

# Evaluation of Lob in MIVAN Technology Using Software

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**Abstract**—The progress of any country can be judged by the progress of the construction industry of the country. Cost and time are the two important entities which plays vital role in any construction activity. Hence it has become necessary to estimate cost and time required to complete the construction. At same time progressive rise in stock of construction industry in India and rapid growth of population and urbanization has led to shortage of accommodation. One of such fastest method of construction technology is Mivan Technology. In existing study an attempt is made to study the nonlinear performance and behaviour of Mivan Structures compared with Conventional Structures. Both type of structure is modelled with same material and loading configuration with identical plan and elevation.

**Keywords** – Mivan System, Conventional System, Soil Structure Interaction, Pushover Analysis

## 1 INTRODUCTION

### 1.1 INTRODUCTION

This chapter gives information about Mivan technology and line of balance method. Mivan is basically Aluminium formwork system. Mivan system was invention by Construction Company from Europe. In 1990, Mivancompany from Malaysia start manufacturing formwork, then after give name MIVAN. This technology is extensively used in Europe, Gulf country and Asia. Formwork is defined as the temporary structure whose purpose to support the building structure. Line of balance (LOB) is a management control process used in construction where the project contains blocks of repetitive work activities, such as roads, pipelines, tunnels, railways and high-rise buildings, precast construction, row houses etc..

### 1.2 MIVAN TECHNOLOGY

Mivan is basically Aluminium formwork system. Mivan system was invention by Construction Company from Europe. In 1990, Mivancompany from Malaysia start manufacturing formwork, then after give name MIVAN. This technology is extensively used in Europe, Gulf country and Asia. Formwork is defined as the temporary structure whose purpose to support the building structure. The progress of the formwork equidistant with the progress of concrete construction through the 20th century. Modern technology must be required in this time because of increasing the population and land available for constructing houses in limitation. For mass housing project, it is essential to know the new technology for completion of project in fast rate, stand to good quality and able to withstand wear. Mivan technology is capable to constructing a huge no. of houses within short period. Mivan formwork is easily removed. All the activity can arrange in simple manner and get result more accurate, well regulate and high quality production at economically with less period

The system of aluminium formwork (MIVAN) 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 aluminium formwork for cast-in-situ fully concrete structure. In this system of 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 can be used repeatedly for approximately 250 times. The concrete is produced in RMC batching plants under strict quality control and convey it to site with transit mixers. The frames for windows and door as well as ducts for services are placed in the form before concreting. Staircase flights, elevation panels, chajjas and jails etc. and other prefabricated items are also integrated into the structure.

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. Construction is a complex process involving basically the areas of Architectural planning, Engineering & Construction. There is growing realization today that speed of construction needs to be given greater importance especially for large housing projects. This is not only essential for the faster turnover of equipment and investment – leading possible to the reduction in the housing cost but also for achieving the national objective of creating a large stock to overcome shortest possible time. Fortunately, some of the advanced technologies catering to faster speed of construction are already available in the country. For e.g. Prefabrication, autoclaved blocks, tunnel formwork, aluminium formwork (MIVAN Technology) of construction etc.

### 1.3 LINE OF BALANCE (LOB)

Line of balance (LOB) is a management control process used in construction where the project contains blocks of repetitive work activities, such as roads, pipelines, tunnels, railways and high-rise buildings, precast construction, row houses etc. It is a control process for collecting facts relating to time, cost and schedule accomplishment, all the project related task is measured against specific plan. LOB shows the process, status of project, crew size continuity, and background of work, time and phase of project activities providing management with measuring tools. LOB assists project management by comparing a formal objective against actual progress, examining only the deviations from established plans, and gauging their degree of severity with respect to the remainder of the project, dealing with

problem and trouble causing areas and problem solving within specific constrains.

- 1 Forecasting future performance.
- 2 A programmed rate of completed units is met.
- 3 A constant rate of repetitive work is maintained.
- 4 Labour and plant move through the project in continuous manner such that a balanced labour force is maintained and keep fully employed.
- 5 The cost benefits of repetitive working are achieved.

Line-of-balance (LOB) is a variation of linear scheduling methods that allows the balancing of operations such that each activity is continuously performed. The major benefit of the LOB methodology is that it provides production rate and duration information in the form of an easily interpreted graphics format. The LOB plot can show at a glance what is wrong with the progress of an activity, and can detect potential future bottlenecks. Obviously, LOB allows a better grasp of a project composed of repetitive activities than any other scheduling technique, because it allows the possibility to adjust activities' rates of production. It allows a smooth and efficient

Flow of resources, and requires less time and effort to produce than network schedules

An early attempt to develop a computer application was made to schedule repetitive-unit construction It was limited to solving the basic LOB problem and was not designed to deal with the many implementation-related problems that were later identified. Clearly, there was a need to develop a computerized system that would make use of the principles but that would also eliminate all of the associated shortcomings. A computer program that can easily and effectively be used by contractors could improve construction productivity significantly.

The Goodyear Company founded the LOB technique in the 1940's and it was then developed by the USNavy in the 1950's. Since then LOB techniques have taken a back Seat and have never been commercialized due to the explosion of systems based on Network Analysis and Critical Path Method (CPM). It should be said that these network and CPM systems have never actually replaced the LOB method; their popularity has simply been due to the unavailability of commercially accessible LOB software. A modified form of the LOB method has been the dominant scheduling technique in Finland since the 1980's.

#### 1.4 SCOPE OF PROJECT

- Forecasting future performance.
- A programmed rate of completed units is met.
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#### 1.5 OBJECTIVES

1. To study the concept of LOB and MIVAN Technology.
2. To understand the relation between LOB and MIVAN Technology.
3. Evaluation of LOB in MIVAN Technology using software.
4. Give discussion and suggestion for effective utilisation of line of balance method in mivan technology for high rise building

#### 1.6 ORGANISATION OF REPORT

- Topic selection
- Collection of literature
- Study of mivan technology
- Study of line of balance method
- Case study
- Evaluation and application of LOB in mivantechnology
- Comparative study of mivan and conventional formwork
- Discussion and suggestions for implementing LOB effective in mivan technology

## 2 METHODOLOGY

### CONCEPT OF MIVAN TECHNOLOGY AND LOB

#### 2.1 INTRODUCTION

This chapter consist of information about mivan technology and line of balance method. it includes mivan systems, mivan formwork and its types along with mivan components like beam, wall,deck etc. This chapter also gives advantages of mivan technology and mivan formwork over conventional one. Comparison of bar chart and line of balance method is also given along with benefits of line of balance method.

#### 2.2MIVAN SYSTEM.

The Mivan Technology System was created by Mivan Company Ltd from Malaysia late 1990s as a framework for building mass lodging venture in creating nations. The units were to be of thrown set up cement, with burden bearing dividers utilizing a formwork of aluminium boards. To be raised by the hundreds, of a tedious outline, the framework guaranteed a quick and prudent technique for development. The solid surface completion delivered with the aluminium frames permits accomplishment of a superb divider complete without the requirement for broad putting. This is one of the frameworks distinguished to be especially reasonable for Indian conditions for mass development, where quality and rate can be accomplished at abnormal state.

It is the most advanced formwork systems. It is fast, simple and adaptable. It produces total quality work which requires minimum maintenance and when durability is the prime consideration. It is a totally pre-engineered system where in the complete methodology is planned to the finest details. In this system the walls, columns and slab are casted in one continuous pour on concrete. Early removal of forms can be achieved by the air curing/ curing compounds. These forms are made strong and sturdy, fabricated with accuracy and easy to

handle. The components are made out of aluminium and hence are very light weight. They afford large number of repetitions (around 250). The re-propping is simple hence short cycle time can be achieved.

### 2.2.1 COMPONENTS OF MIVAN TECHNOLOGY

#### Beam components

- Beam side panel According to the size of the beam the cutting is done to form a rectangular structure.
- Prop head for soffit beam For easy dislodging of the formwork V-shaped head is used.
- Beam soffit panel It support the soffit beam and is a plain rectangular structure of aluminium.
- Beam soffit bulk head It is used to carry the bulk loads.

#### Wall components

- Wall panel An aluminium sheet which forms the face of the wall is carefully and properly cut to fit the size of the wall.
- Rocker It is of L-shape and also a supporting component of wall.
- Kicker It act as a ledge to support and at the top of the panel it forms the wall face.
- Stub pin It helps in joining of two wall panel together.

#### Deck components

- Deck panel It forms a horizontal surface for safety of workers and for casting of slab.
- Deck prop It is a supporting component of deck and also it bears all the loads coming on deck. It is prop head with V-shaped form.
- Prop length It is a length of the prop and it depends on the slab length.
- Deck mid It helps in supporting and to hold the concrete in the middle portion of the beam.
- Soffit length It support the edges of the deck panel.

### 2.2.2 ADVANTAGES OF MIVAN TECHNOLOGY

- Uniformity in all components of structures.
- Casting of all structural member is done a single pour of concrete.
- Scrap value is high.
- Can be erected using unskilled labours and without the removing of props, deck panel can be removed

### 2.2.3 ADVANTAGES OF MIVAN TECHNOLOGY OVER CONVENTIONAL FORMWORK

- More seismic resistance - For the structural member the box type construction provides more seismic resistance.

- Durability of concrete structure is more.
- Due to minimum number of joints, leakage of concrete is reduce and durability is enhanced.
- The carpet area is high due to thin shear wall.
- Finishing is smooth of slab and wall, hence eliminates the plastering work.
- Uniform quality of construction and uniform grade of concrete.
- No further maintenance required due to strong built concrete.
- Lesser labour required.
- As a better sound transmission co-efficient.

Fig 2.1.Mivan formwork

### 2.2.4 MIVAN FORMWORK

- Using this unique system building elements such as wall, floor, balconies, door, and window opening cast in place in single site operation. The Resulting building strong accuracy in shape and size of the building element.
- The main component of Mivan is panel which is excluded from rail section may get result of light weight of formwork.
- Light weight panel gives the good stiffness to weight ratio, minor deflection under concrete loading.
- Panel is made of aluminum composite with 4mm thick skin plate and 6mm thick ribbing.
- Speed of construction : The wall and floor are cast together in one continuous operation and easily removal with less time
- Aesthetic: Room size wall and roof element of building cast against steel plates have very smooth surface so that get the smooth wall and no requirement of plastering.
- Efficiency: 87.5% of plinth area as per useful carpet area.



Fig 2.2 Aluminium Formwork during construction



Fig 2.3 Aluminium Formwork during construction



Fig 2.4 Aluminium Formwork during construction

### 3.2.5 COMPONENTS OF MIVAN FORMWORK

The basic element of the formwork is the panel, which is an extruded aluminium rail section, welded to an aluminium sheet. This produces a lightweight panel with an excellent stiffness to weight ratio, yielding minimal deflection under concrete loading. Panels are manufactured in the size and shape to suit the requirements of specific projects

The panels are made from high strength aluminium alloy with a 4 mm thick skin plate and 6mm thick ribbing behind to stiffen the panels. The panels are manufactured in MIVAN'S dedicated factories in Europe and South East Asia. Once they are assembled they are subjected to a trial erection in order to eliminate any dimensional or on site problems. All the formwork components are received at the site within three months after they are ordered. Following are the components that are regularly used in the construction.

### 2.3 COMPARISON BETWEEN BAR CHARTS AND LINE OF BALANCE TECHNIQUE.

- Bar chart facilitates focusing attention on specific objective, whereas LOB defines the objectives related to production rate, where monitoring is easy at any stage of project.
- In Bar chart, the result of planning activities can be clearly seen, where in LOB the results are carried out on reference with resource allocation and optimization.

- Activities on the critical and those with float can be easily identified, In LOB buffer are provided at start or end of activities, this facilitates the crashing operation.

### 2.4 ADVANTAGES OF LINE OF BALANCE METHOD

- The use of graphic and the visual intuitiveness provided by the separate activity types enables project manager, schedulers, owners, and construction personnel to better visualize the plan of action and more easily communicate the plan to everyone involved within the project.
- Benefits of this method allow the planner to plan a feasible schedule that is not sensitive to disturbances. The main advantage of LOB in scheduling projects is that it can convey important production information (eg. Work location, progress direction, and production rate) in an easy-to-visual graphic format.

### 2.5 ADVANTAGE OF LOB OVER CPM TECHNIQUE

Linear Scheduling is composed of continuous activities, unlike CPM which is composed of discrete activities. Most construction projects are scheduled based on some sort of critical path planning method (CPM). A number of versions of this technique have been developed and is used as the basis for many of the popular project management software packages. Many researchers discussed the suitability of CPM for construction projects, mainly those repetitive projects, such as railroads and multi-story buildings, and more recently for the lean construction concepts. As more complex becomes the project more complex it will be this network approach. Usually such master schedules cannot be accurately detailed too far into the future because of lack of information about actual duration and deliveries. Other important disadvantage relies on the main idea of the CPM method which is focused on finding the path which is critical. The schedule is developed based on this premise and the resource capacity and material requirements are input for the project simulation. The emphasis is on project duration shortage and resource leveling. The fact of having a "critical path" implies having non critical ones, which have float time. It means that the planning construction incorporates wastes what significantly diverts from a modern construction philosophy. The CPM is ineffective and cumbersome for scheduling linear continuous projects but extremely efficient for more complex and discrete type projects. The LOB technique is very suitable for repetitive projects like residential buildings; however it may be adapted for non-repetitive projects as well. The main advantages of LOB schedule are its graphical presentation, easy understanding of the schedule and the goals of planning used in it. The research conducted by the authors aims to improve the LOB concepts on building construction and prove its usefulness. LOB is superior than CPM in its higher compatibility with Building Information Modeling and 3D models. As a visualization tool, it is easier to read a Line of Balance schedule, once you understand how the lines go. Furthermore, as far as setup, for me, Line of Balance seems to be a much simpler way to schedule large amounts of activities, when compared to the Gantt chart schedule on a Primavera program. With a LOB schedule you don't have to replicate that activity every time. That decreases the amounts of pages needed for presentation of a certain sequence of repeated activities from 4 or 5 pages in a Gantt chart to just 1 page on a Line of Balance schedule

## CHAPTER 3

## FUTURE WORK

- 2.1 DATA COLLECTION
- 2.2 BAR CHART
- 2.3 PLOTTING HISTOGRAM
- 2.4 CALCULATION OF COST OF THE PROJECT
- 2.5 INFERENCES
- 2.6 FLOW LINES USING VICO CONTROL SOFTWARE
- 2.7 FINDINGS FOR THE STUDY
- 2.8 FORMULA FOR CALCULATE CREW SIZE

## 2.9. CASE STUDY

Project:- Residential building

Location:- Mumbai

Design Consultant:- J+W Consultant

Built up area:- 675.779sqm

Number of storey:- G+21 floors

## CHAPTER 4

## CONCLUSION

1. With the rise of the population of the country, the task of construction process as monumentally increased. As we all know the construction of high rise building is becoming a trend, and the process of construction of these high rise building takes more time and hence to reduce the duration and cost of the project advanced technology are adopted.
2. The new advanced technology are manufactured for construction of multi storeyed project which leads to production of cost efficient and speedy construction of project.
3. Even though the initial investment of Mivan technology is high, it provides cost efficient project and eliminated the need of plastering work as it gives a good surface finish compared to conventional type of formwork. The duration of project can be minimized by adopting Mivan technology. And hence it is concluded that Mivan technology is not suitable for small scale projects. Line of balance method is effective in finding out rate of production of each activity using crew size. Increase in labours increases the project production rate but increase of labours cause increase in cost.
4. Conventional formwork system is mostly adopted in the world but it has more consume time and costly in construction project. Conventional formwork not suitable where population is large, less land available and construction project work required in speedy. This all condition satisfy in MIVAN formwork system. Mivan technology give the better result in Cost effectiveness, Speed of the construction with higher durability of building structure.
5. In Mivan formwork, speed of construction can be achieved by 4 day cycle per floor. Removing of floor slab forms without removing prop is possible, while in conventional not possible. Displacement of the conventional system is 86% more than that of Mivan structural system.

## CHAPTER 5

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