hardness and strength formwork is removed and the process is known as stripping[2]. Formwork is considered as important construction material since quality of structural members is also effected by the quality of formwork. Conventionally, formworks are made out of timber but with the advancement of technology formworks made of different materials can be found. In recent technologies formworks are made of aluminum, plastic, timber with steel bracings, prefabricated etc. which are being used worldwide in construction industries. Traditional timber formwork system, Engineered formwork system, reusable plastic formwork system, stay in place formwork system, flexible formwork system etc. are some types of formwork systems used all over the world on the basis of material. Similarly on the basis of method of use table/flying formwork, climbing formwork, tunnel formwork, jump formwork, slip formwork are seen in practice[3]. But in Indian construction practice mostly wooden and Engineered formwork systems are seen. In any construction project formwork are considered to be important factor which influence project cost and time as it consists of 35-45% of total cost of structural work [4] and it is found that formwork requires 20-25% of construction cost[5]. Selection of formwork depends on factors such as project type, project duration, cost, location of project etc. Also high labor intensity of works, poor quality of materials and structures are also considered as problem related to selection of formwork technology[6]. In modern days, various formworks are available in the market. In India present formwork techniques mainly available are: Prefabrication Technology, System formwork Technology, Precast Technology[7]. These formworks has many advantages such as higher floor cycle rate, lower material rate and lower material wastage, large number of reuses, low maintenance cost and smooth surface finish[8]. The main characteristics of good formwork:-

1. To provide the safety of the structure during implementation and use [6].
2. To ensure appropriate technical quality such as proper stiffness, placement, assembly, disassembly and geometry of the formwork structure [6].
3. To be economic in order to minimize the time and cost associated with the formwork[9].

Formworks play important role in saving project cost and time so it is necessary to select an appropriate formwork for any type of project. Formworks with different material are available in market among which conventional (wooden) formwork and aluminum formwork are mostly seen in Indian construction practice. Between these two types of formworks conventional and modern conventional formworks are mostly used due to low cost and easy availability.

2. METHODOLOGY

This study was based on document analysis. Several books and articles were collected as the literature of this study. Almost all documents were accessed from online sources. Various words/phrases related to title of this study were used as keywords to search related articles from authentic sources. Related literature was studied deeply and carefully. Required information was noted down and systematically recorded in a notebook. For every information, page of the notebook was divided into three parts. Needed information was clearly and separately written in third part, appropriate referencing was written in second part and the category (introduction, literature review, discussion etc.) in which it should be included was written in first part. Finally, collected data were written to prepare review paper with proper citations using Mendeley software.

3. RESULTS

3.1 Comparison of conventional, aluminum and steel formwork

In India, these two formworks are seem to be widely used in various range of construction projects. Selecting a suitable formwork can give good outcomes to the project. For this, advantages and disadvantages of both type of formworks should be known along with their suitability for the given project. Top five factors affecting the formwork selection are time factor, surface finish, lifespan, cost and safety.

3.1.1 Conventional Formwork system

It is the oldest type of formwork made from timber plank and plywood[10]. These types of formwork can be reused up to 4-5 times and can be easily available all over the India. In conventional type of formwork the floor cycle is minimum of 3-4 weeks[11]. For making wooden formwork the timber should be well seasoned, free from rots and other defects such as cracks and warps. It should be able to withstand the load applied in it during casting of the concrete member. To improve some of the disadvantages of conventional formwork system, modern conventional formwork system is brought in use which uses steel props and various types of jacks (U jacks, T jacks) as support instead of timber support and plywood sheets are used instead of timber planks on slab decks, beams and columns[12].

3.1.2 Advantages of conventional formwork system

Timber shuttering is used mostly in residential buildings and small projects very commonly. It is famous for its light weight, flexibility and easy availability at most of the places[13]. Conventional formwork system requires low initial and maintenance cost as compared to mivan and steel shuttering technology[14]. They can be made in different shape and size as per the need.

3.1.3 Disadvantages of conventional formwork system

Conventional formworks are only suitable for low rise buildings but they can effect the project cost and duration for high rise buildings. These type of formworks have less load carrying capacity than aluminum and steel formwork system[4]. Also it gives low productivity and reusability. Use of wooden shuttering requires more time and labor. If the corners and joints are not fixed properly, grout may come out in the form of slurry which will lead to poor quality of structural member[10]. During construction if timber is dry then it can absorb moisture from the concrete[3]. This type of formwork leaves the surface of the structure rough and to obtain smooth finishes plastering is required. When the useful time period of conventional formwork is over then it has zero salvage value[15].

3.2 Aluminum Formwork System

Aluminum formwork consists of aluminum panels which consists wall panel, deck panel, staircase panel, deck beam, with props, tie rods and pin for attaching purpose[16]. Prop heads are specially designed in such way that deck panels can be removed without disturbing the props.

3.2.1 Advantages of aluminum formwork system

Aluminum forms are used to construct shear walls and other RCC structures, hence no plastering is required as it gives smooth finishing. These forms can be lifted manually and are easy in erection and dismantling[16]. These kind of formwork gives large number of repetition which allows speedy construction[17]. This system allows cast-in-situ construction and monolithic construction. Labor requirement is less as compared to timber formwork[18]. After removal of formwork finishing line can be seen due to lower panel size[18]. It gives good salvage value when the useful life span is over. Mivan shuttering gives large carpet area and better seismic resistance[19]. This type of shuttering is considered as environment friendly as no trees has to cut down for its manufacture[20].

3.2.2 Disadvantages of aluminum formwork system

The main drawbacks of mivan technology are high initial and maintenance cost, structural symmetry is required and skilled labors are required at every stage of construction[21]. No alterations can be done once formwork is constructed[22]. Like conventional system it does not provide flexibility in construction. For small projects they can over cost the overall construction.

3.3 Steel formwork system

Steel formworks are used largely in large projects or in situation where large number of reuses of the shuttering are possible[14]. It is considered good for curved structure such as chimney, tanks, column below plinth level, sewer, tunnel and retaining walls [23].

3.3.1 Advantages of Steel Formwork

Steel formworks are durable, strong and have longer life span also it is easy to install and dismantle. These types of forms do not absorb moisture from concrete preventing honey combing of structure[13]. Steel shuttering can be reused up to 100 to 120 times[15].

3.3.2 Disadvantages of Steel Formwork

Steel formwork is durable and strong as aluminum formwork but it is heavier than aluminum formwork due to high density[22]. It requires skilled manpower for erection and proper care should be taken while pouring concrete into it.

4. DISCUSSION

In various studies above mostly comparison of aluminum and conventional formwork are mentioned. This comparison is based on mainly project time, cost and better construction quality. Conventional formwork technology is used from a very long time in constructions which is considered to be economical in initial investment and also easily available all over India. But construction with conventional formwork takes more time than advance formwork technology. Also these type of shuttering give poor surface finish, requires skilled labour to assemble as well as to disassemble[1]. Conventional formwork system has more wastage, zero scrap value and the number of reusability of these kind of formwork is up to 5-7 times only. Several other factors should also be considered while using wooden formwork, such as safety conditions, weather condition, proper storage etc. In a comparison made among conventional, aluminum and plastech formworks in 22 storey building plastech formwork seemed to be best option[8].

On the other hand MIVAN technology has given best performances for large projects, villas, mass housing or buildings more than 20 stories. These formworks are easy to handle, store, reusable +200 times with low wastage and high scrap value, gives faster floor cycle[24]. Also use of this formwork gives better construction quality, speedy construction and can be used without skilled manpower. Aluminum formworks are easy to carry but contraction cracks can be seen as its demerit. Implementing advancement in formwork will improve the quality of work in construction compared to traditional formwork by nearly 25-30%. The duration of project gets reduced by nearly 15-20% whereas cost gets reduced by 20-25% and the overall safety and efficiency of the work gets improved by 10-15%[25].

5. CONCLUSION

Based on the literature review it can be concluded that to meet the construction demand of present day the modern formwork techniques are considered capable for speedy construction. In large projects such as mass housing, towers, villas etc. It is better to use aluminum formwork and steel formwork rather than conventional formwork due to its faster floor cycle, better surface finish, easy handling and more number of repetitions. On the other hand, wooden formworks are best suited for small housing projects due to its low initial cost, easy installation and availability. Better selection of shuttering method as well as material for a construction project can enhance the project quality as well as its rate of completion. Instead of sticking only on conventional formwork system engineer should be able to realize suitability of types of formworks according to the project. Hence, the selection of formwork for any kind of building project depends on the importance given to the time and cost of the project. The result of this study will help engineers and other technical persons to know different types of formworks with their merits and demerits for proper selection based on the nature and size of the project, so that quality construction could be achieved in estimated time and budget.

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