

# A Review Paper on Aluminium Formwork and It's Utilization in Affordable Housing

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## ABSTRACT:

In affordable housing selection of formwork system is a crucial factor for the completing a houses in less time. Formwork consists about 35-40% of cost required for any RCC member. In this review paper study conventional and aluminium formwork. Conventional formwork is suitable for the small housing project. Aluminium formwork is suitable for mass housing and high rise building project. This study aims to do comparative analysis in between the conventional and aluminium formwork on the time, cost and quality parameters. Government affordable housing scheme like Pradhan Mantri Awaas Yojana (PMAY), require mass construction of houses in minimum duration at minimum cost. Aluminium formwork provides cost effective houses in minimum time. Aluminium formwork gives superior quality finished walls and slab which does not require the plaster.

**KEYWORDS:** Aluminium formwork, Conventional Formwork, Affordable Housing, Duration, Cost

## INTRODUCTION:

In the whole world construction industry is one of the biggest industries. After agriculture, the construction industry is the second largest industry in India. In India construction industry provides employment to larger number of people. Construction industry has significant contribution in the Indian economy. Construction industry impacts GDP growth rate by 11% (2015). Formwork plays an important role in building construction so make the right decision in choosing between different type formwork. Formwork consists about 35-40% of cost required for any RCC member. By choosing appropriate type of formwork, cost of construction will reduce.

Aluminium formwork system was developed by a Canadian engineer W.J. Malone in late 1970s. Aluminium formwork was developed for low cost housing unit in developing countries. Aluminium formwork has been used extensively in Europe, Gulf and Asian countries. Aluminium formwork is suitable for the mass building construction or high rise building construction. This formwork casted concrete wall and slabs monolithically in one continuous pour. Aluminium formwork is stronger and easy to handle. Aluminium formwork can be used repetitively around 200-250 times.

India's population is the second largest population. Due to increasing population in the India, the demand of housing is also increases. In recent years cost of houses increases rapidly due to high demand of houses and inflation. In India, major part of the population comes under the low income group (LIG) and economically weaker section (EWS), who cannot afford house. Indian government launches many schemes under affordable housing for economically weaker people who cannot afford buying a house. Affordable housing refers to housing units that are affordable by that section of society whose income is below the median household income. Pradhan Mantri Awas Yojana is a government scheme which will provide houses for urban poor people with a target of 20 million affordable houses by 31 March 2022. Mass construction of houses is required for complete this demand. Aluminium formwork is cost effective when used in mass construction. Aluminium formwork require less time than conventional formwork. Houses construct from aluminium formwork require less maintenance cost. So aluminium formwork can help in provide affordable in less time.

**LITERATURE REVIEW:**

**Prof. R. B. Bajare, Shubham Deshmukh, Ashwin Mahajan, Roohi Karnataki and Indrayani V. Patil (2017)** have mentioned the remedies to common faced in the Mivan Technology. They have studied on the deficiencies like Honey-combing, Cracks due to shrinkage in the concrete and segregation. Objectives of this study to increase workability of concrete, increase strength of concrete and reduces cracks due to shrinkage of concrete.

**Sreenath. V, B. Prakash Rao, Anup Wilfred Sebastian and Chengappa K.K (2018)** have studied on the analysis the suitability of modular aluminium formwork technology in a framed structured by considering the quality, speed of construction, labor requirement, cost of construction and other factors. They have conducted study on a project in Bangalore, Karnataka, India namely Salarpuria Sattva Divinity which comprises of a commercial (2B+G+5) and ten residential towers (G+21). A comparative study in between the Conventional RCC Framed Structure, Aluminium Formwork on RCC Framed Structure and Mivan Structure. The research defines the advantages and limitations of using modular Aluminium Formwork.

**SS. Asadi and PV. Parneeth (2017)** have done a comparative study on different types of formwork utilized in construction industry. This study shows advantages and disadvantages of different type of formwork used construction project. This study gives the method of selecting the best suitable formwork for the building. A questionnaire survey conducted in 22 major companies like L&T, SPRE, GDCL, NCC etc. Comparative study of formwork is based on various factors like Cost, Quality, Safety, Cycle Time etc in different regions like Mumbai, Chennai, Hyderabad, Banagalore and Pune.

**K. Loganathan and K.E. Vishwanatahn (2016)** have done a study on cost, duration and quality analysis of different formworks in High-Rise Building. The different formwork, on which the study has been done, are Conventional, Modern Conventional, Steel and Aluminium Formwork. This study mention the various types of factors for selection of the formwork are duration, repetition, quality, cost, safety, type of structure and maximum load capacity etc. The study have been done on four different companies project which are True Value homes, Sri Dhaksha projects, Gannon Dunkerly & Co ltd and Sri Jay Constructions. According to this study aluminium formwork scrap value is 50%, which is higher than other type formwork. In this study, the major disadvantage of aluminium formwork is that no changes can be done once the formwork fabricated.

**Jignesh Chotaliya and Hiren Rathod (2016)** have compared the Aluminium Formwork and Conventional Formwork system. Comparison has been done on the basis of cost and time parameters. In this study shows beenefits and disadvantages of the aluminium formwork. According to this study, aluminium formwork gives high quality of construction at higher speed and reasonable price.

**Yadav P.D and Konnur B.A (2018)** have done study on the comparison in between the Conventional and Mivan Formwork. In this the comparison has been done on the cost and duration factors of the formwork. Estimated duration of aluminium formwork is 98 days to complete the first floor while the conventional formwork took 167 days to complete the first floor. In this study, construction cost is higher in Mivan formwork than Conventional formwork. Mivan formwork Duration is almost 25% less than the conventional formwork.

**Mayank Patel, Jayesh Kumar Pitroda and J.J. Bhavsar (2015)** have done a case study on Godej Garden City located in Jagatpur, Ahmedabad which is constructed by using the Aluminium formwork. In this project two types of Aluminium formwork used which are Kumkang Aluminium formwork and Mivan Aluminium formwork. According to this study, aluminium formwork saves duration and cost of the construction work. Due to light weight of Aluminium formwork is labor friendly and easy to handling. Aluminium Formwork gives better surface finishes so no need of plaster.

**Himanshu Rivankar and Akshay Chordiya (2017)** have done a comparative study on the merits and demerits of the conventional timber formwork and aluminium formwork. The various factors which included in this study are cost, time and quality of the formworks. The studies mentioned the various types of components of used in aluminium

formwork. This study shows slab cycle time for aluminium formwork is 10 days while conventional formwork slab cycle time is 21 days. This study mentioned that overall cost of the project using Aluminium formwork is less than using the Conventional formwork.

**Nagi Reddy Sattigari, Ashwin Mahalingam and George Thomas (2017)** have developed the software application for automation of scheme preparation and BOQ calculation of Aluminium Formwork. Software application has been developed using visual basic 6.0 for the L&T project. This application used spatial details of a building from AutoCAD drawing and used optimization algorithm to develop a formwork and Bill of Quantities. This application used in two ongoing L&T projects for validation. The advantages of this software application are reduction in fabrication costs, reduction of lead time between drawings received and execution, eliminate errors in BOQ calculations and improve readability of scheme drawing. This application tool can use in regular or irregular rectangular or square shapes but it cannot develop schemes for curved or inclined shapes.

**Ashish P. Waghmare and Renuka S. Hangarge (2017)** have done comparative between the Conventional, Aluminium and Tunnel Formwork. The factor consider in this comparison of formwork are cost and time. This study has been done on three different residential building with G+12 floors which used different formwork. This study showed that construction cost of conventional formwork is high while tunnel formwork is low. Time required using aluminium formwork for construction is less than conventional but more than tunnel formwork. Tunnel formwork is most cost and time effective than others.

**Rabi Das, Indranail Bhattacharya and Raja Saha (2016)** have done comparative study on different type of formwork used in construction industry. This study divided the formwork into two types. Based on the materials different formwork used in construction industry are timber formwork, plywood formwork, steel formwork, aluminium formwork, plastic formwork and fabric formwork. Based on the structural member type of formwork used in construction industry are wall formwork, column formwork, beam work and foundation formwork. This study shows the striking procedure of formwork. This study shows estimation of cost deduction due to repetitive use of aluminium formwork. Aluminium formwork initial cost is very high but it is more economical when used several times.

**Pujari Bharagvi S., D. B. Bhosale and R.D. Shinde (2018)** performed a study on Kumkang Aluminium Formwork system. This study gives brief information about the different component of Kumkang aluminium formwork. This study gives brief detail about various type connectors used in the assembly of Kumkang Aluminium Formwork. Cycle of Kumkang aluminium formwork is about 8 days. This study shows the advantages and disadvantages of Kumkang aluminium formwork. Procedure of erecting the aluminium formwork also mention in this study. This study based on the comparison of Kumkang aluminium formwork and Conventional formwork. Kumkang aluminium formwork gives superior quality and high speed work than Conventional formwork. Kumkang aluminium formwork is cost effective over the Conventional formwork.

**Renuka Hangarge, Ashish Waghmare And Shridhar Patil (2017)** performed a study on the comparison of Conventional, Aluminium and Tunnel formwork. This study shows that waste generated from formwork is high in the complete process of construction a building. Aluminium formwork generated less waste than conventional formwork. The total project cost reduced about 40% by using the aluminium formwork over conventional formwork. The total duration using aluminium formwork is about 50% less than conventional formwork. The number of repetition of aluminium formwork is about 200-250 which make aluminium formwork more economical.

**R. Thiyagarajan, V. Panneerselvam and K. Nagamani (2017)** have studied on aluminium formwork used in High-Rise building construction. This study gives current existing formwork system used in mass housing construction in Tamil Nadu. This study based on the project duration, project cost and quality of work affect due to the type of formwork used. A comparative study of conventional and aluminium formwork has been done. The floor cycle of aluminium formwork in this study is 7 to 10 days. Aluminium formwork is 100% recyclable material so it saves environment such as reduces tree cutting.

**Ninjal M. Parekh, Bhupendra M. Marvadi and Umang Patel (2015)** performed a comparative study on the different type of formwork used in construction industry. The aim of this study is to maximize the quality of work, reduced the time and construction cost of project. Two building project has been taken for this comparative study. First project is Paavan city Modasa and second project is Tulsi city Badlapur. Both project used the aluminium formwork for the construction of building. Cost comparison in between Paavan city aluminium formwork and conventional formwork shows that when aluminium formwork used 50 times than it cost of construction 2% more than the conventional formwork but when aluminium formwork used 160 times than it cost of construction 20% less than the conventional formwork. Time taken for the construction of one block in the Paavan city is 64 while conventional formwork taken the 242 days. Scrap value of aluminium formwork is 50% which is higher than conventional and steel formwork.

**Patil R.S., Pawale D.B., Tambe H.D., Pawar P.D. and Wakchuare A.V. (2016)** performed a study on Mivan technology using aluminium formwork. This study shows a comparison of cost and time in between the conventional formwork and Mivan Formwork technique. Mivan formwork technique gives more seismic resistance to structure than conventional formwork. Mivan technique has less number of joints which reduces the leakages and increase the durability.

**Swapnali M. Karke and M.B. Kumathekar (2015)** have been done a comparative study in between the traditional and modern formwork system. Timber conventional formwork and plywood conventional formwork comes under the traditional formwork. The different types of modern formwork are Mivan formwork, tunnel formwork, climbing formwork, flex formwork, heavy duty tower system, slab formwork and column formwork system. This study has been done on traditional formwork, mivan formwork and steel formwork. This study shows that wastage due to formwork is about 27.5% of total material wastage in construction industry. This study concluded that mivan technology and steel formwork reduces the construction cost in less time.

**Prathul U. and Leeladhar Pammar (2015)** studied on the analysis of the productivity by comparing Mivan and Conventional formwork. This study data has been collected from Brigade Compolis site under taken by Shapoorji Pallonji & Co. Ltd in Bangalore. Productivity calculated by using the formula (Productivity= Quantity of work done/ Number of Man-day's). Average Productivity of conventional formwork is 2.1Sqm/man-day's while average productivity of mivan formwork is 5.8 Sqm/man-day's for the same site conditions.

**Jyoti Suresh Magdum and Madhav Bhalchandra Kumthekar (2017)** performed the Comparative study on the various types of Aluminium Formworks. Comparison of the aluminium formwork has been done by using time parameter and cost parameter. Aluminium formwork divided into two types on the basis manufacturer company which are Mivan and Kumkang. For data collection used two different projects. Case study of Blue Ridge is constructed by using Mivan technology while case study of Nanded City is constructed by using Kumkang technology. Construction cost using Mivan technology is 8331 per square meter while using Kumkang technology is 12912 per square meter.

**Aaqib Majid Khan and Chitranjan Kumar (2017)** described the need of mivan formwork in Indian construction industry. Comparative study has been done on conventional and aluminium formwork. This study describes all activities uses in mivan technology. Different type of parameters used for comparison of mivan formwork and conventional formwork. This study shows that mivan technology give speed of construction, superior quality, smooth finishes and less maintenance cost over the conventional formwork. Concrete used in mivan formwork gives more strength than concrete used in conventional formwork.

**Shankar Bimal Banerjee, Pawan Dilip Barhate and Vipul Pradip Jaiswal (2015)** study gives the brief introduction of Mivan technology. This study shows Aluminium formwork load bearing capacity is about 7-8 tonnes per square meter and weigh around 18-20 kg per square meter. This mentioned cycle time of aluminium formwork is 7 days per floor. Mivan technology provides high quality construction at reasonable price in short duration.



**Danish Sadruddin Ansari and Pratik Sudhakar Kudale (2016)** performed comparative analysis of Mivan formwork Building and conventional formwork based on the cost and time parameter. Building used for the case study has G+21 floors. Mivan formwork sealed area is 8747.28 square foot and conventional formwork sealed area is 9786.67 square foot. This study uses cubic contents method and bar bending schedule formula for the estimation of material. This study is done for a project at Hinjewadi phase-3, by Peagasus Properties Pvt. Ltd. This study shows that cost of construction in mivan formwork increases by 20-25% than the conventional formwork. Mivan technology uses 25% less duration than conventional method.

**Patil Dhanashri Suryakant and Desai D.B (2013)** studied on the cost analysis & effectiveness of Mivan formwork over the conventional formwork. This paper is based on the case study of Godrej Garden Enclave which is constructed by the construction division of Godrej and Boyce Mfg. Co. Ltd. Different type of component of aluminium formwork is also described. This comparative study of formwork based on the cost and time parameter.

**Dr. M.N. Bajad, Rohan P. Shah and Harsh Kumar C. Ughareja (2016)** performed study on the aluminium formwork system. Necessity, advantages and disadvantages of aluminium formwork is also described in this study. This paper based on comparative study in between the conventional and aluminium formwork. This study shows that selection of aluminium formwork depends on the project type and project requirements. Aluminium gives high quality of construction and it is cost effective for the mass construction. Aluminium formwork require less time than conventional formwork.

## CONCLUSION:

Aluminium formwork is lightweight and easy to handle. Aluminium formwork is cost effective than conventional formwork for mass building construction. Aluminium formwork floor cycle time is less than the conventional formwork. Aluminium formwork gives the superior quality than the conventional formwork. Aluminium formwork initial cost is higher than the conventional formwork. Aluminium formwork is not cost effective when it used smaller project. Aluminium formwork require less maintenance. Aluminium formwork gives good finish surface than conventional formwork. Aluminium formwork is very much suitable for the high-rise building construction. Aluminium formwork require less duration than the conventional formwork. Aluminium formwork gives more seismic resistance to the structure. Aluminium formwork can be use in the construction of affordable housing because it is cost effective for mass construction building.

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