Structural Design of Aluminium Formwork Used in Highrise Building

Sanket S. Desai[1], Dr. V. R. Rathi[2]
P.G. Student, Pravara Rural Engineering College, Loni, Maharashtra, India[1]
Professor, Dept. of Civil Engineering, Pravara Rural Engineering College, Loni, Maharashtra, India[2]

Abstract **- The role of Formwork is important for concrete to harden in the desired shape. Formwork is the temporary or permanent support structure/mould into which concrete is poured. It is also known as centring or shuttering to gain strength and durability.**

The aluminium formwork construction method is 25-year older methods in Europe countries. but this method of construction is new type in India. This method is fastest construction compare with another present work is deal with design, construction period and estimation. In Aluminium formwork all members are constructed using concrete, which consist of only walls and slab. Framed structure is beam, column, and slab. The wall is 250mm thick brickwork. Present work selects same plan of structure and compare structural design, estimation and project duration in aluminium formwork and conventional method. 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 1 to 2% of the total project cost of the structure and this material is used for 300 times of repetition .

When considering a construction project 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 present study is to 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.

I.INTRODUCTION

In every year the construction industry provides new techniques up to date. The aluminium formwork construction technique is a new technique in the construction industry. This type of construction provides speed, high strength and quality of the structure. Aluminium formwork another name is Mivan technology.

The construction industry is one of the biggest industries in the whole world. The contribution of this industry towards the global GDP is enormous. In recent years due to globalization and advancement in technologies there has been a tremendous development in the construction industry. However, despite of the boom in construction activities the scenario on the housing front remains far from satisfactory.

This type of construction is a successful construction in East Asia and European countries. This type construction used in part of Burj Kalifa in Dubai. Aluminium formwork construction is a load bearing structure and wall is construction of reinforced cement concrete.

Aluminum formwork consists of high strength RCC wall. The load carried by RCC wall. This is more earthquake resistance compare to framed structure. Aluminum is a high strength material and long life compares with wood and plywood. Aluminium formwork is no need to provide wall plastering whereas Framed structure need wall plastering. Due to ever increasing population in countries there is an overgrowing demand for housing. Now keeping in view the gigantic task of providing affordable shelter to masses, adoption of modern and cost effective technology assumes greater significance.

1.1Advantages of Aluminium Formwork

Aluminium Formwork System is highly suited to load bearing wall construction whereas traditional formwork consisting of plywood and timber is not suitable to the high pressures of fresh concrete on the wall.

a. Cost: Use of this formwork in load bearing design gives an average of 15 per cent cost saving in the structure of the building and increased usable floor space of 8 per cent over RCC design.
b. Time: For 100 per cent work, construction through slab beam wall construction takes X time and through Aluminium Formwork technology the time required is 1/6th of the X time.
c. Environment Friendly: The technology is environment friendly as there is no use of timber. The formwork gives the box or cellular design resulting in the walls giving support to the super structure in two directions. As a result, the structures are more resistant to earthquakes than the traditional RCC column and beam designs.
d. Lifting: As the Aluminium Formwork is lightweight, no tower cranes are required for the same unlike in tunnel framework.
e. Labours: Due to simplicity of the assembly, only unskilled labors are required with minimal supervision.
f. Repetitions: The Aluminium Formwork System is removable and can be reused hundreds of times with little maintenance.
g. Scrap Value: Moreover, the requirement of steel is also reduced in this technology as aluminum has a higher scrap value.

1.2Limitation 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.

1.3Component of Aluminium Formwork

A) RK:- mostly start from floor level, rarely start from different level, standard fabrication drawing, width varies from 50 to 600 mm, hieght 50mm but it can changeable based on project.

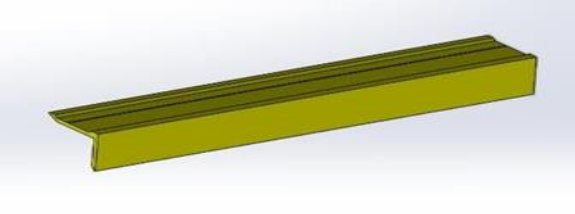


Figure 1.1 :- Rocker

B) Wall panel (W):- start 50 mm above from floor level, Standard fabrication drawing Width varies from 50 to 600 mm, Some std lengths-2050, 2250, 2400, 2450 etc. Or vary as per project.

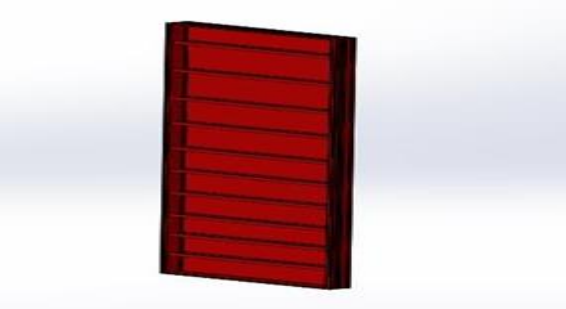


Figure 1.2 :- Wall Panel

C) IC,ICL,ICR:- Section 100x100 ,start 50mm above from floor level ,standard fabrication drawing.

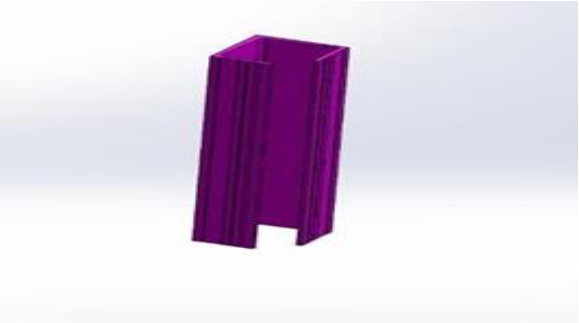


Figure 1.3 :- Internal Corner

D) SB :- Beam bottom panel, standard fabrication drawing, use when beam width more than 200mm,beam width = panel width, maximum length up to 800 mm.

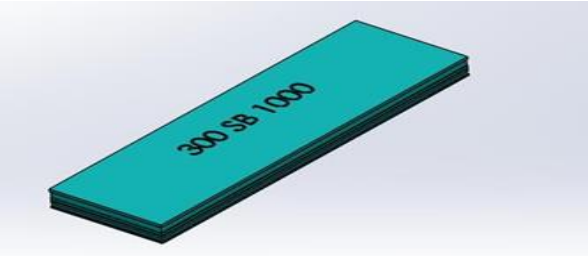


Figure 1.4 :- Beam Bottom Panel

E) CP:- Channel with single prop at Centre, standard fabrication drawing,a<=200

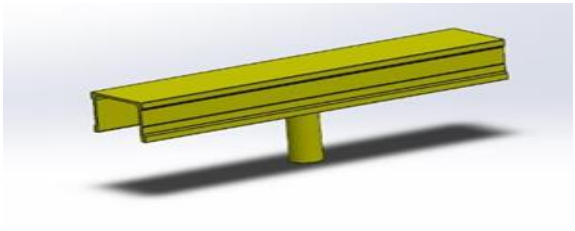


Figure 1.5 :- Channel Prop

F)PH:- Sheet panel with single prop at Centre, mostly uses at beam junctions, fabrication drawing by design department.

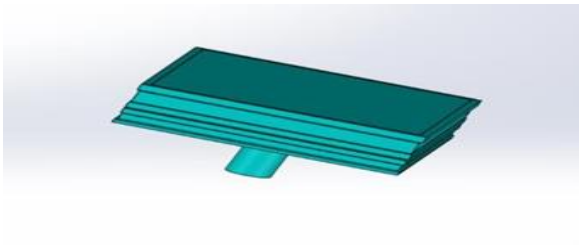


Figure 1.6:- Prop Head

G)KICKER:-

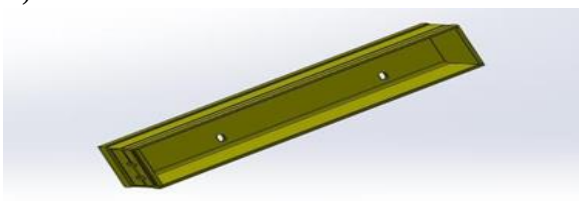


Figure 1.7 :- Kicker

H)Formwork Structure

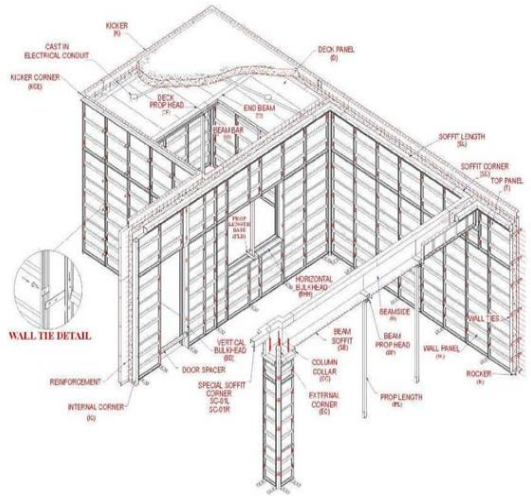


Figure 1.8 :- Mock of Aluminium Formwork

II.RELATED WORK

Aarti Nanasaheb Kote. et.al. [2009]

The aluminum formwork system was developed by the Malaysian Company, which is why the alumin formwork technology is named after it Mivan is coming up with new construction technology for the successful complete ion of a mass housing project in India. In this project, we discussed the cost Comparison of Mivan technology with conventional construction technology. The technology of Mivan is absolutely fine with cost, quality and time saving as compare to conventional. Outcome for this paper, Compared to the conventional method, construction costs with MIVAN formwork are by Approximately 1to 2% of total cost of structure is used for 300 times of repetition for structure.[1]

Sandip.P.Pawar. et.al. [2014]

One of the most important factors in determing 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 1 to 2% of the total project cost of the structure. When considering a construction project 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 high-rise building 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 this paper is to present about the existing formwork types in Maharashtra and to show each one will affect the project duration, project cost and the quality of the work. For that a research has been carried out and outcome of this paper, when the aluminum formwork is used in the construction project, the total project cost and the duration of the project is lesser than the other formwork types.[2]

Kushal Patil. et.al. [2015]

The Mivan technology is absolutely fine with cost, quality and time saving as compare to conventional. In this project we have taken a review from the people who are occupying the houses constructed by mivan technology to get the feedback from occupant on

mivan technology. The project also include remedial measure for one of the defect in mivan technology i.e. segregation while placing the concrete resulting honeycombing in shear walls by using "Master Glenium ACE 30JP" admixture. outcome of this paper, mivan technology is the need of time to solve the problems of mega housing projects in India.[3]

N.Kalithasan1. et.al. [2016]
The aluminium formwork construction method is 25 year older methods in Europe countries. But this method of construction is new type in India. This method is fastest construction compare another type.Our project is to compare than design, construction period and estimation. In Aluminium formwork all members are constructed using concrete, which consist of only walls and slab. Framed structure is beam, column, and slab. The wall is 250mm thick brickwork. This project selects same plan of structure and compare structural design, estimation and project duration in aluminium formwork and conventional method. outcome of this paper, project time is half of framed structure. So, consider reducing labour cost in aluminium structure. And another think Aluminium formwork structure is more strength and earthquake resist compare than framed structure.[4]

K.Loganathan . et.al. [2016]
The selection of a suitable formwork system in high-rise building construction is a crucial factor to success the project on time. So the selecting a suitable formwork system to affects the entire construction cost, time and quality of construction. The objective of this study is to identify the different formworks used for the construction of high-rise building. And also analyzing the advantages, limitations and site-specific problems in usages of such formwork in tall building. For that, five ongoing projects are selected and data is collected to identify how each type will affect the project cost, project duration and project quality from selection of formwork. This will helpful for the contractor to choose appropriate formworks for construction project. outcome of this paper, 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 project.[5]

Mr. Amol S. Deshmukh. et.al. [2016]
For any successful project there should be proper planning, detailed thinking, and good management. Along with that construction methodology & technology is also very important nowadays. In construction one of the important factors is formwork. The cost of formworks is much higher than we consider it in project cost; it is around 20-25% of the project cost. The quality of construction mostly depends on the formwork used. Now a day to cast RCC load bearing structure in a monolithic way, advance formwork technologies like Tunnel formwork, Aluminium formwork and Doka formwork is used. It includes the walls, beams and the slab to be cast monolithically. This paper aimed at studying the Tunnel Formwork and Aluminium Formwork and compare on basis of time & cost parameters. outcome of this paper, Completion in 1/3th time than that by Aluminium Formwork system). Hence in long term consideration Tunnel formwork system is beneficial than that of Aluminium Formwork system.[6]

Pathan Majead H. et.al. [2019]
Man from the start of time is known to have construction etiquettes. In the high-rise buildings, the core is one of the most important elements in such enormous structures. Fast and efficient construction of the concrete core of a high-rise building is essential to maintain phased progress on other parts of the building. Formwork is one of the most important factors in determining the success of a construction project in terms of speed, quality, cost and safety of work as it accounts about forty percent of the total project cost of the structure. 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 selected 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, fibre glass, etc. Significant use of advanced formwork is suitable for complex construction processes and provides best results in cost effectiveness. This project describes the comparative analysis of conventional formwork and modern formwork techniques.[7]

L Ravi Kumar. et.al. [2019]
Computer Aided "Analysis, design and estimation of RC Shear Walls G PLUS 13 Multi-Storied Residential Building" involves analysis of building frames by using STAAD Pro. Conventional method of analysis involves lot of complications and tedious calculations such analysis is a time-consuming task. Analysis can be made quickly by using software's. STAAD Pro is the leading design software in the market. Many design companies use this software for their project design purposes. Hence this project mainly deals with the analysis of the building by using STAAD Pro , drafting by AutoCAD, Architecture design by REVIT architecture and Estimation done by the MS excel. Outcome of this paper , this type of formwork saves time ,cost & gives strength of structure.[8]

Israth Ansari Shaik. et.al. [2019]
Nowadays due to the globalization has brought a lot of changes in the ways of construction across the globe because the spread of newer and innovative technologies across the communities in the world has become simple and the cross-border knowledge sharing has become faster and accurate. Formwork, which temporary structure, help in mounding of concrete into desired shape Support the loads imposed on it holds as well as underpins wet cement till the time it fixes, is a critical component in development. This investigation plans to look at benefits and negative marks by utilizing a regular timber Formwork framework, Reusable Plastic /PVC/Aluminum Formwork System, Table Form/Flying Form systems, Jump Form System Slip Form Systems and Permanent Insulated Formwork Systems in the construction industry in developed countries has improved the standard of the construction industry. One of the most important factors in the determining understand the recent advancements in the Formwork systems with reference to their technological advantages over the traditional Formwork systems and to compare and analyze the impacts of the advancements in the Formwork systems over the traditional Formwork systems on the construction project management. Form the above problem research has been done, are the rectified results will present in this study. the project quality of the work. Outcome of this paper, The duration of the project gets reduced to 15-20% when applying this advancement formwork in the construction site. By using this advancement formwork cost gets reduced to nearly 20- 25 %. The safety and efficiency of the work get improved to 10-15%.[9]

Prasad Kolekar. et.al. [2020]
In this day, to fulfill the need of shelter of population growth and increasing industrialization, fastest construction need at the short time. In construction industry Formwork act upon key role in construction. It constitutes 60% time and 40% cost of the total project value. We know the difficulties& wastage in construction by using conventional formwork system. So there is New Technology invented named Mivan Formwork System. In this paper we done with detailed study of Conventional Formwork firstly and after that we passed out so many Drawbacks for this Formwork. Then we started detailed study of Mivan Formwork system and overcome the drawbacks of conventional formwork system so that we are achieved final conclusion of the paper Mivan Formwork is cost effective, time efficient and produces better quality if the quantum of work is more.[10]

Objectives Of Study
Present 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.
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.
Aluminium formwork aim to maximize the used of modern construction techniques and equipment on its entire project. The aluminium formwork system can achieve not only faster rate of construction but can also bring down the structural cost by 1 to 2% percent over the conventional method with lesser labour input.

III.METHODOLOGY

The methodology includes collection of data from the site visits, interviews with project manager, site engineer, workers, from literature review, internet etc. The building plans, structural drawings for the proposed houses are obtained from the design

engineers. The quantity estimation of materials is calculated by multiplying the length, width and height of the elements. The cost per unit is calculated with the actual and average rates of material available in the market.

3.1Physical Properties of Aluminium Construction Material:-

There are certain essential physical properties of aluminium, which is essential for the design.

A) Weight of Aluminium Metal

The density of aluminium is 2.70g/cm^3, while this is 7.9g/cm3 for the structural steel used in construction. The values of alloys that is used for the wrought products will lie in the range of 2.67 – 2.80 g/cm^3. An approximate value of 2.7g/cm^3 can be used in the design also by following formula: For sections, Mass = 0.0027A Kg/m and Weight = 0.027A N/m For Plate sheet, Mass = 2.7t kg/m^2 and Weight = 27t N/m^2

Here A= sectional area in millimeter square and 't' is the thickness of the plate in millimeter (mm). The table-1 below shows the density of various metals along with aluminium.

Table 3.1:-Density of Different Metals

Element		Density in (g/cm^3)	Density relative to Al
Lithium	Li	0.53	0.20
Magnesium	Mg	1.74	0.64
Aluminium	Al	2.70	1.00
Titanium	Ti	4.51	1.67
Zinc	Zn	7.13	2.64
Tin	Sn	7.28	2.70
Iron	Fe	7.87	2.92
Copper	Cu	8.93	3.31
Silver	Ag	10.50	3.89
Lead	Pb	11.34	4.20
Gold	Au	19.28	7.15
Osmium	Os	22.58	8.37

B) Elastic Constants

The modulus of elasticity (E) of the aluminium metal is very low. The metal is kind of springy in nature. The pure aluminium at the room temperature is compared with the structural steel based on modulus of elasticity as follows:

Pure Aluminium have a value of E = 69kN/mm^2 The Structural Steel have a E = 205kN/mm^2.

The value of E for wrought alloys range between 69 to 72kN/mm^2. The British standards employs an E value equal to 70kN/mm^2. This is employed for design purposes and this value is similar to that of glass. The modulus of elasticity of aluminium will decrease in a steady manner with an increase in temperature. This drops from 67 to 59 kN/mm^2 from a temperature of 100 to 200 degree Celsius respectively. The Poisson's ratio is higher than that considered for the steel. This is based on the experiments and the researches considered. The value of shear modulus is given by: G = E/ (2(1+v); ————Equation no: - 1

If the value of Poisson ratio v = 0.33, then the shear modulus G = 26kN/mm^2.

C) Thermal Expansion of Aluminium

The coefficient of thermal expansion of aluminium is = 23.5 x 10-6^{o}C. This value for the wrought alloys lie in the range of 22 -24.6 x 10-6^{o}C. A value of 23 x 10-6^{o}C is used by the British Standards in the design of structures. The value of coefficient of thermal expansion increase with temperature.

D) Melting Point of Aluminium

The aluminium have a melting point of 660oC under pure condition. This value is 1500^{o}C for mild steel. The alloys used have a lower melting point. The boiling point of the metal is 1800^{o}C.

E) Electrical Conductivity of Aluminium

This is a standard material used in the making of conductors in the overhead transmission lines. This metal competes with the copper in certain applications. The resistivity of the aluminium metal at the room temperature is 2.7-ohm cm. This metal on alloying have greater change.

3.2 Stages of Aluminium Formwork Technology:

Aluminium formwork technology consists of the following stages which are carried out in planned manner. Each and every activity is interlinked with each other. Productivity of the work will be greater than in conventional method. Same stages are repeated for same design of houses which are of same design.

- Wall Reinforcement
- Wall Formwork Erection
- Slab formwork Erection
- Slab Reinforcement

- Monolithic Concreting
- Deshuttering Panels

DESIGN OF WALL PANELS (ALUMINIUM)
Pressure from Concrete = 26 kN/m^3 Max Pouring Height = 2 m
ACI 347 = 57.07 kN/m^2
CIRIA Report - 108 = 53.51 kN/m^2
Max Hydrostatic Pressure shall be at Bottom Portion = 26*2 = 52.00 kN/m^2
Design Pressure with F.O.S. =1 = 52.00 kN/m^2

A.DESIGN OF MEMBER 1 – SHEET Span-1
Span(1)=0.205m
Pour Height = 2 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
Stress available in Table 25 of IS 8147- 1976
=143 N/mm²
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 52.0000 kN/m^2 B.M. = 52*0.205^2/10 = 0.21853 kN-m
Z required = (0.21853*1000000)/143
= 1528.1818 mm^3
Z available I xx/y = 2406.6667 mm3 SAFE Deflection = (2.5/384)*(WL4 /EI)
= 1.898 mm SAFE
0.585

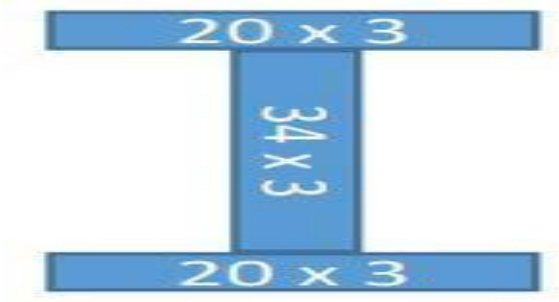
0.325	9
0.325	8
0.300	7
0.275	6
0.250	5
0.250	4
0.225	3
0.225	2
0.225	1

Standard Wall Panel
Span-2
Span (2) = 0.205 m
Pour Height = 1.775 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4
y = 0.0019 m
Pressure on Sheet = 46.1500 kN/m^2
B.M. = 46.15*0.205^2/10 = 0.193945375 kN-m Z required = (0.193945375*1000000)/143
= 1356.2614 mm^3
Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.684 mm SAFE Span-3
Span (3) = 0.205 m
Pour Height = 1.550 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 40.3000 kN/m^2
B.M. = 40.3*0.205^2/10 = 0.16936075 kN-M Z required = (0.16936075*1000000)/143
= 1184.3409 mm^3
Z available I xx/y = 2406.6667 mm3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.471 mm SAFE Span-4
Span (4) = 0.230 m
Pour Height = 1.325 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 34.4500 kN/m^2
B.M. = 34.45*0.23^2/10 = 0.1822405 kN-m
Z required = (0.1822405*1000000)/143
= 1274.4091 mm^3
Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.992 mm SAFE Span-5
Span (5) = 0.23 m Pour Height = 1.075 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m4 y = 0.0019 m
Pressure on Sheet = 27.9500 kN/m^2
B.M. = 27.95*0.23^2/12 = 0.123212917 kN-m
Z required = (0.123212916666667*1000000)/143
= 861.6288 mm^3
Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.616 mm SAFE Span-6
Span (6) = 0.255 m
Pour Height = 0.825 m

Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 21.4500 kN/m^2
B.M. = 21.45*0.255^2/12 = 0.116232188 kN-m Z required = (0.1162321875*1000000)/143
= 812.8125 mm^3

Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.874 mm SAFE Span-7
Span (7) = 0.28 m Pour Height = 0.55 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 14.3000 kN/m^2
B.M. = 14.3*0.28^2/12 = 0.093426667 kN-m
Z required = (0.0934266666666667*1000000)/143 = 653.3333 mm^3
Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.816 mm SAFE Span-8,9
Span (8,9) = 0.305 m
Pour Height = 0.25 m
Density of Concrete = 26 kN/m^3 Sheet Thickness = 0.0038 m
I xx = 4.57267E-09 m^4 y = 0.0019 m
Pressure on Sheet = 6.5000 kN/m^2
B.M. = 6.5*0.305^2/12 = 0.050388542 kN-m
Z required = (0.0503885416666667*1000000)/143 = 352.3674 mm^3
Z available I xx/y = 2406.6667 mm^3 SAFE Deflection = (2.5/384)*(WL4 /EI) = 1.162 mm SAFE

B.DESIGN OF MEMBER 2 - I STIFFENER



I STIFFENER
Span = 0.586 m
Stress available in Table 25 of IS 8147 - 1976 is 143 N/mm^2
I xx = 50986 mm^4 Y = 20 mm
Pressure on Member '1' = 1.775*26 = 46 kN/m^2 Load = 46.15*(0.225/2+0.225/2) 0.250
= 10.38375 kN/m
B.M. = 10.38375*0.586^2/12 = 0.2971 kN-m Z required = 0.29714485125*1000*1000/143
= 2077.9360 mm^3
Z available = I / y = 2549.3000 mm3 SAFE Deflection = WL4 /384EI = 0.908 mm SAFE

C.DESIGN OF MEMBER 3 - SIDE FRAME

SIDE FRAME
Span (Wall tie spacing) = 0.400 m
Stress available in Table 25 of IS 8147 - 1976 is 143 N/mm^2
I xx = 114427.08 mm^4 Y = 32.5 mm
Pressure on Member '1' = 1.775*26 = 46 kN/m^2 Load = 46.15*0.586/2 = 13.52195 kN/m
B.M. = 13.52195*0.4^2/10 0.250 = 0.2164 kN-m
Z required = 0.2163512*1000*1000/143
= 1512.9455 mm^3
Z available = I / y = 3520.8333 mm^3 SAFE Deflection = WL4 /384EI = 0.114 mm SAFE

3.3 Cost Analysis of Aluminium Formwork And Conventional Formwork:

Table 3.2 :- Cost Comparison

Sr. no	Name of work	Unit	Aluminum formwork	Conventional formwork
1	Area of project	Sqm	3500	3500
2	Cost of product	Rs	10000	500
3	No of repetition	Nos	100	8
4	Cost of material	Rs	35000000	1750000
5	Cost of material for 1 repetition	Rs	350000	218750
6	Additional charges	Rs	10000	10000
7	Total cost of material for 1 repetition	Rs	360000	228750
8	Cost of material for 1 sqm	Rs	102.85	65.35
9	Scarp value	Rs	30	0
10	Cost of material for 1 sqm	Rs	72.85	65.35

IV CONCLUSION

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.

V. FUTURE SCOPE

Following are some points for future scope of this study:

1. The aluminum formwork method is used for commercial ,residential project etc.
2. In this method no need of brickwork, plastering .
3. Aluminum formwork method saves the times of construction.
4. Modifications are impossible as parts are cast in RCC.
5. This type of method is not used in chimney, bridge ,dam construction etc.
6. High grade of concrete this type of structure is not used.

REFERENCE

[1] Aarti Nanasaheb Kote, Aahuti Ramesh Nandeshwar "Duration Comparison of Mivan Formwork over the Conventional Formwork", International Journal for Research in Engineering Application & Management (IJREAM),pp.37-39, 2009.

[2] Sandip.P.Pawar,P.M.Atterde "Comparative analysis of formwork in multistory building", International Journal of Research in Engineering and Technology, Volume: 03 Special Issue: 09,pp.22-24,2014.

[3] Kushal Patil, Ajitkumar Jadhav, Nikhil Shingate "Mivan Technology", International Journal of Engineering and Technical Research (IJETR), Volume-3, Issue-6,pp.30- 32 June 2015.

[4] N.kalithasan1,k.shanthi,b.joseravindraraj, r.vi jayasarathy "Structural design of aluminium formwork structure over framed structure", International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST), Vol. 2, Issue 4,pp.37-40, April 2016.

[5] K.Loganathan , K.E.Viswanathan "A study report on cost, duration and quality analysis of different formworks in high-rise building", International Journal of Scientific & Engineering Research, Volume 7, Issue 4, pp.190-195,April-2016.

[6] Mr. Amol S. Deshmukh, Mr. Manas A. Shalgar "Study of Tunnel Formwork versus Aluminium Formwork", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 12,pp.477-480,Dec -2016.

[7] Pathan Majead H., Akash Padole, Amir Ali Plasterwala"Design and Cost Analysis of Advanced Shuttering", International Journal of Engineering Development and Research, Volume 7, Issue 3,pp.98-105,2019.

[8] L Ravi Kumar, K. V. Ganesh, T Bhanu Prakash, P Geetha, Afjal Basha"Analysis, Design and Estimation of RC Shear Walls G Plus 13 MultiStoried Residential Building", International Journal for Scientific Research & Development,Vol. 7, Issue 02,pp.1551- 1563, 2019.

[9] Israth Ansari Shaik, B.G. Rahul " A Critical Study on Technological Advancements of Formwork in Construction Project Management", International Conference on Advances in Civil Engineering, Volume-7, Issue-6C2, pp.120-124,April 2019.

[10] Prasad Kolekar, Vishwajeet Nigade, Shivaji Hajare, Prathamesh Kamble, Sagar Patade, Amit Kumavat, "Analysis and Comparison of Mivan Formwork System with Conventional Formwork System", International Research Journal of Engineering and Technology (IRJET), Volume: 07 Issue: 06,pp. 4906-4910,June 2020.