COMPARISION OF CONVENTIONAL WITH ALUMINIUM FORMWORK SYSTEM

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ABSTRACT

Construction industry is having greatest part in economy of India. If we observe the current situation of global economy and increment in population in India, land acquisition has turned out to be more troublesome. To satisfy the need of shelter of this increasing population and expanding industrialization, quick construction is the need of time. At the same time, because of deficiency of land Vertical development is preferable than Horizontal one. Formwork assumes a vital part in construction of the buildings. It constitutes 20% cost and 60% time of the aggregate construction. This project does the comparison of the Conventional Formwork, Tunnel Formwork and Aluminum Formwork systems. Because of increment in tenants, individuals began to develop the home structures. At the early days buildings were built utilizing traditional type formwork framework where wooden planks, runners, poles were used for the formwork. With the advancement of technologies, man tends to utilize plywood in its place of planks, steel jacks for support instead of wooden poles. The below study is carried out to compare different Formwork systems on the basis of Time & Cost.

KEYWORDS: Conventional Formwork, Aluminum Formwork, Construction Cost, Time, Quality and Quantity.

INTRODUCTION

This section is discussed about the technology used in revolutionary construction system, which has been broadly utilized in India. Utilizing this unique formwork, walls, floor slab, columns, beams, stairs, balconies together with door and windows opening are thrown set up in a solitary based activity.

GENERAL

The Mivan technology system was developed by Mivan Company Ltd from Malaysia late 1990 as a system for constructing mass housing project in developing countries. The units were to be of cast in place concrete, with load bearing walls using formwork of aluminum panels. To be erected by hundreds of repetitive design the system ensured a fast and economical method of construction. The concrete surface finish produced with the aluminum forms allows achievement of a high quality wall finish without the need for extensive plastering. This is one of the systems unified to be very much suitable for Indian conditions for mass construction, where quality and speed can be achieved at high level.

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The speed of construction by this system will surpass speed of most of the other construction methods. The progress made by the construction industry of any country could be considered as the index of development of that country. Further the number of puce house built in any country could be another index. While there has been a progressive rise in stock of housing in India since independence, the speed thereof has not kept pace with the rapid growth of population and urbanization. As result, the shortage of accommodation is increasing continuously and the situation has become acute in urban areas. Construction is most important part of development and it is significant sectors of Indian economy. India is having second largest population in world and in future demand of housing increases desperately with this problem India should desperately need to plan for acquisition of land and rapid creation of dwelling units today there is growth in population for that speed construction needs to be given greater importance especially for large housing already available in the country. For e.g. prefabrication, autoclaved blocks, tunnel formwork, aluminum formwork of construction etc. The use of Mivan formwork in construction industry is very low in India AS compared to other countries.

The use of mivan formwork in construction having great potential, especially needs for current developing India and not using mivan formwork as an alternative construction material and not using it where it is economical is a heavy loss for the country. This new method of construction by mivan technology can increase productivity, quality and performance of work through the use of better construction equipment, materials and time saving as compared to conventional. In cities like 'Mumbai which have a considerable amount of humid atmosphere, there are chances that the shuttering may keep expanding and contracting due to change of atmosphere and the shuttering plywood may bend subjecting to bulging of sides of Column, Retaining Wall, Footing, Beams, Chajas, etc.

**LITERATURE SURVEY**

This section presents the introductory contents related to the subjects of seminar. Firstly, it discusses the conventional formwork system with modern formwork system with whole assembly and components. Finally compare with cost time and along with their estimates.

**GENERAL**

- Kushal Patil, Ajitkumar Jadhav Nikhil 3 June 2015 (IJRET) volume 3 focused on the cost compression, user review, from the survey and cost comparison win situation for builder who is going to construct and consumer who is going to time solve problems of mega housing projects in India.
- Prof. Ashish P. Waghmare, Renukas. Hangarge (IRJET) volume 4 according to data analysis obtained aluminum formwork is cost effective in comparison with conventional formwork.
- Prof. Patil R.S., Pawale D.B. Tamble H.D. Dept. civil engineering traditionally, construction firms all over the world have been slow to adopt the innovation and changes. And finally focused on the maximized the used of modern construction techniques and equipment’s on its entire projects.
- Mr. Amol S. Deshmukh Pg. In construction and project management (IRJET) Dec 16 Completion in 1/3th time than that by conventional formwork system is beneficial.
- Prof. R.B. Bajare (IOSR) journal of mechanical and civil engineering vol 4 Aluminum formwork is not effective for small projects based on the project type, Floor height of formwork can be chosen.
- Dinesh Sadrunddin (IJER) volume 5 cost of construction in modern formwork system is less by 25 to 30 %.
Construction industry tapas wini mohapatra samant pvt.ltd after removal of formwork mold high quality concrete is produced to accurate tolerances. Erected using unskilled labor.

Miss Patil Dhanashri Suryakant (IOSR-JMCE) analyzed the parameters of cost effectiveness time, quality, and quantity control. The quality and speed must be given due to consideration with to regards to economy.

Ankit S. Kadam Akshay T. Kokare, (IJORI) focused on the cost parameters with valuable suggestions it gives the better quality of construction and but also increases the speed of construction activities.

K. Longanathan K.E. Viswanathan volume 7 issues 4 April 2016 concluded that from conventional formwork system is tedious and wastage of material is high as compared to modern formwork system.

Aaqib Majib Khan, Chitrnanjan Kumar from (IJSR) the modular formwork system can be used for the construction of all types of concrete systems involving column, beam slab elements or for box type structure involving slab walls combinations.

Dr. jayeshmar research date authors aluminum formwork saves cost and time of the construction works. it is light in weight so labour friendly and handling of its is easy.

Dr. ing. abebe dinku, Dr. Ing. christoph motzko degree of science in civil engineering.

Construction technology and management studied on the application of modern formwork systems in Ethiopia, alternative formwork materials such as, plastic, glass reinforced plastic etc are not well known and used by local construction companies.

Steel panels and timber are the most commonly used formwork material.

Swapnali M. Karke from civil dpt. Karad mahastra studied on the comparison of the traditional and modern formwork systems, he suggested that different formworks, systems provide a wide range of concrete construction solutions that can be chosen to suit the needs of a particular developments. This guide seer out their key features process efficiency, safety, sustainability and other considerations in order to help constructions professionals.

Rewal meet hemant, bharakhada mayank prakash, Thakur college of civil engineer and technology, shuttering design and cost comparison conclude that, cost analysis of shuttering also cannot be done without various observations from place to place and also from site to site.

MATERIALS

This section presents the introductory contents related to the materials used for the construction by using different formwork systems and headlights its components

WHAT IS FORMWORK?

The molds made up from some rigid material such as timber or steel plates in which concrete is placed and in which it is harden are called “formwork “steel formwork is used in the form o plates which can be bolted together to form molds of different shapes and size according to the dimension of structural members.

REQUIREMENTS OF GOOD FORMWORK

ECONOMY

The cost of material should not be very high. The assembly and dismantling or stripping time should not be very long, to save time and money during concreting. It should be easily strippable without damage so that it can be repeatedly used. The construction lines in the formwork should be true and the surface plane so that the cost finishing the surface of concrete on removing the shuttering is the last. Formwork
should be easily removable without damage to itself so that it could be used repeatedly.

QUALITY

The formwork should give adjust right edges and plane surface with the goal that completing expense subsequent to expelling formwork is limited. The joints in the formwork ought to be unbending with the goal that the swelling, turning, or listing, because of dead and live load is as little as could be expected under the circumstances. Unnecessary distortion may deform the surface of cement.

SAFETY

It should be strong enough to withstand the dead and live loads during construction so that there is no accident and there is no danger to structure or labor. It should be strong enough to take the dead and live loads during construction.

FORMWORK CLASSIFICATION

Formwork can be arranged by an assortment of classifications, identified with the distinctions in sizes, the area of utilization, construction materials, nature of activity, or just by the brand name of the items. Anyway the tremendous measure of tropical wood being devoured every year for formwork has brought about feedback from tree huggers, and additionally the nonstop acceleration of timber costs. As result there has been a solid inclination to utilize other formwork materials or systems to supplant timber.

CLASSIFICATION ACCORDING TO SIZE

Grouping as indicated by the span of formwork can be exceptionally direct practically speaking. There are just two sizes for formwork, little sizes and substantial measured. Any size which is intended for task by laborers physically is little size. Regularly the erection procedure is ideally taken care of by single laborers, with site work best done autonomously to maintain a strategic distance from conceivable holding up times. Because of reasons of single size and weight, the materials and construction of little estimated formwork are accordingly limited. At display the most widely recognized system are made of timber and aluminum, and are more often than not as little boards.

There is seldom medium sized formwork. In case in which large sized formwork is used. The size of the form can be designed as large as practicable to reduce the amount of jointing and to minimize the noun of tilt. The stiffness required by large sized formwork can be dealt with by the introduction of more stiffening components such as studs and soldiers. The increase in the weight of the formwork panels is insignificant as a crane will be used in most cases.

ACCORDING TO THE LOCATION OF USE

There are very few compelling formwork systems for stairs and staircase. The entangled three dimensional nature of a component including suspended boards and riser sheets, and additionally the need to adapt to altogether different spatial and dimensional fluctuations as required by singular outline circumstances, can't be accomplished by an all-around received formwork system.

ACCORDING TO MATERIALS OF CONSTRUCTION

CONVENTIONAL FORMWORK

This is the most established sort of formwork utilized as a part of the construction industry. This compose utilizes timber, bamboo, stone work and carpentry in the construction. Tis write is particularly reasonable for little houses with a few stories and still they are utilized as a part of such constructions. Be that as it may, this isn't appropriate for the enormous undertakings or tall structure.
MODERN CONVENTIONAL FORMWORK

In present day traditional formwork further developed materials are utilized and they can reuse for a few times. The distinctions of the two sorts are that steel props and different kinds of jacks are utilized as backings in the formwork in expressed of timber backings and compressed wood sheets is utilized rather than timber boards on section decks, pillar and segment.

STEEL FORMWORK

mostly used in large construction projects r in situations where large number of re used of the same shuttering is possible it is suitable or circular or curved shaped structure such as tanks columns chimneys etc. and used for structures like sewer long life. Reuse can be assumed to vary from 100 to 120.

ACCORDING TO NATURE OF OPERATION

Formwork can be worked physically or yet the other power lifted techniques. A few systems are furnished with a specific level of versatility to facilitate the raising and striking procedure, or to permit even minute utilizing rollers, rail or tracks timber and aluminum shapes are the main physically operable sorts of formwork. They are outlined and developed in way that they can be totally taken care of freely without the guide of any lifting appliances. on the opposite end of the scale , such system are utilized as a part of substantial estimated and skyline count spread working with confounded format plans which required the systems adaptability.

ACCORDING TO THE BRAND NAME OF THE PRODUCTS

A few protected or marked formwork system have effectively entered the neighborhood construction advertise in the previous decade. These incorporate items from mark SGB, RMD, VSL, MIVAN, THYSSEN AND CANTILEVER. Every one of these organizations offers its own specific items; while some can even give an extensive variety of administrations including configuration support or delicate assessing exhortation. As the use of innovation bulling methods is gaining more attention from various sectors in the community advanced formwork system is obviously a promising solution. The input through research antidevelopment by the well-established formwork manufactures is of no doubt contributing to efforts in these areas.

All above classification of formworks focused on the mainly two formworks, i.e., Conventional and modern formwork.

CONVENTIONAL FORMWORK SYSTEM

TIMBER AND BAMBOO

This ordinarily comprises of standard confined boards integrated over their backs with flat, part called waling. The waling is given the fundamental capacity of opposing the even face of wet cement. One side of the divider formwork is first collected guaranteeing that it is effectively adjusted, plumbed and swaggered. The steel fortification pen is then put and situated before the opposite side of the formwork is raised and settled. Compressed wood sheet in blend with timber is the most widely recognized material utilized for divider formwork. The typical technique is to make up divider shapes as confined boards with the compressed wood confronting sheet screwed on to studs on a timber outline. This takes into consideration the compressed wood to be effectively evacuated and turned around and utilized on the two sides to build the quantity of reuses. The dividers shapes are vulnerable to edge and corner harm and should be painstakingly taken care of. Uncommon consideration must be given to make the projections pen up, offering ascend to unsatisfactory grout escape and a poor complete to the cast divider. The genuine measurements are to some degree littler for completed and unpleasant sawn timber.
Unpleasant sawn timber will have measurement around 1/8-in. longer than completed S4S amble. Wood Sizes ordinarily uses alongside their area properties are given in amble use in shaping cement must unsurprising quality is impacted by numerous variables. That has been investigated and arranged amid assembling will convey a stamp showing the animal varieties, grade dampness condition when surfaced, and maybe other data.

MODERN CONVENTIONAL FORMWORK PLYWOOD

Plywood is accessible in two sorts outside and inside. The outside is made with water confirmation stick and has all employs improved with C review facade. While numerous outside plywood boards could be utilized, the plywood industry create an exceptional item planned for concrete shaping called employ frame. This panel has two smooth sides usually grade B veneer on front and back. And is available in three classes: class 1, class 2, and structural 1. Class 1 is stronger than class 2 because of the higher grade of veneer used in the panels. Structural 1 is the strongest of the three classes. And is intended for applications where high strength, and stiffness and maximum reused are desired. Ply form is also available with a surface treatment of thermo setting, resin-impregnated material that is bonded to the panel surface. This abrasion resistant surface, which gives an extremely smooth finish to concrete and allows more reuses of gang forms, is called a high-density overlay.

MODERN FORMWORK SYSTEM

The most punctual formwork systems made utilization of wooden scantlings and timber sprinters as it empowered simple framing and making at site. Be that as it may, these wooden scantlings and timber sprinters have a tendency to lose their Structural and dimensional properties over a period time and after rehashed use consequently posturing wellbeing issues. A large number of the mischances occur in Reinforced Cement Concrete (RCC) construction in light of substandard formwork and platform. Presently center must be moved to other key factor Formwork, to confront the difficulties for the consummation of quick track ventures. By going in for system formwork, generous reserve funds are conceivable by speedier profit for speculations.

The significant points of interest of steel areas in formwork are the capacity of steel to shape longer traverses and it uncertain potential for reuse when taken care of with sensible care.
Steel area is use in the creation of various formwork parts in particular. Steel boards shapes horizontal and vertical shores, Steel sheet and vault parts use for joist and waffle pieces, Steel channels for formwork propping. Other substantial structures and formwork are additionally made of steel, for example, connect formwork. Steel is utilized for formwork when different materials are difficult to utilize as a result of their low quality. Steel frame is commonly protected, and reasonable burdens are for the most part distributed by the producers.

Source: (www.architejaved.com)

**ALUMINUM FORMWORK**

Aluminum formwork also known as MIVAN Technology. MIVAN system is formwork construction, cast-in-situ concrete wall and floor slabs cast monolithic provides the structural system in one continuous pour. Large room sized forms for walls and floors slabs are erected at site. These forms are made strong and sturdy, fabricated with accuracy and easy to handle. They afford large number of repetitions (around 250). The concrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers. Formwork systems for buildings are classified as either horizontal or vertical formwork. Horizontal formwork systems are those used to form the horizontal concrete work (slabs or roofs), while vertical formwork systems are those used to form the vertical supporting elements of the structure, e.g., columns, core walls, and shear walls. Aluminum 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. The system of Aluminum forms has been used widely in the construction of residential units and mass housing projects. It is fast, simple, adaptable and cost-effective. It produces total quality work which requires minimum maintenance and when durability is the prime consideration. This system is most suitable for Indian condition as a tailor-made aluminum formwork for cast-in-situ fully concrete structure.

Source: (www.architejaved.com)

**Figure 2. Steel formwork systems**
COMPONENTS

COMPONENTS OF MIVAN FORMWORK

The fundamental components of the formwork are the board, which is an expelled aluminum rail segment, welded to an expelled aluminum rail segment, welded to an aluminum sheet. This delivers a lightweight board with an astounding solidity to weight proportion, yielding least diversion under solid stacking. Boards are made in the size and shape to suit the prerequisites of particular ventures. The boards are produced using high quality aluminum composite with 4 mm tough skin plate and 6mm thick ribbing behind to solidify the boards. The boards are made in Mivan devoted industrial facilities in Europe and south East Asia. When they are gathered they are subjected to a preliminary rising with a specific end goal to dispense with any dimensional site issues.

BEAM COMPONENTS

BEAM SIDE PANEL

It forms the side of the beams. It is rectangular structure and is cut according to the size of the beam.

PROP HEAD FOR SOFFIT BEAM

It forms the soffit beam. It is v shaped head for easy dislodging of the formwork.

BEAM SOFFIT PANEL

It supports the soffit beam. It is a plain rectangular structure of aluminum.

BEAM SOFFIT BULKHEAD

It is the bulkhead for beam. It carries most of the bulk load.
DECK COMPONENTS

DECK PANEL
It forms the horizontal surface for casting of slabs. It is built for proper safety of workers.

DECK PROP
It forms v shaped prop head. It supports the deck and bears the load coming on the deck panel.

PROP LENGTH
It is the length of the prop. It depends upon the length of the slab.

DECK MILD
It supports the middle portion of the beam. It holds the concrete.

Soffit length
It provides support to the edge of the deck panels at their perimeter of the room.

DECK BEAM BAR
This is the deck for the beam. This component supports the deck and beam.

OTHER COMPONENTS

INTERNAL SOFFIT CORNER
It forms the vertical internal corner between the walls and the beams, slabs and the horizontal internal cornice between the walls and the beam slabs and the beam soffit.

EXTERNAL SOFFIT CORNER
It forms the external corners between the components.

EXTERNAL CORNER
It forms the external corners of the formwork system.

INTERNAL CORNER
It consists of two pieces of vertical formwork at dear external intersections.
WALL COMPONENTS

WALL PANEL
It forms the face of the wall. It is an aluminum sheet properly cut to fix the exact size of the wall.

KICKER
It forms the wall face at the top of the panels and acts as an edge to support.

STUB PIN
It helps to joining to wall panels it help to joining two joints.

Source: (www.slideshare.net)
Figure 5. Deck components

Source: (www.slideshare.net)
Figure 6. Other components
METHODOLOGY

ASSEMBLY

The simplicity of Aluminum Formwork and the tedious idea of the get together process make it conceivable to precisely program construction successions and along these lines process durations well ahead of time. Furthermore, this empowers the untalented work to work with the formwork, along these lines lessening the weight on talented work when this is hard to come by. On leaving the manufacturing plant, all boards are plainly named to guarantee that they are effectively identifiable on location and can be easily fitted together utilizing the formwork regulation illustrations. MIVAN points utilizing present day construction procedures and gear in the entirety of its projects. On leaving the MIVAN manufacturing plant all boards’ region obviously marked to guarantee that they are effectively identifiable on location and can be easily fitted together utilizing the formwork balance illustrations. All formwork creatures at corner and continues from that point.
SIMPLICITY IN PIN AND WEDGE SYSTEM

The boards are held in position by a basic stick and wedge system that goes through gaps in the outside rib of each board. The boards fit exactly, basically and safely and require no supporting. Building can be built rapidly and effectively by incompetent work with pound been the main excessively required. Once the boards have been numbered, estimating isn’t required. The outcome is an average 45 to multi day cycle for floor to floor construction.

EFFICIENT QUICK STRIP PRO HEAD

One of the principle technical features which enables this aped to be attended using a single set of formwork panel is the unique v shape a prop head which allows the quick strip to take place whilst leaving the propping undisturbed. The deck panels can therefore be resumed immediately.

CYCLE

Mivan is the system for the scheduling and controlling crafted by other associated construction patterns, for example, steel fortified solid arrangements the work cycle takes after specific grouping. It is takes after by situating of the sections and stage on the level. This activity requires 7 to 10 hrs. .kickers and external suit are fixed in 7 hrs. The wall shutters are erected in 6hrs. Major activates of reinforcement required the 10 to 12 hrs. The fixing bob electric conduits is about and finally pouring of concrete take place

This is very much synchronized cycle for a time of 7 days a time of 10 to 12 hrs. is left in the wake of cementing for the solid to pick up quality before the start of the following cycle the formwork collected nearby sides speedy and simple process. On leaving the mivan processing plant all boards are plainly to guarantee that they are effortlessly distinguished nearby and can easily fitted.

Day 1: erecting of correctly reinforced bars and one side of vertical formwork.

Day 2: erecting of second side of vertical formwork

Day 3: fixing reinforcement bars for slab and casting for slab.

Day 4: removal

ERECTING FORMWORK

RESULT

Prof. Ashish P. Waghmare, department of civil engineering, focused on the cost and time estimation for conventional, aluminum formwork, (IRJET)volume:04 issue:o7 ISSN 2395-0056 from the data analysis of 1000 m² total time required for conventional formwork building.816 days. And time required for the 10000 m² area is about 484 days from that analysis aluminum formwork saves the time of construction. Aluminum formwork is better for use in construction, and then conventional formwork and along with time effective.

The results obtained on the basis of time are as follows:
Graph shows the comparative study based on cost comparison between conventional and aluminum formwork system. From the given analysis cost difference is about 40,42,130.12 for conventional formwork system and 23,14,129.43 for aluminum formwork system. Aluminum formwork saves the cost of construction.
CONCLUSION

This section presents the discussion and conclusion contents related to the subject of Project. Firstly, it discusses the basics and then the different techniques. These are the following conclusion carried out from the literature review and case studied:

From the results obtained we can conclude that aluminum formwork is cost effective on comparison with conventional formwork. Aluminum formwork is better for use in the constructions. Where time effective formwork is necessary so, Aluminum formwork system also helps to saves the time. It also saves the time and cost of finishing.

REFERENCES

[2]. Jignesh Chotaliya, Hiren Rathod M.E. student, Civil Eng. Gujarat, India study on cost duration and quality analysis ISSN; 2394-1766.
[6]. K. loganathan K.E. Viswanathan CE & M kangayamindia. Study report on cost, duration and quality analysis of different formworks in high rise buildings, IJS&E volume 7 issue4 ISSN 2229-5518, April 2016 email iogulogank@gmail.com.
[7]. Dinish Sadruddin Anasari B.E. University of Pune, comparative analysis of mivan formwork building and conventional formwork building based on cost and duration, IIRJE volume no.5 ISSN:2319-6890 1August 2016.
[13]. Swapnil M. Karke, Civil Department gov.clg of eng. Krad Maharashtra, comparison of use of traditional and modern formwork system. IRJET volume 03.