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Mivan Formwork in Construction

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ABSTRACT

Construction industry mainly depends on cost and time so to achieve certain goals traditional methods only can't be used so to make the industry fast and more profitable new technologies are being introduced and also are being used all around the world. As construction is the significant sector of the Indian economy and due to India's rising population so to achieve its housing requirement new technologies are being developed and used and the most common out which is Mivan formwork.

Mivan is a quality aluminum structure developed by a European construction company known as Mivan Company Ltd. In 1990, the company from Malaysia began manufacturing these formwork systems. This innovative form of work is actually suitable for constructing houses in large quantities at a faster speed.

1. INTRODUCTION

1.1 General

Formwork is being used in construction industries as an most important aspect, so as the formwork technology increases the construction industry will see a positive boost in terms of fast construction and eventually the end outcome will give us economic benefits.

As the population is increasing, constructing a number of houses to overcome high population rise is a tough task so to make the construction speed fast mivan formwork system has been used in construction in recent years.

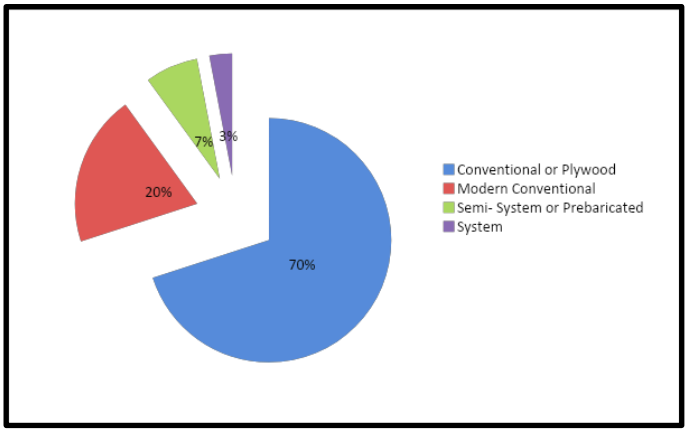
1.2 Historical development

Mivan is an aluminum formwork system developed by a European construction company. In 1990, the Mivan Company Ltd . from Malaysia started manufacturing these formwork systems. Before Mivan was introduced as an formwork system wooden ply formwork system was used and still been used but due to its limitations and poor workability it has been changed with aluminum formworks in most of the high rise structure.

Mivan formwork is more likely used in Europe, Asia, Gulf Countries, and other parts of the globe. It is suitable for constructing a large number of houses in a short period of time using room size forms to construct walls and slabs in one constant pour on concrete.

Big famous towers in Mumbai are also constructed by mivan formwork like lodha one towers, dosti towers all big builders have adopted mivan as their main formwork system for construction.

This chart shows that Indian construction has been changing and adopting new form of construction formwork but still lacking behind in some parts where replacing or changing the existing formwork system is not accepted yet.



1.3 Aim

The aim of our project is to know all the aspects of MIVAN FORMWORK and get to know all the techniques used at the construction site and study the 7 day cycle both practically and theoretically.

1.4 Objective of the work

1. To study the basic construction techniques and general studies of Formwork it's capabilities and usability.

2. To gain an understanding of the existing research.

3. To do a Case study of a construction site with Mivan formwork and study its practical aspects see how an aluminum formwork system works and make the activity list with details of the site.

4. To compare mivan formwork with other forms of formwork system.

1.5 Scope of the work

Even the mivan technology is not similar to the existing formwork system but it has more advantages than the disadvantages of the technology it will used in wide range in coming future it will eventually gain popularity among builders and owners and no towers will be made without the use of mivan as formwork system, It is also cost saving and less time consuming.

2. LITERATURE REVIEW

2.1 General

The basic knowledge about the past researches and advancements in this field is to be known, before starting the work in it. A Literature Review is a text written on the study of the past work and our understandings from them. In other words, It is a form of work acquired to get the knowledge about the past works and inventions in that field, and to get a clear idea about the methods and ways for going ahead with our work. Literature review isn't any form of new works, it is only the content taken from secondary sources for reference.

As for our work on the topic "MIVAN FORMWORK IN CONSTRUCTION", we have gone through many papers that are related to this topic which were presented and published nationally as well as internationally

This MIVAN topic is pretty trending nowadays, this made our work easy in finding out the pictures, papers, articles and other needful data. We have gone through the literature and papers related to the different Formwork Technology of some of the developed countries with their major cities in consideration. We have also gone through oral communication with some of the people related to MIVAN Technology, to get a basic idea about our topic.

2.2 Literature review

Atul R.Kolhe, et. al (2014), For implementing the 'Location Based Repetitive Scheduling Method (LBRSM) and analyzing the results the commercial housing project 'MEGAPOLIS', at Pune city has been taken asa case study. The data were collected during several visits to the field and site offices from the different persons.The consultant for the project is RSP, Singapore who are the pioneers in integrated township designs and Belt Collins, Singapore, who are the global leaders in the art of landscaping. This prime project has been introduced by Pegasus Properties Pvt. Ltd. and has been execute by Joint Venture of two Leading groups in Pune, 'Kumar Properties' & 'Avinash Bhoslae Group'. Every Building is to be executed with two floors sub structure in conventional works & the rest in 'MIVAN' type of specialized aluminum base material.

Arbaz Kazi, et.al (2015), International Journal of Research in Engineering and Technology: To address the housing and transportation requirements of an exponentially increasing population, Indian construction industry has grown by leaps and bounds. Thus with the globalization of Indian economy & introduction of multinational companies in India for construction activities, it has become imperative to have precise & speedy construction projects. Formwork is an important part of construction and it takes 25-30 % of total cost of construction. Thus with the use of new technologies in formwork, construction permits casting of larger elements in a single pour, which reduces time and labor requirement as compared to conventional methods.In this paper, an attempt is made to have a comparative study of established conventional formwork technology with a set of new formwork techniques, which are currently not used much in the Indian construction industry; and hence suggest which method is superior for the construction project under consideration.

Ganar A. S., et.al (2015), The project involves cost and duration analysis of a building constructed by Conventional formwork building and MIVAN formwork building. The buildings are of G+12 floors and the area of both the buildings are 771.92 Sqm with 2.95 m as the height of each floor. The analysis involves the quantity calculation for cost for both buildings and duration comparison of conventional formwork building and MIVAN formwork building.

Kushal Patil, et.al (2015), The aluminum formwork system was developed by Malaysian Company and that's why the aluminum formwork technology is named after it. Mivan is a new construction technology upcoming for successful completion of mass housing projects in India. The project also includes remedial measures for one of the defects in mivan technology i.e. segregation while placing the concrete resulting honeycombing in shear walls by using"MasterGleniumACE30JP"admixture.

Mayank Patel, et.al (2015), Formwork systems are among the key factors determining the success of a construction project in terms of speed, quality, cost and

safety of the works. The rapid advancement in the field of formwork along with the innovation in concrete as a material has led to a revolutionary change where safer, quicker, sustainable and more efficient construction is possible these days. The aluminum formwork system is very cost effective. This is one of the systems identified to be very much suitable for Indian conditions for mass construction, where quality and speed can be achieved at a high level. The labor handles this method effectively to speed up the construction, to assure quality control.

Prathul U, et.al (2015), Productivity is the important factor affecting the overall efficiency in Construction sites. At site level productivity can be grouped under various departments like productivity in concrete, steel work and shuttering. The main aim of the study is to analyze productivity by comparing conventional and Mivan formwork. The study showed that mivan formwork has higher productivity when compared to conventional formwork and proves economical for repetitive jobs.

Sajeet.S.B, et.al (2015), In recent times due to globalization, the construction industry has started focusing on new innovative ways of working. The construction industry has started adopting new technologies and approaches in order to increase the overall efficiency of the project. The "aluminum formwork systems" which is also called as Mivan wall System is one such new technology which has been used extensively across the world. Further investigation is carried out to know the contribution of different shapes of Mivan wall building to lateral strength and lateral stiffness of the high rise building. Along with this the comparison has been carried out between different shapes of Mivan wall building.

3. Mivan Technology

3.1 General

In this part everything related to mivan its limitations, advantages, its usability, special features, everything is explained according to the literature reviewed and the studies made on the formwork system on case study.

There are a number of buildings in Mumbai that have been constructed using mivan india is fastly adopting mivan as an most used formwork system so knowing all the concepts related to it is very beneficial.

3.2 Advantages of Mivan Formwork

1. Mivan Formwork requires relatively less labor
2. Faster completion of floors
3. Lesser number of joints and reduced leakages
4. Smooth finishing of wall and slab
5. Low maintenance
6. More seismic resistance
7. Huge carpet area
8. Good quality construction work
9. Faster completion
10. No need for plastering

3.3 Disadvantages of Mivan Formwork

1. Alignment maintenance needs skilled laborers.
2. Initial setup takes time.
3. It is expensive and used for typical floors only.
4. It needs skilled laborers for alignment maintenance.
5. Construction joints should be set properly.
6. Leakage issues like seepage, leakages during monsoon.

3.4 THE KEY USES OF MIVAN FORMWORK

1. Easy to operate within less time.
2. Includes the 3S scheme of construction to give strength, safety, and speed.
3. Slabs and walls are easily formed in one consistent development.
4. Assembling and fitting the part of shuttering.
5. Beam construction and column are removed.
6. Construction of slabs and walls in a simultaneous way.

3.5 MAIN FEATURES OF MIVAN FORMWORK

1. Load Carrying Capacity
2. Striking Time
3. Durability
4. Cycle Time

3.6 Formwork- Components

Mivan Formwork consists of many components which when connected to each using the drawing provided then it can be used for concreting, the material used for making these components are high strength aluminum alloy.

The main components of mivan are

1. Wall components
2. Beam components
3. Deck components
4. Other components

4. METHODOLOGY

4.1 General

The method used for gathering the information knowing the concepts related to mivan formwork is explained in this part of the research paper. Step wise plan of our project has been stated in this part of the report, Means firstly we started with the theoretical study of the topic in which we gathered previous studies made on it and also studied them for getting to know the entire concept of the topic theoretically.

Once the theoretical methodology is completed we headed towards practical methodology in which by choosing a construction site and analyzing the working of mivan technology there in a floor to floor slab cycle.

4.2 Theoretical Methodology

The theoretical methodology consists of the theoretic approach to the topic when we study all the previous research papers, journals, articles, etc.. study materials to get the idea of the topic this is considered as a theoretical approach on construction technology.

Considering our topic at the very start we have been collecting the literature present on the internet. After collecting more than 50 research papers we after studying them in depth got to know all the concepts of the technology in terms of theory and were then ready to go to a construction site to work out all these concepts practically.

4.3 Practical methodology

A practical approach to the research work was performed by identifying the formwork new techniques all around the world studying then the concerned literature reviewed on formwork system data collection and analysis later is perfromed this all works are helped at construction site at the time of case study.

We have performed a 7 day slab cycle internship at a construction site equipped with mivan formwork there. We have made notes of all the activities at site and noted down all the small points studied there with the help of site engineers and project managers working there and took pictures of each and every activity in detail.

5. CASE STUDY

5.1 Introduction

In our project which is totally an practical type of project which must include an case study for to study the aspects practically and for also to check the theoretical knowledge at site and test it over their so to do so we after searching choiced an site which was well equipped with mivan technology and had everything we need to learn in our project.

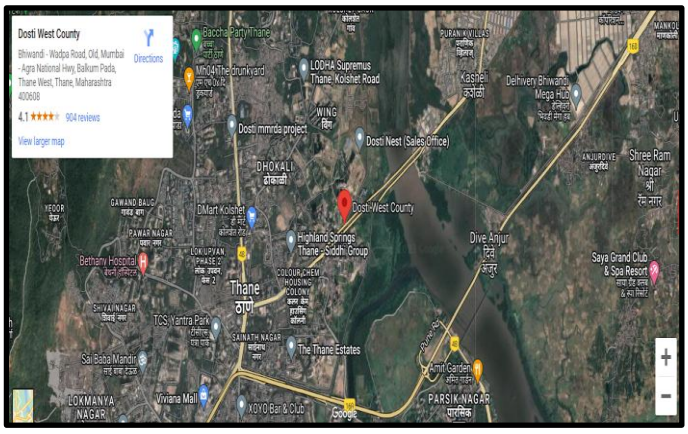
Generally, a case study is either formatted as an essay or a report. Here we have divided all the points of the case in different parts to understand it better. This is a descriptive kind of case study.

5.2 Site Details

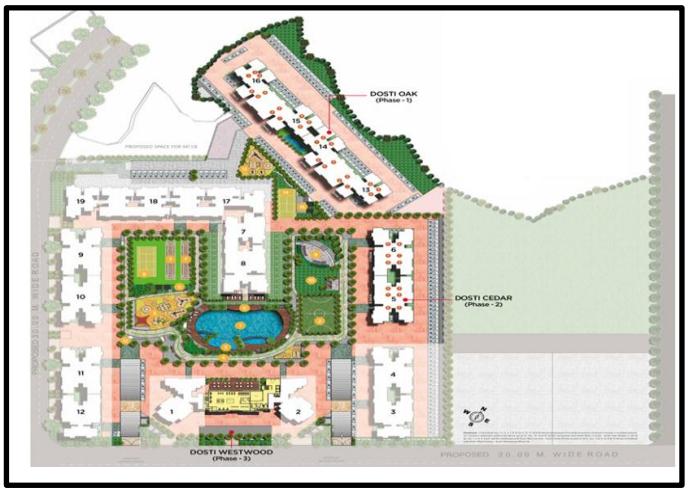
1. PROJECT NAME - DOSTI WEST COUNTY TOWER PINE 7
2. DEVELOPER - DOSTI DEVELOPERS
3. Design Architect - ACIPL / Pravin Jadhav
4. Architect on Record - 10 FOLDS ARCHITECT & CONSU
5. Consultant - JW consultants LLP
6. Construction Contractor - JP Enterprises
7. PLOT AREA - 6500 sq mts
8. Project Type - Residential project
9. Environmental Exposure Condition - Moderate
10. AREA OF BUILDING - 6500 sq ft
11. Floors - 30
12. Timeline of case study- 25 December 2022 to 3 Jan 2023
13. Site Photo

5.3 Location of Case Study Site

DOSTI WEST COUNTY, Bhiwandi - Wadpa Road, Old, Mumbai - Agra National Hwy, Balkum Pada, Thane West, Thane, Maharashtra 400608.



5.4. Site Layout



5.5 Steps of Case Study

1. Appropriate Site Selection
2. Preparation of Questionnaires
3. Collection of Data
4. Analysis of Data
5. Comparison of data collected
6. Conclusion

5.6 Mivan Shuttering 7 days Slab Cycle

Here we have explained the standard 7 days cycle it may change to 8,9 or 10+ days according to site conditions but the activities involved in it remains same sometimes the big companies with good knowledge about the technology complete this 7 days cycle in 4,5 or 6 days with good workers and night duty it can also be achieved.

Each individual day which activity we should do to achieve a slab cycle of 7 days. This 7 day slab cycle is further divided into 14 activities which can be seen in detail further.

5.6.1 Day 1

Activity 1st- Grid line work

In this activity points are given by the surveyor and as per the points given the grid line is placed as x axis and y axis according to the drawing. The grid lines never change from the start of the building drawing till the end of the building drawing, So keeping the reference of these can help in maintaining the structure. The engineer must always ensure checking of formwork with the reference to grid lines only.

Hole is left in the slab with the help of placing sleeves and then using a plumb bob by aligning it to the upper floor grid line can be placed easily. This method saves money and time and its accuracy is same as that of the surveyor.

Activity 2nd- Thesi work

In this activity thesi work is done using wooden patti of usual size 15 mm to 20 mm width and can be of 200 mm length. It provides support to the vertical panels to be erected and on this wooden patti vertical panels are hung and fixed for the casting.

If the column size is of let say 300 mm in width the wooden patti are fixed at spacing of 310 mm by keeping 5 mm gap each between both the wooden patti this is done because of the width of panel which also has to be included in the thesi work so that column constructed is of right dimensions.

Thesis are fitted on its place with the help of concrete nails by drilling the slab at least 2 nails are to be there for the better support for the thesi. There should be one thesi in every 1 m distance from the other thesi just to make it more safer and reliable.

On site the corners should have more of thesi then compared to the center as it has more chances to collapse.

In this thesi work has to be completed and these are the things which have to be kept in mind while doing thesi work.

Activity 3rd- Column and non structural wall reinforcement work

This is the standard activity which is common in all construction fields. The purpose of reinforcement is to provide additional strength for concrete where it is needed.

As per Structural drawing complete reinforcement work is done the bars are placed according to it and the covers are also provided by keeping the structural drawing in mind and as per this and after its checking work is completed.

5.6.2 Day 2

Activity 4th- Column and wall panel erection work

Wall panels are placed on kickers and kickers are supported by the thesi which was fixed previously.

The main thing to be considered during this activity is the oiling of the panels of the side facing the concrete to overcome the chances of sticking of concrete on the panel and for better finishing.

This wall panels are fixed with each other vertically using the pin and wedge the standard number of pin pattis used are it should be 600 mm between two pin pattis and at the bottom sides should be at the distance of 300 mm distances as the pressure of the concrete at the time of casting is high at the bottom side of panel.

Deck paneling will only be started ones the wall panels are intact ones wall panel work is done beam bottom works are started as soon as the wall paneling is done.

All wall panels are attached with a flat tie which should be one flat tie from bottom at 200 mm and all other at 500 nm intervals as there will be high pressure of concrete in the bottom side.

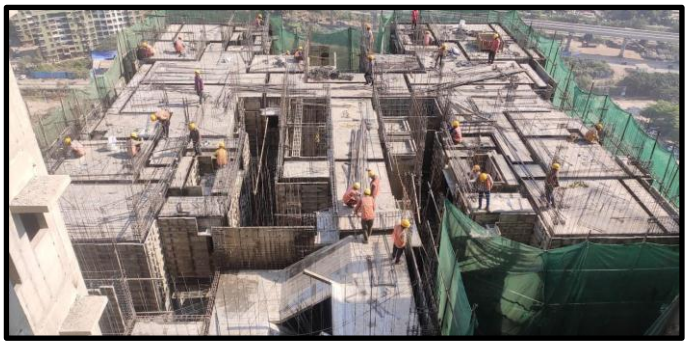
5.6.3 Day 3

Activity 5th- Deck panel work

Deck panel work means to complete all the shuttering work for upcoming slab in this activity so to start with reinforcement of the slab on next day.

In this activity slab soffits are placed as per the dimensions and the deck work is completed manually.

This activity totally depends on the drawing provided; according to it only the slab soffits and deck panels are fixed for the further reinforcement work to be done.



Activity 6th- Internal Checking

At this point of time as the paneling and deck work is completed its checking has to be done for to proceed on the next activity, This checklist provides a check points to engineers to ensure correct execution of work and avoid reworks.

It's very difficult having repairs later and cost huge and may cause losses to the owner if not executed properly.

In a broad way there are two types of checking which are considered in sites mainly internal checking and the external checking, Internal checking is done when the internal components are fixed and they are checked according to the kayam line dori and dimensions are checked according to drawing.

5.6.4 Day 4

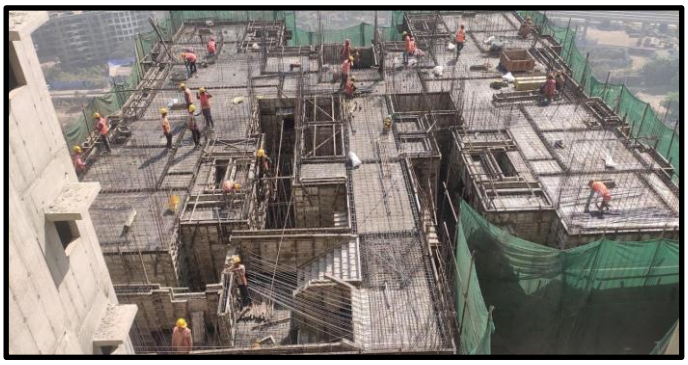
Activity 7th- Beam and Slab reinforcement work

It is also a common process as that of the conventional method reinforcement works is the same in both types of formwork only the type of formwork changes. The reinforcement steel should be free of any loose scale, rust, mud, or oil.

Cutting of reinforcement should be done beam wise and for the total number of the beams, required for slab. Extra length of cutting bars at the ends leads to improper end cover.

Make sure that cover blocks used for casting of slab and beam have the same grade as of concrete. They are not broken and properly positioned and should not get disturbed during concreting operations. Proper cover to reinforcement should be provided to slab bottom, beam bottom and sidewalls.

Before placing the concrete, Check the reinforcement details with a bar bending schedule and get an approval from a structural consultant.



Activity 8th- Leveling work of slab

There are two common methods used on site to check the leveling of the slab one is by using dumpy level ane second one which is most used is by marking the TBM and by line dori making the slab on level.

A. Slab level check by dumpy level

Setting up Your Level, find a benchmark location at the site where you want to check the leveling. set the tripod up near the spot you want to measure. then connect your device to the tripod and position it over 2 leveling screws and adjust them accordingly. Turn your telescope 90 degrees and adjust the third leveling screw. Check your level's calibration by turning it 180 degrees. Focusing Your Level, Remove your dumpy level's lens cap. Adjust the eyepiece until you can see the device's crosshairs. Twist the device's focusing knob until the image is clear.

Taking a Measurement, Position an E staff on top of your benchmark spot. Find the height difference between your level and the benchmark spot. Calculate your level's actual height using the benchmark height. Find the height difference between your level and the unmeasured spot. Calculate the spot's actual height using your level's height.

B. Slab level check by marking TBM on column

At construction sites this communication is not possible, so how one worker at the upper side of the slab and one worker at the downer side of the slab communicate it is by the help of a hammer. When a worker checks the length of slab bottom to the line he smashes the slab ones so that the worker at the bottom will come there and if he finds slab is low then he will smash the hammer 2 times so the down side worker will understand and tighten the slab accordingly.

And same as if the slab is high then he will smash the hammer three times on the panel and by understanding this worker will loosen the ms props down there. In this way leveling of slab is done on the sites and it is the most used method as it doesn't require any machinery as such like dumpy level.

Activity 9th- External Checking

Then the external checking is done at the top of slab in which alignment and the works has been done according to drawing is done or not is checked properly by the civil engineers and the authority specialist in Mivan is their at the time of external checking. The common check of Mivan in external checking is Plumb bob check, lift check, stairs checks. Right Angle Check is done on the slab to check the overall alignment of the slab. In this type of checking 2 long spans of the slab are considered and then also considered as the sides of the right angle of triangle and then its hypo is calculated manually and practically if matched overall alignment is proper of the slab.

5.6.5 Day 5

Activity 10th- Electrical conduiting work

An electrical conduit is a tube used to protect and route electrical wiring in a building or structure. Electrical conduit may be made of metal, plastic, fiber, or fired clay. Most conduit is rigid, but flexible conduit is used for electrical wiring purposes in the construction Industry.

Conduits which are to be taken in the ceiling slab shall be laid on the prepared shuttering work of the ceiling slab before concrete is poured. The conduits, boxes, accessories, joints, etc. shall be laid along with the conduits.

5.6.6 Day 6

Activity 11th- Complete grid line checking

Complete grid line checking means that all the panels should be at right distance from each other so the room dimensions are not to be affected because of it. All supporting panels should be in the right position and must be tight and fixed properly to overcome chances of collapse at the time of casting.

Activity 12th- Arrangement for Casting

Making arrangements for the casting the previous day because in mivan there is a mass concreting so to avoid delay the setting of the 125 mm diameters pipelines are fixed with the diesel or petrol pump to pump the concreting up in high rise structures. Production of Concrete, Stock of material shall be sufficient to start the concrete. It shall be ensured by stores/purchase depth that concreting is not stopped on account of materials. All plants and machinery are checked and made in working conditions. Concrete Pouring, Proper walkways/platforms shall be arranged so that the supports of the pipeline and manpower are not directly standing on reinforcement.

Activity 13th- Safety Checkings

1. Ensure that workers use safety tools and equipment for example safety helmets, safety shoes, goggles, gloves, and vest.

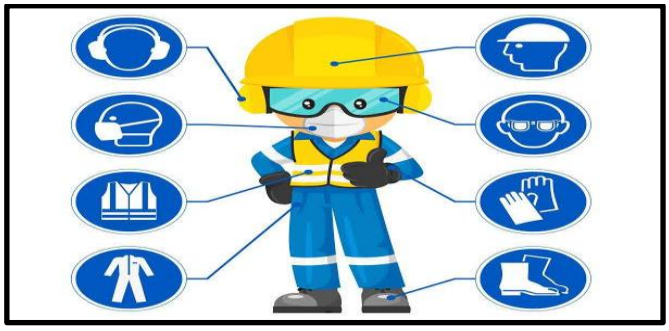
2. Safety devices and safety warnings should be provided from site entrance to the casting area.

3. Check whether adequate lighting is provided in case of night concreting.

4. Check whether the competitor company has not done any missive on the site as it is common in big projects.

5. The pipelines should be checked if there is no opening as the pressure of the concrete in the pump is high at the time of casting.

6. Safety nets should be their own place completely intact with also including vertical safety nets which should be completely vertically to minimize the chances of anything falling downside.



5.6.7 Day 7

Activity 14- Casting

As the complete floor is casted at ones in this form of construction so there is no use of contraction joints as mostly used in conventional way of construction. Cast the concrete according to the pathway decided earlier and follow the instructions given by the site engineer given to the workers. Firstly columns are filled with concrete then beam and lastly concreting of the slab is done at the site consisting of mivan formwork. To avoid the voids and to get better finish good quality needle vibrators are used on the sites mostly of best in class as it has to go right through the bottom of columns and shear wall and vibrate it.

Rubber hammer are the other things which are used at the construction sites and hammer made with rubber which makes vibrations when hit hard on wall panels. So the workers hit it on the panels from downside at the time of casting. After that power float is used for the smooth finish surface purpose.

After this casting of slab is done, All post concrete activities are conducted on site which are common with conventional formwork systems.

6. COMPARISON

6.1 Introduction

When we compare mivan with other forms of formworks we can see many changes in terms of its materials used, the work cycles and comparison in terms of end outcomes in this way mivan can be compared with other sort of formworks.

Mainly in India the most used formwork is conventional type of formwork so comparing it with mivan makes the most sense in terms of speed of construction, quality, aesthetics, external finishes, maintenance and also the cost comparison has to be done and all this comparison will be done with the reference to case study and research works done till now.

6.2 Quality Comparison

As mivan is a new technology and is for the new era of construction it also provides great quality in terms of wall finishing and smoothness of the wall no voids are seen after the concreting maximum of it is wiped because of the good construction material used and aluminum formwork used.

Houses made by mivan formwork systems are more powerful than houses made from conventional formwork systems.

6.3 Aesthetics Comparison

In conventional construction partition walls are made with block work except shear walls all the walls are made with block works and hence shows the unevenness with beams and columns and gives an un aesthetic look to the structure.

In mivan all the wall and other components of the superstructure are casted together so it doesn't show unevenness and gives the building an aesthetic look.

6.4 External Finishes Comparison

In conventional formwork systems and in block work manual cement plastering is required and is also not permanent it requires continuous repair and due to its poor strengths it has to be repainted frequently and while in mivan external wall shows smooth finishes and requires no repairing frequently.

6.5 Maintenance Comparison

In Conventional form of construction there is an high chances of maintenance work as plaster requires repair ceiling plaster may get affected due to leakage so as inner walls may get affected due to leakage as the block wall tends to have maintenance cost high but as compared to mivan their is an negligible cost of repair and no frequent repairing is needed in this kind of construction.

6.6 Cost Comparison

As cost in conventional initial phase of the project is very less as compared to the mivan but in long term mivan wins the cost comparison as mivan is for 250 slab cycles using is for construction is the first choice for builders financially. As mivan is an aluminum formwork it has good scrap values also which is way more than other forms of formwork.

Sr.No.	Formwork	Scrap Value%
1.	Conventional	10%
2.	Steel	30%
3.	Aluminum	50%

7. RESULT AND ANALYSIS

In a country like India where each day a new construction project is being started and being at the top in terms of population growing, The need of adopting new construction techniques is most here so to cope with this population and need of mass housing technology mivan can be used in India and is safe to use according to indian construction requirements and is better then the existing formwork systems which have been used till now in construction industry.

We can now say that aluminum formwork is better for high rise structure but now there are many other factors to be considered when selecting a formwork system. Mivan can't be used anywhere like for small projects if used there it will be sent to scrap at an early time without using it fully.

1. Availability of local resources
2. Formwork cycle required?
3. Crane dependency?
4. Enough repetitions of floors?
5. Construction period specified?
6. Environmental Friendly?
7. Size of building?
8. Floor plan symmetricity?
9. Type of building design?

These are the questions which affect the selection of formwork techniques and formwork selection should be done according to it so as to avoid losses.

8. CONCLUSION

Our conclusion will be that mivan formwork can become backbone to the Indian construction industry, As india being the construction capital of world due to the frequency of the construction going on in India and due the large population adopting mivan as the main form of Formwork system will be very much beneficial to our countries growth, it can fulfill our demand for efficient and sustainable housing also the speed of construction and cost is less as compared to other forms of formwork system.

1. Adopting new techniques in construction after using traditional techniques for many years is very difficult but needs to be adopted for the betterment of the Indian construction industry.

2. It can also be concluded that the overall cost and duration is reduced drastically when we use mivan as the main formwork system instead of conventional formwork system.

3. The floor to floor cycle when using mivan is of 7 days which is standard which changes due to site conditions it goes to 4 days and even at 10 days which is still way less than conventional formwork system which is of 20 days minimum.

4. Mivan formwork is not only the fast pace construction system but also the cost efficient and can be used for mass township projects.

5. Mivan even has indirect benefits as it has good scrap value and is 100% recyclable and also thus environment friendly.

It can now be concluded that mivan is an most suitable type of formwork system in India as it is economical since labor cost is comparatively less and the number of repetition is more and is also time saving.

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