International Engineering Journal For Research & Development
Vol.4
Issue 4

E-ISSN NO:-2349-0721

Impact factor : 6.03

MIVAN FORMWORK SYSTEM IN BUILDING CONSTRUCTION-A REVIEW

Kanchan S. Kokate
Student M.E. Construction Engg & Management
Prof Ram Meghe College of Engineering & Management
Badnera-Amravati, India.
Email address:Kanchu.kokate@gamil.com

Prof. Syed Sabihuddin
Associate Professor, Department of Civil Engineering
Prof Ram Meghe College of Engineering & Management
Badnera-Amravati, India.
Email address:syed_sabihuddin@rediffmail.com

Abstract-

Construction is one of the significant sectors of Indian economy and is an integral part of development of country. India's population in present scenario is the second largest in the world which leads to increased demand for housing. To fulfill this requirement India should desperately plan for rapid construction works. One of the important parameter of a successful construction project in terms of speed, quality, cost and safety of work is the formwork used in project. Formwork consumes about 35 to 40 % cost of the project. Formwork enables to cast and construct the important elements and components of any construction project, which are required to be strong and effectively handle the structure. Mivan is comparatively a new construction technology upcoming for successful completion of mass project especially repetitive in nature. This paper focused about the cost and time consideration of Mivan Formwork system with Conventional Formwork system. The Mivan Formwork system is appreciably efficient with cost, quality and time saving as compare to Conventional Formwork system. The basic ideology is to bring the attention on Mivan Formwork system over conventional formwork system and highlighting the affectivity of Mivan formwork system over Conventional formwork system.

Keywords: Mivan formwork, Time and Cost optimization, Quality.

I. INTRODUCTION

Mivan Technology System was developed by Malaysian company as an efficient system for constructing the mass housing projects in the developing countries. To be erected by the structural elements many time that too of a repetitive design, the system ensures a fast and economical method of construction. The strong concrete surface finish produced with the aluminum forms allows achievement of an excellent quality wall finish without the need for external as well as internal plastering. This particular system is identified to be very much suitable for Indian conditions for mass structural construction, where quality and speed can be achieved at excellent level that too at economical cost. The speed of construction by this particular system will surpass the speed of most of the other recent construction methods and technologies used. Mivan is one of the sophisticated- engineered formwork fabricated in Aluminum Monolithic pouring. Walls, columns, slabs & beam are poured together in particular system. The utilization of mivan formwork in the construction industry of India is comparatively very less as to the other developed countries around the globe. The utilization of mivan formwork system in construction industry has the greater potential. This formwork as a sophisticated construction material but it is also economical in heavy type of construction. The recent method of construction by this technology can appreciably increase the productivity of construction, built quality and durability of construction work through the use of efficient construction tools, construction materials, and time for construction saving compared to conventional technologies or methods. This technology is one of the recent construction technologies upcoming at the greater speed for the successful completion various construction project across Indian construction industry, especially mass housing project. This particular study is very essential because it can provide the necessary important information on the building total cost and complete duration comparison between the conventional available systems and Mivan building system in Indian construction industry, where economy and time both play very important role.

II. LITERATURE REVIEW

Following are the reviews based on literature for modern techniques of construction and comparison with conventional techniques:

1. **Pathan H. Majead, Akash Padole, Amir Ali Plasterwala (2019):** Explained that in high rise building construction, the most efficient way to speed up the work is by achieving a very short floor cycle. That directly depends on the selection of formwork for the construction. The formwork development is equally important to the development of concrete in the construction industry. Nowadays extra effort has been put to improve the design of shuttering which ultimately leads to the reduction in weight. Apart from the primary materials of conventional techniques, the materials are now extended to aluminum, plastic, fiber glass, etc. Significant use of advanced formwork is suitable for complex construction processes and provides best results in cost effectiveness. Thus from the above points it is quite clear that construction by aluminum and doka formwork is quite expensive than the Conventional Method. However, it can save considerable amount of time in construction of high-rise building. Also, many of the finishing works is saved in aluminum and doka which includes plastering (both internal and external), brickwork.

2. **Bhagirathi Singh, Dr. Pankaj Sing (2019):** Covered every aspect related to conventional and aluminum form of construction. Thus, they infer that aluminum form construction with Conventional formwork, Tunnel formwork, Climbing formwork, mivan formwork, Slip formwork Tunnel formwork stands to these expectations as it allows a slab cycle within 1 to 3 days and high quality which reduces finishing works. This reduces cost by 40% and time by 60% when compared to conventional formwork.

3. **Vijay anil Sonawane, Harshita Ambre (2019):** India is the developing country where rapid development in infrastructure sector is more important. For that purpose using advance construction technique over the old or traditional construction techniques is important. For that purpose use of aluminum formwork by replacing conventional formwork system in the construction of mass housing projects like multi story buildings, row houses projects etc. Formwork system plays a very important role in successful and timely completion of construction project. From the comparative analysis it's clear that, Aluminum formwork is not only Cost effective but also time saving technology in comparison with Conventional Formwork. Aluminium formwork is better for use in the constructions, where Time saving formwork is necessary, than Conventional Formwork (especially mass housing projects). It can be useful in the developing country like India where repetitive type of mass housing projects is constructed.

4. **Akshay Gulghane, Nikhil Pitale, Sanket Sanghai (2018):** Construction is one of the significant sectors and integral part of Indian economy. Also, it is of the important parameter in development of country. India is desperately planning for rapid manufacturing and creation of dwelling units for economical construction facilities Formwork enables to cast and construct the important elements and components of any construction facilities, which are required to be strong and effectively handle the structure. Mivan is comparatively a new construction technology upcoming for successful completion of mass project especially repetitive in nature. In this paper they have discussed about cost as well as time comparison of Mivan technology with conventional formwork technology. The Mivan technology is appreciably efficient with cost, quality and time saving as compare to conventional one. The basic ideology is to reach a sturdy conclusion regarding the superiority of the two techniques over another. This technology also enables us in saving considerable amount of time in construction of high rise building.

5. **Ummer Farooq Hurrah1, Misbah Danish (2018):** Construction is a complex process involving basically the areas of Architectural planning, Engineering & Construction. Fortunately, some of the advanced technologies catering to faster speed of construction are already available in the country. For

e.g. Prefabrication, autoclaved blocks, tunnel formwork, aluminum formwork (MIVAN Technology) of construction etc. review consists of an overview, a summary, and an evaluation of the current state of knowledge about a specific area of research. It may also include discussion of methodological issues and suggestions for future research. This literature focused on aims to maximize the use of modern construction techniques and equipment's on its entire project.

6. **V.Sreenath, B. Prakash Rao, Anup Wilfred Sebastian, K.K.Chengappa (2018):** This paper defines in brief, the need of Modular Aluminum Formwork in the Indian construction industry and analyses the suitability of Modular Aluminum Formwork technology in a framed structure by considering the quality, speed of construction, labor requirement, cost of construction and other related factors. The same typical floor plan was also prepared in a complete Mivan design, for comparison. The estimation of cost for one floor of all the three structures using these three different formworks was prepared. The construction using Mivan technology seemed to be the most economical in the long run considering the number of repetitions possible with the formwork. The modular aluminum formwork construction was found to be as expensive as that of using conventional formwork for the RCC framed structure, considering only the initial costs (Maintenance and finishing costs are not considered),But the quality obtained with the use of modular aluminums formwork, the stability due to monolithic construction, the increased carpet area and the speed of construction.

7. **P.S.Kaushik., Govind shay Sharma, Vinod kumar., Pawan Meena (2018):** paper will describe the mythology of unconventional building construction techniques. Material selection is a complex and delicate task determined by the immense number of building material options. Likewise, multiple factors are often considered by the architect when evaluating the various categories of building materials. Green buildings is a concept on the same theory, In the effective view green construction includes, increasing energy efficiency of a building using green natural or renewable resources instead of non-renewable resources. In this paper we are presenting the factors to be considered to decide the selection of materials for green construction.

8. **S. Bharagvi pujari, D. B. Bhosale, R. D Shinde. (2018):** Among the total cost of construction a major part is occupied by formwork. Therefore, the cost of construction can be reduced by proper planning of system of formwork to be used. Usage of Formwork technology has increased extensively in construction industry as it enables faster execution and better results. Indian construction industry has eventually adopted some of the world class formwork technologies which are reasonably economical and easy for operation using semi-skilled labor. These papers aims to save cost invested in construction and reduce the time required for construction by using Kumkang formwork system and show the benefits of the Kumkang formwork system on conventional formwork system. We thus infer that using Kumkang formwork system is cost effective and saves construction time proving better quality of construction

9. **V. Aditya, Dr. s. ananda Kumar,(2018):** For a country like India where population and inflation have faded, poor people dream of owning a home will be made true only by government sponsored affordable schemes. Pradhan Mantri Awas Yojana (Gramin) is one such scheme launched by P.M Narendra modi in 2015 to provide shelters to the homeless by 2022 (i.e.) within 7 years which is a time constrain. This technology can be made useful for the PMAY scheme. In this scheme technology used for construction of affordable houses gives quality and speed achieved at high degree, which is the need of the day. The cost of construction done by the aluminum formwork technology is 18.4% lesser than the conventional methode.There will be no need to borrow money through loan or from lenders for excess cost as in the case of conventional methode.Over all government sending for this projects can be saved up to average 20% cost . This cost can be used for implementing renewable energy like solar power for the same house itself. Duration of construction by aluminum formwork technology is less than conventional .In seismic zones this technology will be best suitable than conventional and

also prefabricated structures because of use of shear reinforcement for wall also. This method is best suitable for a row houses scheme which gives cost effectiveness over the construction.

10. **Parvathy Ravi (2018):** This report is about how modern methods of construction can be used to build good quality homes more quickly and efficiently. The objective of this paper is to achieve the modern aspects of the modern construction throughout the world and to aware the people of the modern construction technology so as to save time, money, resources and energy. The research is to develop a detailed study of the current level of use of modern construction technology and market size in different constructions like load bearing R.C.C.walls with aluminum formwork technology, glass fiber reinforced gypsum load bearing, (GFRG) panels for affordable housing. The aim to make the construction market aware of the modern construction technology and to know benefits and methods so as provide greater efficiency in the construction process, resulting in increased production, better quality in less time and with less waste so reducing the environmental impact on the earth After independence, our country has made rapid strides in many spheres of life including science and technology, education, poverty, employment, household wealth, health, etc. But most important of them all is food, clothing, and shelter which we have been trying to provide for everyone but there is still a large way to go. Out of these, we are focusing more on housing as it is directly connected with our profession.

11. **Nikita Patel, namrata Verma (2017):** Monolithic system; we have to deal with the brief study of monolithic construction and have some advantages of this construction over traditional method for modern housing monolithic structure is most dominant structure which doesn't have any extra expenditure. In economical aspect and also it is a time efficient construction process. In today's world time saving is the most important agenda of everyone, so through using this procedure, housing construction field reaches in the peck All walls, slabs, stairs, together with door and window opening are cast in place in one operation at site by use of specially designed, easy to handle with less labor and equipment efforts, modular formwork made of aluminum formwork. In this system the lateral and gravity load resisting system consists of reinforced concrete wall and reinforced concrete slabs. Reinforced concrete structural walls are the main vertical structural element with a dual role of resisting both the gravity and lateral loads. Due to the resisting power of seismic waves is high in concrete working it also suitable for construction in seismic zone. In rainy areas it is also adaptable because concrete have a great resistance to seepage. In monolithic method use the industrial waste fly ash to replace 15-20% of the cement used in construction which also helps to save the environment and cost of construction.

12. **S.S.Asadi, P.v. Praneeth (2017):** Based upon the survey and comparison from live project key contributing factors that plays a significant role in selection of formwork are cost, quality, cycle time, Number of reputations, safety, administration of change orders, and performance of concrete. By comparing the above parameters through study and graphs from questioner, the fallowing conclusions can be made Cost adopted for MIVAN formwork is highest among the all formwork systems this is because of use of aluminum in making of formwork even though cost of mivan is high due to higher number of reputations the overall cost reduces which makes it favorable in repetitive kind of works. Mivan gives highest Number of reputations compared with conventional formwork. Faster construction can be achieved with formwork as cycle time is less compared to conventional formwork. As per safety management mivan is the best in the industry compared with the others Form work systems. From the above analysis mivan formwork is the highly rated formwork system, because of its higher Number of reputations in use, with smooth and exact surface finish which brings down overall cost and also provides superior quality types of structures with less time. In case of non-repetitive and availability of less labor and improper feasibility with site and storage area restrictions wood formwork is preferred to mivan formworks.

13. **Muslim (2017):** A questionnaire survey is conducted on high rise building construction projects (above G+5) for find out factors influencing formwork selection in construction projects. The Selection of formwork system is highly dependent on individual site/project environment. This study received 30 responses. Respondents were include of contractors, site engineer and project managers. The major conclusions arrived are: Erection and dismantling time is found at prime importance for the Adoption level of formwork. Wooden and steel frameworks are at maximum usage with 50% and 49% respectively. Relatively Cost wise reduction and Quality assurance are expected from construction industry at adoption level. Wooden and steel frameworks are at higher acceptance from the Formwork availability itself and involved labor supply point of view. Steel Framework is at higher demand at labor level in at various suitability of construction. And the most used formwork was steel and steel with plywood formwork because of material initial purchasing cost is low compared with mivan formwork and the observed constrain in adaptation of mivan formwork lack of confidence as well as skilled labor requirement and cost. According to their rank indexes the top 5 factors has been ranked accordingly for 30 completed surveys. The top 5 factors are quality and surface smooth, time factor, lifespan, cost and safety. For the major constrain the model need to be prepared from that project managers select the appropriate formwork to their construction sites.

14. **Vasav R. Rakholia1, Srinil H. Soni (2017):** This paper means to look at benefits and faults by utilizing an ordinary timber formwork system and current formwork system like Mivan. The examinations incorporate costs, time, and nature of these frameworks. For better comprehension of this subject, diverse development destinations are contemplated where most propel methods in formwork are utilized and the information gathered from these locales is exhibited keeping in mind the end goal to give examination between present day Mivan formwork and conventional formwork framework Formwork, which holds and supports wet cement till such time it cures, is an exceptionally key component in concrete construction. The modern methods of construction such as 'Mivan formwork system' are the key to meeting the demand for efficient, sustainable housing. Also the quality and speed must be given due consideration with regards to economy.. This type of formwork often had poor safety features and gave slow rates of construction on-site and huge levels of waste – inefficient and unsustainable. Modern formwork systems, which are mostly modular, designed for speed and efficiency. They are engineered to provide increased accuracy and minimize waste in construction and most have enhanced health and safety features built-in. by using 3R system i.e. reduce, reduced, and recycle.

E-ISSN NO:2349-0721

15. **Miss. Jyoti Suresh Magdum, Prof. Madhav Bhalchandra Kumthekar, Prof. Gayatri Dhananjay Jadhav,(2017):** In the world of competition the contractor is trying to reduce the cost of the formwork to reduce the cost of the product. But the reduction in cost of the product may leads to the problem of unevenness, honeycombing, and lack of levels & lines. To avoid this new development is taken place in the form of Aluminum formwork. Several formwork systems are in use at different places in the world, eventually the systems which are reasonably economical and easy for operation with skilled labor are more useful in India. Leading players in this industry are Doka, Mascon System, MFE Formwork Technology (Mivan), Meva, Waco, Forming Access and Support, Inc. (FASI), Peri, BSL Scaffolding, Uday Structural's & Engineers, Paschal and Pranav Construction Systems. In the present construction the cost of formwork may differ 20% to 65%, in case of fears competition contractor is always trying to complete the project in time with better & acceptable quality without line & level. If at all you want to make tool to effective shuttering the line, level or quality of concrete is increased the costs for touchup will n times high, again that may become the problem for sustainability & durability of structure. Hence in incent time lots of advancement has taken place in case of formwork technology. The world is moving basically from Timber to Steel & now from Steel to Aluminum. For AF the advantage is lightweight & more the number of usages.

16. **Prof.Ashish P.Waghmare,(2017):** Proposed an generalized approach, at early days building were constructed using conventional type form work system where wooden planks, runners, poles were used

for the form work. With the development of technology, a tend to used plywood in its place of planks, steel jacks for support instead of wooden poles. Due to increase in inhabitants, people started to construct the dwelling building. At early days buildings were constructed using modern type form work system.

17. **Naveen V. Chikkaveerayanavar, Naresh Patil (2017):** Discussed on the rise of the population of the country, the task of construction process as monumentally increased. As we all know the construction of high rise building is becoming a trend and the process of construction of these high rise building takes more time and hence to reduce the duration and cost of the project advanced technology are adopted. The new advanced technologies are manufactured for the construction of multi stored project which leads to production of cost efficient and speedy construction on residential projects.

18. **Rahul B. Mojidra1,Pinal H. Patel,Vinu R .Patel (2017):**Focused on the seismic design of buildings, reinforced concrete structural walls, or shear walls, act as major earthquake resisting members. Concrete walls are provided for the additional gravity force resistant. The properties of these seismic shear walls dominate the response of the buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately. In these papers conventional, monolithic with external walls structural systems and monolithic with internal wall system for G+ 20, G+ 25, G+ 30 story's was studied with the help of ETABS v 15 analysis and design. Additional Parameters like Lateral displacement, story drift are calculated for both the structures. we concluded that there is drastic improvement in the monolithic structure as compared to conventional structure in term of strength as well as cost.

19. **Faizan M. Munshi1, Prof. Farhan Vahora (2017):** generally, a building can be defined as 'An enclosed structure intended for human occupancy'. A building has two basic parts; Substructure or foundations and Superstructure. Over many years, engineers have observed that, there are different type of structural system which categorized by construction material (e.g. concrete, masonry, steel, or wood) and each structural system have different performance against lateral forces or gravity loads. Broad categories of structural systems are: Load Bearing wall systems (e.g. masonry, concrete), Building frame systems (e.g. concrete, steel, and wood), Moment-resisting frame systems, Dual systems, Cantilever column systems. In this, reinforced concrete shear walls are widely used in tall building for its excellent seismic behavior. The main scope of this study is to study related to different type of Structural Systems, to study of various provisions of IS 13920:1993 for shear wall, to perform dynamic analysis of G+15 storey building using response spectrum method, problem formulation for zone III and Comparative study will be carried out for; Different thickness of shear wall.

20. **Prof. R. B. Bajare, Shubham Deshmukh1, Ashwin Mahajan, Roohi Karnataki, Indrayani V. Patil4. (2017)** The purpose of choosing Mivan Technology over conventional method was the speedy construction, Monolithic homes in landslide prone zone and Strengthened structure in high rainfall intensity area. Due to complexity of reinforcement and less thickness of wall, problems of honeycombing and shear cracks due to mass concreting are observed on sites and also, the problem was identified on other sites too. Therefore these problems need to be tackled in effective way to ensure quality and safety of structure. These problems can be reduced by improving concrete characteristics to meet the objectives; performed the compression test and slump cone/ flow table test on the concrete using admixture. On site only M25 grade was used as the structure was single story building. But we have tested the M35 and M45 also because the result will be beneficial to multi story building which use the M45 and M 35 commonly and in combinations. thus this projects concludes that the problem of honeycombing will be reduced and the strength is increased by used of admixture.

21. **Miss Renuka Hangarge, Mr.Ashish Waghmare Mr. Shridhar Patil (2017):** There are several types of formwork are available in construction industry. The data collected from different companies to compare the cost, duration and quality of different types of formwork .from the analysis, initial cost for

aluminum formwork is high when compared to other types. While comparing with duration, productivity, quality and repetition. Aluminum formwork is an effective technique for mass construction projects. For typical floors aluminum formwork is economical since number of repetition are high and labor cost s comparatively lass when compared with other types. At the same time aluminum formwork is not effective for smaller projects on the project type and floor height can be chosen.

22. **P.Dinesh, M.Soundararajan (2017):** This study focused on identifying the qualitative factors affecting the selection of the formwork at various constructions. Adaptability & Flexibility (Fixable Sizes) Formwork should be modular and adaptable for various sizes and shapes of the structural system, so that it can be used for many projects. Formwork should be viable for the particular project based on cost and availability, Quality & Surface Finish Quality, of structural finish ,Availability Material and supplier availability, Cost , Type of Structure , Time Factor Faster floor cycle is always affects the formwork selection are also adaptability, flexibility, quality cost, type of structure, time factors plays major role while selection of formwork.

23. **Mitul R., Rokade Nikhil S. Bhor, Aniket K. virkar, Aksah yrode , & Maid Nilesh S.maid (2017):** When the concrete is set, the formwork is removed and a solid mass is produced in the shape of the inner face of the formwork. Formwork systems are among the key factors determining the success of a construction project in terms of quality, quantity, labor, time and cost. The purpose of this paper is to identify the various factors that influence formwork output. When considering a construction project the contractor wants to finish the work rapidly with greater profit and the client wants to use the building as soon as possible.

24. **A.sharmila1, Aaron christober (2016):** in this literature factors affecting selection of formwork were identified through literature study & experts opinion. A questionnaire survey is conducted on high rise building construction projects (above G+5) to find out factors influencing formwork selection in construction projects. The study received 30 respondents the collected data was analyzed through both Relative Important Index method and Microsoft excel. According to their rank indexes the top 5 factors has been ranked accordingly for 30 completed surveys. The top 5 factors are quality and surface smooth, time factor, lifespan, cost and safety. Based on these factors comparative table was prepared from that decision support model was made. And this was analyzed on ongoing and completed projects it gives more than 90% accurate results. From this model the project managers can select the formwork easily based on their requirements.

25. **Arbaz Kazi1, Fauwaz Parkar (2015) :**In the study project, Plastic formwork seems to be the best feasible solution for the construction project, Although DOKA, PERI, RMD etc. seems to consume less time but the overall cost is quite large and in India, where there are many uncertainties involved in a project, any stoppage of work due to whatever reason, leads to a huge impact on the pockets of developers; as Doka, PPERI and RMD needs additional equipment along with its own infrastructure to perform its functions. For this study, mivan formwork technique was not taken under consideration, as its initial cost is very high. Also recent studies have shown that mivan shuttering becomes economical only if it is used in Mass Housing Projects. The decision was made on parameters like cost, quality, speed of construction etc. but the aspects like safety, uncertainties, site restrictions and constraints must be studied in detail to have a complete picture of reality and hence arrive at a more precise and trustworthy decision.

III. CONCLUSION

Based on literature survey it can be concluded that the modern methods of construction such as mivan formwork system is the way to meet the requirement of efficient and sustainable housing. Mivan formwork construction system is able to provide high quality construction at affordable cost with unexpected speed of construction. This technology has a great potential for application to present Indian scenario to provide affordable housing to its rising population. An overhead charge in mivan

formwork reduces with subsequent use and fast construction. The traditional formwork can be used for 7 to 8 times whereas Mivan formwork can be utilized for more than 250 times. Mivan formwork overcomes the issues of repairs and modification due to improper workmanship. Mivan formwork can be said the most appropriate system for high rise and massive construction projects. Thus it can be summarized that mivan formwork system can be economical for projects of repetitive and massive in nature or else conventional formwork system would be economical.

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