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To study of LOB Method for Planning of Construction Project

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Abstract: *Despite the fact that network-based methods, such as the critical path method (CPM), have been demonstrated to be effective tools for scheduling and progress control, they are not appropriate for projects that involve repetitive activities. This is due to the fact that repetitive operations frequently generate differing production rates. Bar charts, on the other hand, are easy to create and comprehend, and they have a level of appeal that is global; yet, they are unable to display the dependencies that exist between activities. One of the most significant advantages of the LOB approach is that it offers information on output rate and duration in the form of graphics that may be easily understood. Planning and scheduling approaches that are mostly utilised in the construction and manufacturing industries, which are characterised by a high prevalence of repetitive processes, are known as linear scheduling methods. The Line-of-Balance Scheduling Technique, often known as LOBST, is a linear scheduling system that enables the balancing of activities in such a way that each activity is carried out in a continuous and efficient manner in each successive unit. In addition to this, the research focuses on the distinction between the two scheduling approaches, namely the Critical Path Method (CPM) and the Line of Balance Method (LOB). In this study, we examine a number of journals that are associated with LOB and CPM in order to gain an understanding of the methodologies. Furthermore, in this work, a VICO control software 2008 version used for to put on the technique, and a case study of a road is also implemented on it, with the goal of achieving a deeper understanding of the approach.*

Keyword: Line of Balance, CPM, VICO software, Planning, Construction Project

Introduction

The purpose of this research is to identify the current projects that could benefit from incorporating the Line of Balance technique, an alternative method of planning and scheduling, and to document the fundamental principles required and current difficulties encountered in software development so that this method can be improved for future use. The research also focuses on how the Critical Path Method (CPM) and the Line of Balance Method (LOB) vary in scheduling. Following that, you should apply this approach while you plan, work on, monitor, and present your project. In order to have a better grasp of the technique, this study applies software to it and then uses a road case study to illustrate it. Compared to other techniques, LOB is not widely used in India anymore.

On the other hand, word on the street is that this method, when used with the right tools, will be a boon to all big infrastructure and real estate projects. Consequently, the LOB technique can be utilised in software development and for projects involving repeated tasks, such as road construction, piping, and residential developments including large apartments or row houses. Visual aids like the "Line of Balance" let managers quickly assess whether all the moving parts of a complicated operation are "in balance"—that is, whether all the tasks that were supposed to be finished by the time of review were actually finished and whether any tasks that were supposed to be finished later are falling behind. Here are the tasks involved in the house's superstructure, together with the estimated number of man-hours needed to complete them. A reasonable number should be assumed for the gang size of the activities. In this paper we discuss the case study of road project and compare result of CPM and VICO software in brief.

Overview of VICO Control 2008 Software

According to a practitioner of LOB from India, the usage of LOBST has been more prevalent in the construction industry. This is mostly owing to a lack of understanding and awareness among those involved in scheduling, as well as the absence of suitable software programmes. This thesis introduces VICO software, which is based on LOBST. This technology can be utilised by the business now and is also applicable for Construction Managers entering the profession.

A. Location Breakdown Structure (LBS)-- This innovative method enhances advanced planning and scheduling capabilities, encompassing task planning, detailed forward planning,

risk mitigation, resource allocation and optimisation, procurement planning, logistics management, and cost planning.

The programme is designed in a modular fashion, allowing for the incorporation of an expanding array of supplementary features. The current list of components includes the Design mode.

B. Location-Based Management System (LBMS)-- aids in the supervision of project progress, identification of issues, implementation of control measures, and provision of timely project management information for maximum effectiveness. The advanced modules enable the management of quality, job prerequisites, and schedule optimisation to enhance production efficiency through simulation. The software is modular, with a growing range of additional functions. The current list of components is:

- ✓ **Risk simulation** refers to the process of simulating or modelling potential risks in order to assess their impact and develop strategies to mitigate them.
- ✓ **Procurement** refers to the process of obtaining goods or services from external sources, typically by purchasing or contracting.
- ✓ **The Controlling mode** refers to a certain mode or approach used in managing and controlling various aspects of a project or organisation
- ✓ **Micromanagement** (requires a controlling approach)
- ✓ **Expenses**
- ✓ **Supply chain management** (requires procurement)
- ✓ **Quality control and prerequisites**

Literature Review

As per By Mohammad A. Ammar and Emad Elbeltagi, Project managers always struggle to schedule multi-unit building projects with repeated activities. Schedules that maintain logic restrictions and assure uninterrupted resource use from one unit to the next are needed for these projects. The scheduling method in this research considers logic and resource continuity limitations. The critical path method network of one unit is used. We use start-to-start and end-to-end partnerships. A constant production rate is expected. The proposed method simplifies the process of determining the controlling path for logical and resource-critical units. The proposed approach is automated by a commercial scheduling software macro-program. A

model creation and implementation process is outlined, and an example application validates the approach. The approach's pros, cons, and possible extensions are then examined.

As per Trahash K. Matey et al.., Though limited in construction, linear scheduling works well for repeating tasks. Line of balance scheduling uses network technologies. Line of Balance works best for linear, repetitive tasks. Housing, urban development, road construction, high-rise constructions, pipelines, and precast concrete production require line of balance scheduling. Flow line graphs help simplify and detail project monitoring instead of Gantt charts. The project manager must maximise resource consumption. The result will indicate LOB and VICO's optimum project scheduling strategy for project flow line computation. LOB and VICO technologies graph repetitive tasks, allowing project managers to compare predicted and actual production rates and make progress.

As per Gunnar Lucko, *Construction* managers must analyse project schedules. Parallel to critical route, linear scheduling is examined. Reviewing the linear scheduling model and repetitive scheduling strategy, the most developed methods. A fresh mathematical analysis method for linear and repeating schedules is offered after discussing a published example. Singularity functions are a powerful mathematical model for linear or repetitive building operations and buffers in productivity scheduling. Creating initial equations, stacking, consolidating, and determining criticality are detailed. The suggested solution uses mathematical methods to integrate activities regardless of productivity changes and does not require scheduling graphics.

As per Meena R. Nageeb and Bradly T. Johnson, many construction projects are planned and managed using the Critical Path Method Scheduling Technique (CPM). Numerous studies have proven that the Line of Balance Scheduling Technique has several advantages over the CPM scheduling technique and can solve many scheduling problems. Research shows that supporting software. Due to software issues, the construction industry has been slow to implement LOB scheduling. Construction technologies, theories, and concepts have advanced, requiring more efficient scheduling and management solutions. Before VICO CONTROL, there were few attempts to create a well-supported, user-friendly LOB scheduling software programme for the construction industry.

In the paper of Guilherme Henrich, Lauri Koskela, Activity- and location-based construction scheduling are the norm. The first involves a logical order and duration of actions. Activity-based scheduling systems include Gantt Charts, CPM, PERT, Critical Chain.

However, location-based scheduling assumes that numerous activities use the same resources. Methods include Line-of-Balance, Vertical Production Method, Time-Location Matrix Model, etc. Network and linear deterministic project scheduling are difficult due to construction uncertainty. Building project failures occur when production management tactics including material flows, value generation, pull system techniques, human aspects, etc. fail to handle current production management difficulties.

Methodology

Following is the methodology used for the paper preparation.

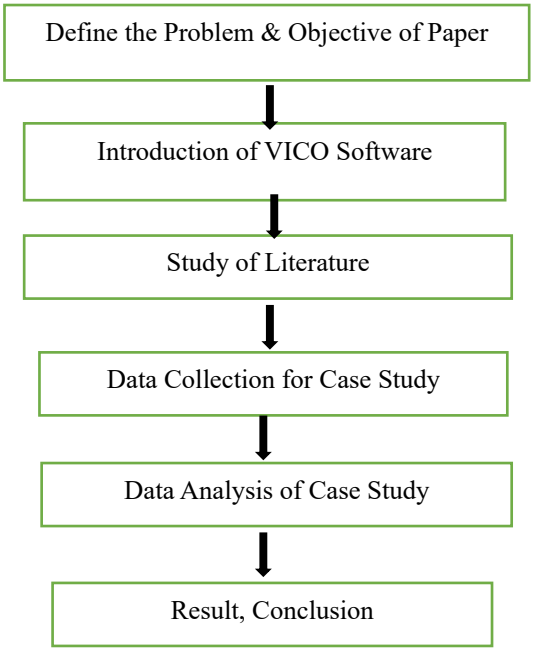

Figure No.1 Methodology of Paper

Methodology for LOB

Following are the steps adopted for drawing LOB graphs for scheduling of high-rise building:

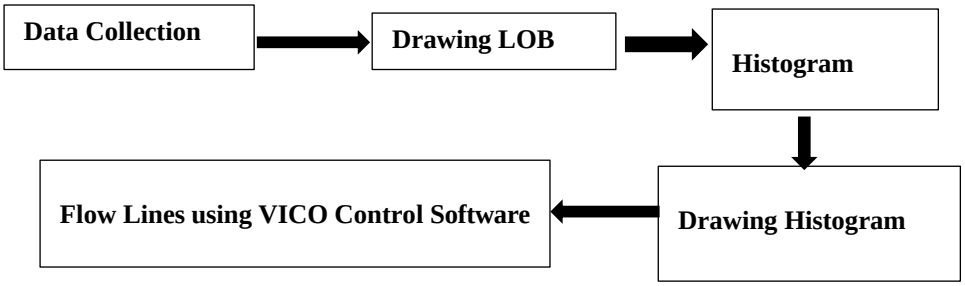

Figure No.2 Methodology for LOB

Case Study –

Due to the fact that there are several activities that take place during the construction of residential buildings, beginning with the foundation and ending with the finishing touches, scheduling high-rise buildings is intended to accomplish a significant goal. The various activities that are repeated meet the requirements of my goals, and the location that I have selected for the work that I will be doing on my project is in PCMC area.

In data collection we collect the data from a residential building site which is in PCMC area. This site is having 2 Tower and the estimated cost of project is more than 12 crores. The starting and finishing of project was 01/11/2022 to 31/03/2025. We collect the data as follows

- ✓ Scheduling of work data
- ✓ Planned and Actual number of labours required on site
- ✓ Maximum number of labours available at site per day.

Formula For Calculate Crew Size:

1) Crashed Gang Size at Chosen output rate (G)

$$G = \frac{\text{(R x Man hour per unit)}}{\text{(No. of working hour per man per week)}}$$

2) Actual Gang Size (Ga) Ga = **Actual gang size**

3) Actual Duration for one unit (D)

D = (Man Hrs. per Unit) / (No. of man per Gang * No. of working hour man / day)

(Number of working hours per day = 8 Hours excluding lunch hours)

Table 1- Housing Construction Project Data

Activity	Man hours	Gang size
Column	336	14
Beam	336	14
Slab	560	14
Doors & Windows	96	3
Flooring	336	6
Brickwork	280	7

Plaster	120	5
Painting	96	6

Given:

- No. of houses: 20 Units
- Desired Rate: 2 units/week
- Working hours: 8hrs/day & : 5days/week
- Buffer time: 3days

Activity 1- Columns (Typical Calculation)

- Duration: = 336/ (14*8) = 3 days
- No. of gangs needed: = (4*336)/ (14*8*5)

  =2.4= 3 approximately
- Start of unit 1(1): = 0 Days
- Finish of unit 1(1): = 3 Days
- Start of unit 20(1): = Start unit 1+ (n-1)*(duration/no. of gangs)

  = 0+ (19)* (3/3)

  = 19 Days
- Finish of unit 20(1): = 19 + 3

  =22Day
- Check: = 22 / (5days/week)

  = 4.4 weeks
- Rate: = 20/4.4 = 4.54 houses/week

Activity 2-Beams (Typical Calculation)

- Duration: = 336/ (14*8) = 3 days

- No. of gangs needed: = (4*336)/ (14*8*5)

  =2.4= 3 approximately

- Start of unit 20(2): = Finish of Unit 20(1) + buffer

  = 22 + 3 = 25 Days

- Finish of unit 20(2): = Start of Unit 20(2)+ Activity duration

  = 28 Days

- Start of unit 1(2): = Start unit 20(2)- (n-1)*(duration/no. of gangs)

  = 25 – 19*(3/3) = 6 Days

- Finish of unit 1(2): = 6 + 3 = 9Days

- Check: = 25-6 / (5days/week)

  = 3.8 weeks

- Rate: = 20/3.8

  = 5.2 houses/week

Process of Using Software for analysis

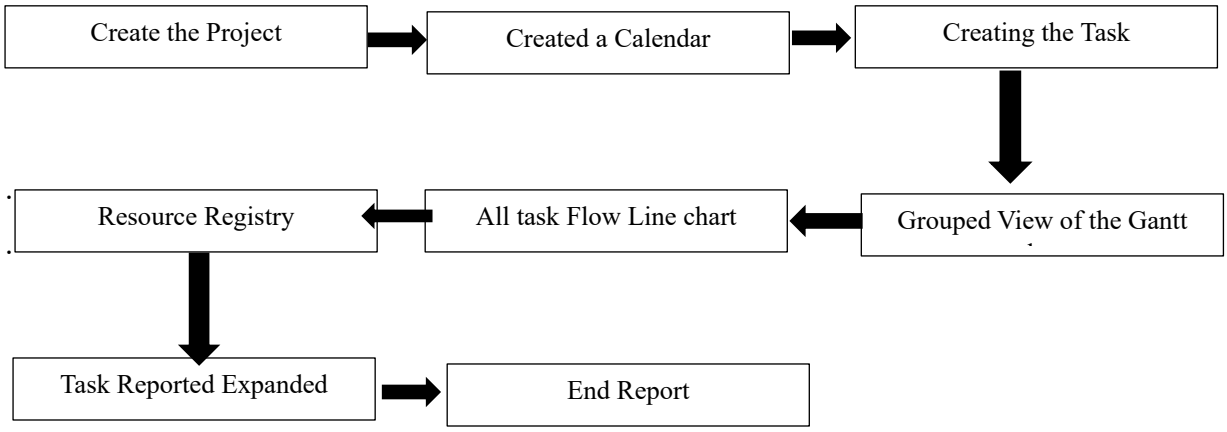

Figure No.3 Process of Using Software.

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Table 2. Typical data for Activities with Crashed Duration

Activity Symbol	Task Name	Planned Duration	Crashed Duration
A	Column Reinforcement	3d	2d
B	Elect & Plumbing Conduiting Fixing	3d	2d
C	Column Shuttering	3d	2d
D	Slab Beam soffit fitting	3d	2d
E	Slab Shuttering fitting	3d	2d
F	Slab Beam Reinforcement fitting	3d	2d
G	Slab Reinforcement fitting	3d	2d
H	Slab Elect. & Plumbing Conduiting laying	3d	2d
I	Slab & Beam Outer Sides fitting	3d	2d
J	Slab & Beam Consultant Check	2d	1d
K	Column Casting with M25 Grade	2d	1d
L	Slab & Beams Casting with M-25 Grade	1d	1d

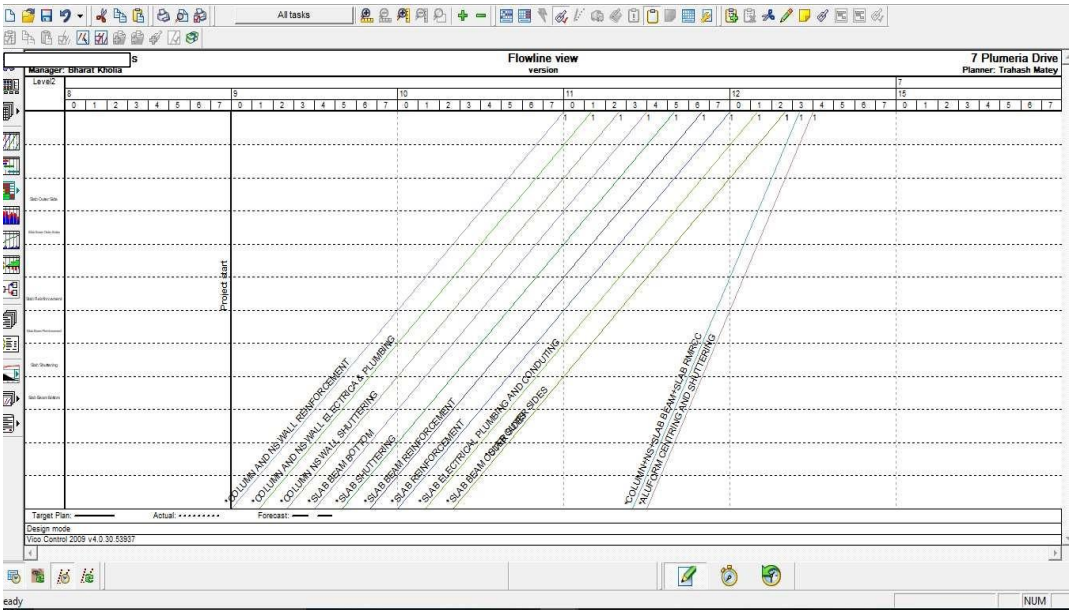

Figure No.4 Vico control view for crashed work

Vico control view gives flow line views for project work, fig 4 is planned project work for construction site for shows actual work done on construction site for ground floor to 6th floor. Data is collected from MSP report on site. The above figure shows the crashed work on site by using Vico Software.

Conclusion

LOB assumes a homogeneous production rate for an activity. Although the standard CPM is extensively used to schedule construction projects, it has many drawbacks in scheduling recurring projects. Insufficiencies include repeating similar actions and relationships and ignoring production data like production rate and job location. Therefore, LOB scheduling can produce a productive resource-driven schedule.

- ✓ Applying line of balance scheduling to site data enables ongoing project monitoring at milestones.
- ✓ LOB calculation yields optimistic values for effective and idle force ratios.
- ✓ VICO control software correctly analyses flow line view.
- ✓ Work activity progress rate is determined for achievable results.
- ✓ Successfully analysed and computed production rate utilising LOB for site work.
- ✓ Graph for recurring tasks shows linear timetable for project activities.
- ✓ Labour costs are computed using LOB for planned, real, and crashed situations.

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