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Application of Lob in High Rise Structure

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Abstract:- Network scheduling methods like Critical Path Method (CPM), Program Evaluation and Review Techniques (PERT), and bar charting are found as less effective in case of linear projects planning, in which the model repetitive activities. Existing literature survey proves that linear scheduling techniques are much suitable to manage linear nature projects like highway, tunnels and high rise building. Linear scheduling is a practical tool, which is utilized successfully for developing and maintaining the construction schedule as well as for seeking alternative schedules to the existing schedule to the existing schedule. Coupling the strong visual advantage (s) and flexibility of this technique with a systematic approach, the balance method (LOB) is used in the repetitive type of activity and save lots of time in the projects. In a building construction most of the activities are repetitive in nature. The present work is focused on LOB method to complete the project in minimum time duration. Live running building project is selected for the research. LOB and CPM both methods are implemented and compared in this building schedule. CPM is widely used in planning and schedule in construction. Result show that in existing method 270 days are requires to complete the project but in CPM requires 248 days and LOB takes 180 days only. The result shows that LOB is more useful in the repetitive type of activity.

Keywords:- *Line of Balance, Critical Path Method, Building, Primavera, Scheduling, Activity.*

I. INTRODUCTION

Keeping a construction project on path can be complicated at times; however, implementing a few methods can help ensure that the process will run much smoother. Efficient scheduling may help to remove many of the problems in production, notify everyone when different materials are needed, and improve the efficiency of the project. It's all about finding what works best for your project and with your team. Gantt chart and critical path method are the most common method in construction sector they're widely accepted on construction sites and are popular for their simplicity and versatility. Gantt charts consist of a list of activities with all of the information about the activity, in regards to time. The start time/date, duration, and completion time/date are all included. The detail of the information varies with each project. The more difficult a project is, the more difficult the schedule needs to be. Gantt charts just used for time tracking but to track other aspects of the project as well. They can be used to examine the number of resources needed which will also keep the project on schedule considering the necessary equipment will always be available.

The Line of Balance (LOB) Scheduling Technique was originated by the Goodyear Company in the early 1940's and was developed by the U.S. Navy in the early 1950's for the programming and control of both repetitive and non-repetitive projects. Line of Balance (LOB) is a method of showing the repetitive work that may exist in a project as a single line on a graph. Unlike a Bar Chart, which shows the duration of a particular activity, a LOB Chart shows the rate at which the work that makes up all of the activities has to be undertaken to stay on schedule, the relationship of one trade or process to the subsequent trade or process is defined by the space between the lines.

II. OBJECTIVE

- To understand the principal of line of balance technique.
- To implement the method on a building construction project as a schedule comparison technique.
- To analysis the effectiveness.
- To compare existing project duration, traditional method (CPM) with the help of primavera and line of balance method (LOB).

III. LITERATURE REVIEW

Arditi and Albulak (1986) study shows that the linear scheduling method was best suited to project that display repetitive characteristics, but their use in construction industry was limited. Line of balance (LOB) was a linear scheduling method that also makes use of network technology. Its benefits and shortcomings were investigated in a high-way surface treatment project where LOB had been used experimentally. It was determined that LOB was extremely sensitive to error in man hour, crew size, and activity duration estimate.LOB allows a better grasp of the project than any other scheduling techniques because it was possible to adjust activities rates of production. It provides a smooth and efficient flow of resources and required less time and effort to produce than network schedules.

Vorster et al. (1995) Paper presented by the need of linear scheduling as a practical and visual tool for use in planning transportation construction projects. Network analysis techniques and bar charts do not provide the planner with an adequate means of analyzing the way in which crews move through time and space. Linear schedules can be used to overcome this problem. A review of linear scheduling research was presented to show the

need for a standard format that combines the best of prior research and experience.

Kallantzis et al. (2007) suggested linear scheduling method, which provides an alternative way of scheduling repetitive projects, to the commonly used network method. The study compares the critical path of the kallantizis-lamboropoulos repetitive project model against the network scheduling critical path method, aiming at delving into and pointing out the differences and similarities between them. Initially, the rule for transforming the linear project into an equivalent CPM network was proposed. Then the rule was applied on sample linear projects. Due to the additional constraint for maintaining resource continuity that the linear method takes into account, the critical paths vary. The constraint was subsequently removed from selected activities and comparison was repeated; the critical path then coincides. In order to validate the findings and ensure impartiality of results, a random linear projects generator was developed. A group of twenty-five random linear projects and their equivalent networks was produced. Their critical path were analyzed, compared

Pai and Rai (2013) paper presented one aspect of a Repetitive Scheduling Method (RSM) or Line Of Balance Scheduling Technique (LOBST) applied for a housing project having project activities repetitive in nature. Linear scheduling methods are planning and scheduling techniques mostly used in construction and manufacturing industries where repetitive operations are abundant. The Line-Of Balance Scheduling Technique (LOBST) is a linear scheduling method that allows the balancing of the operations such that each activity is continuously and efficiently performed in each consecutive unit. Some construction projects that involve sets of tasks organized in repeating sequences are similar to continuous manufacturing processes in their structure. The basic concepts of LOBST have been applied in the construction industry as a planning and scheduling method Examples of such projects include pavement construction, multi housing projects, and high rise building construction. Today, LOB application has been further expanded, making it suitable for a whole spectrum of activities ranging from research and development through job-shop and process flow operations.

Sharma et al. (2018) studied the Line of Balance (LOB) on an ongoing bridge project. Calculated the time required to complete the project using LOB and compared with the duration obtained from CPM and actual time required for completing the project. Line of Balance was found as optimized scheduling technique as per the comparison of actual, CPM and LOB.

IV. METHODOLOGY

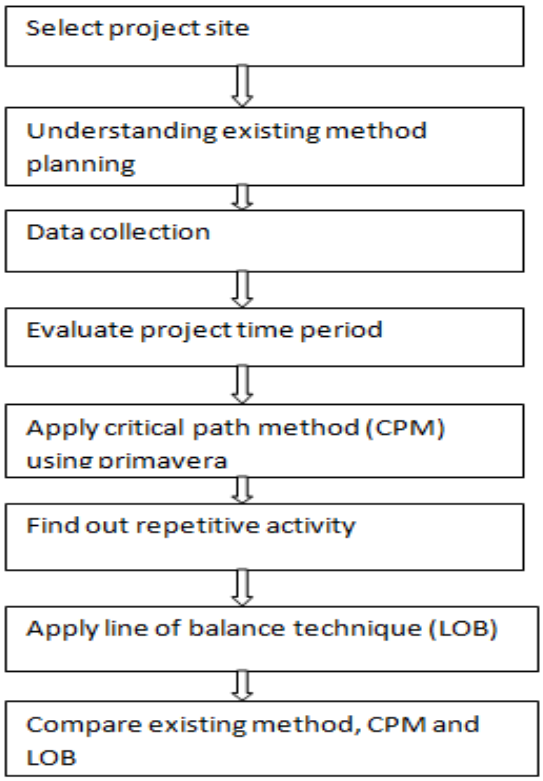

Fig 1:- Flow chart of methodology

V. DATA ANALYSIS

The present study is focus on the construction of building at Mahalakshmi nagar.

Sr. No.	Parameter	Specification
1	Total area	60X60 ft.
2	Span between two columns	Min= 7.25 ft.
		Max= 14 ft.
3	Foundation	Footing type
4	Sub structure	Square + slope
5	Super structure	RCC T-beam slab
6	Column size	8"X18"
7	Beam size	8"X17"
8	Stair case	Riser= 6"
		Thread= 10"
9	Slab height Ground to 1st floor First floor Second floor	 11'6" 10'0" 10'0"

Table 1:- Existing technical site report

Sr. No	Activity	Duration (days)
	Building construction	
1	Project start	
2	Project management	
3	Project complete	
I	**Grading**	
1	Layout of work	1
2	Site clearance	1
3	Investigation of strata	5
4	Design and drawing	5
5	Material purchase	4
II	**Foundation**	25
III	**Structure**	
1	Construction of column	25
2	Construction of water tank	8
3	Construction of plinth beam	14
4	Construction of beam and slab	43
i	Ground floor	
ii	First floor	
ii	Second floor	
5	Construction of walls	40
i	Ground floor	
ii	First floor	
ii	Second floor	
iv	Parapet wall	
6	Construction of staircase	13
i	Up to first floor	
ii	Up to second floor	
IV	**Interior**	50
1	Plastering	
2	Tiling	
3	Electrical	
4	Plumbing	
5	Painting	
6	Decor	
V	**Exterior**	9
1	Plastering	
2	Painting	

Table 2:- Building construction project activity

VI. ACTIVITIES HAVING SCOPE OF LINEAR SCHEDULE

The activities which are repetitive are selected to plan and schedule as per LOB technique are presented below.

- Grading
- Foundation
- Construction of column
- Construction of water tank
- Construction of plinth beam
- Construction of beam and slab
- Construction of staircase
- Construction of walls
- Interior
- Exterior

❖ *Apply Line of Balance Technique*

We need to find the value of No. of units, duration of operation, No. of gangs used and put the value of following into the formula

Activity start= ((no. of units -1)*duration of operation)/ no. of gangs used following calculation are as follow:-

A. Grading

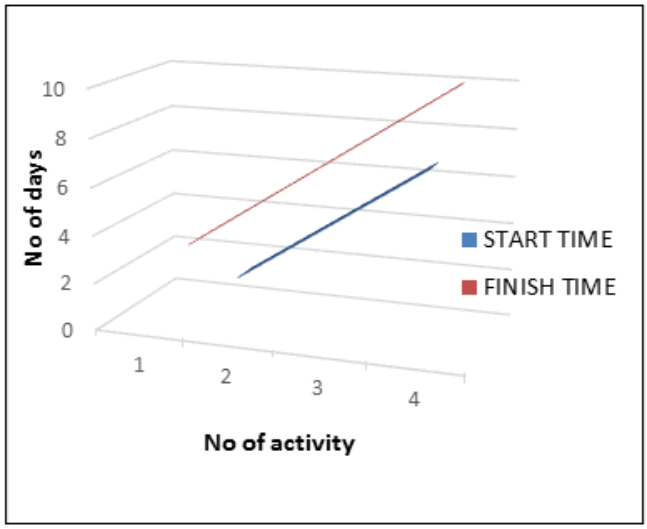

Fig 2:- Lob graph for grading

Figure 2. shows LOB graph for Grading. X-axis shows the no of activities involved in grading and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities**.** Total no. of activities (units) are 4, while the no. of days required for complete the grading obtained are 10days

B. Foundation

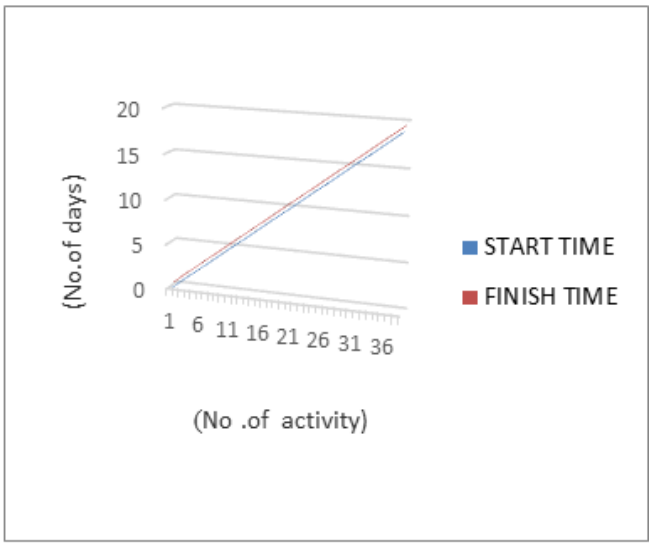

Fig 3:- LOB graph for foundation

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Figure 3. Shows LOB graph for foundation. X-axis shows the no of activities involved in foundation and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) is 38, while the no. of days required for completing the grading are 19.5 days.

C. Construction of column

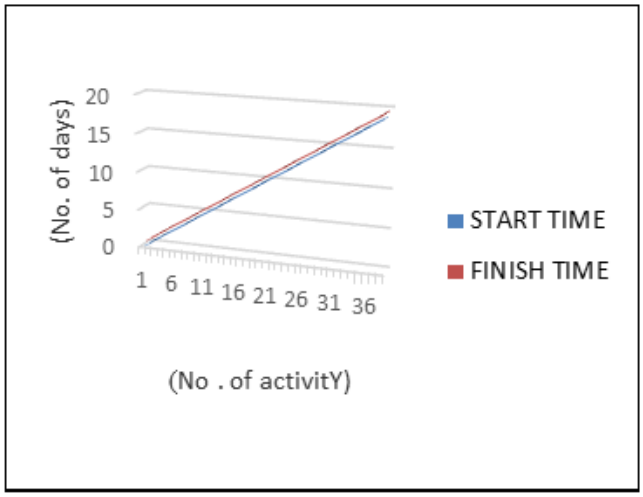

Fig 4:- Lob graph for column

Figure 4. shows LOB graph for column. X-axis shows the no of activities involved in column and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 38, while the no. of days required to complete the grading obtained are 19.5 days.

D. Construction of water tank

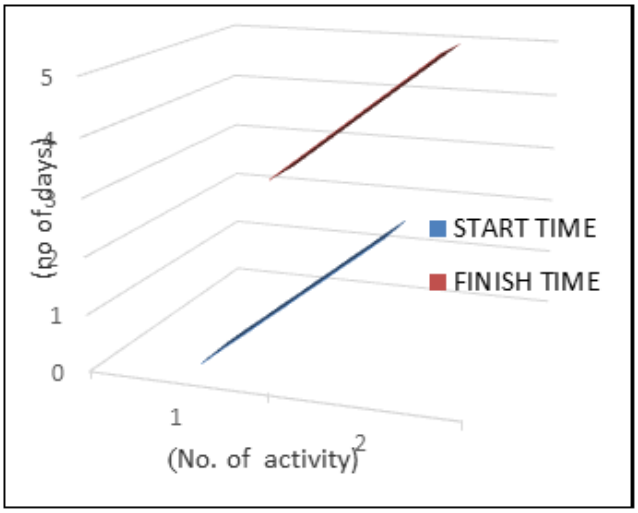

Fig 5:- LOB graph for water tank

Figure 5. shows LOB graph for water tank. X-axis shows the no of activities involved in water tank and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 2, while the no. of days required for complete the grading obtained are 5 days.

E. Construction of plinth beam

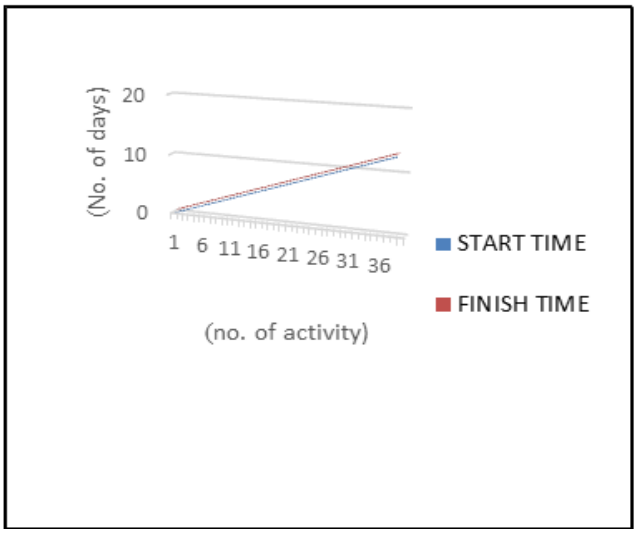

Fig 6:- LOB graph for plinth beam

Figure 6. shows LOB graph for beam. X-axis shows the no of activities involved in plinth beam and Y-axis shows the duration of activities in number of days. Blue color line represents start time for activities and red color show the finish time of activities. Total no. of activities (units) are 38, while the no. of days required for complete the grading obtained are 13 days.

F. Construction of beam and slab

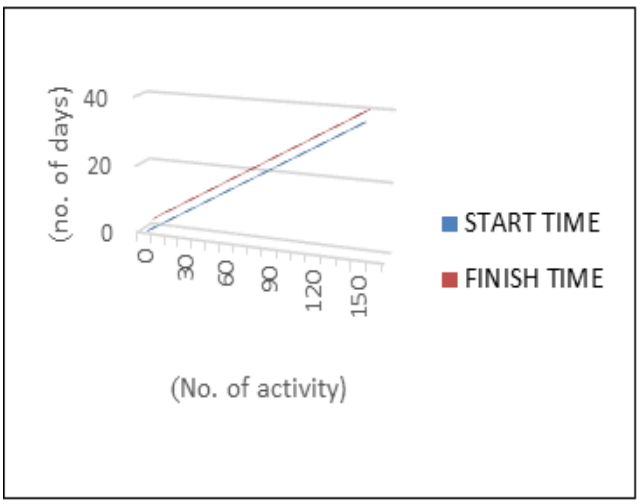

Fig 7:- LOB graph for beam and slab

Figure 7. shows LOB graph for beam and slab. X-axis shows the no of activities involved in beam and slab and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 152, while the no. of days required for complete the grading obtained are 38 days

G. Construction of wall

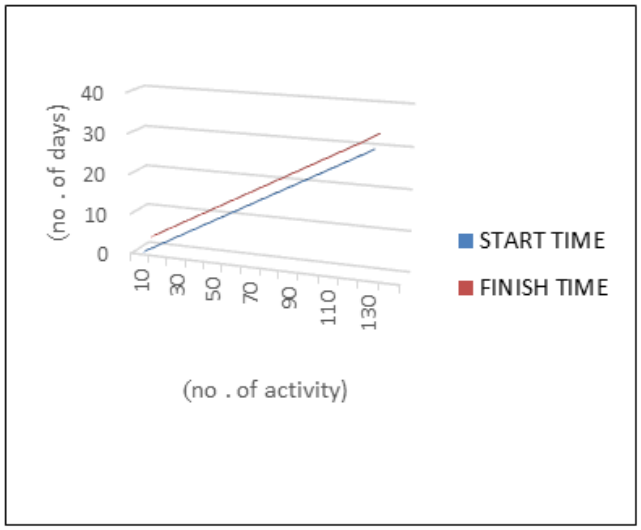

Fig 8:- LOB graph for wall

Figure 8. shows LOB graph for wall construction. X-axis shows the no of activities involved in walls construction and Y-axis shows the duration of activities in number of days. Blue color line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 130, while the no. of days required for complete the grading obtained are 33 days.

H. Construction of staircase

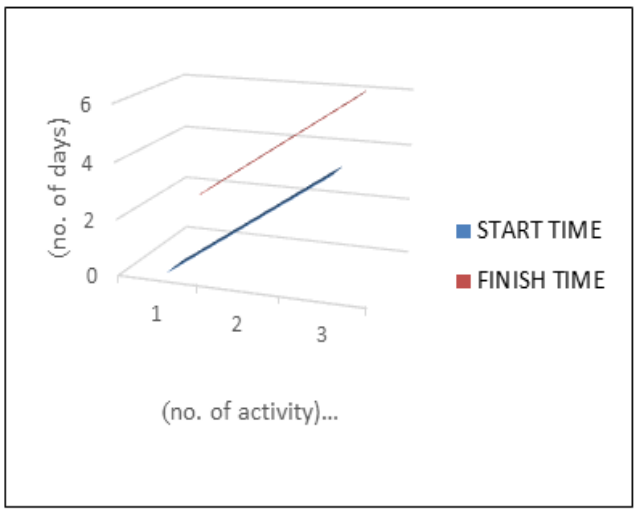

Fig 9:- LOB graph for staircase

Figure 9. shows LOB graph for staircase. X-axis shows the no of activities involved in staircase and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 3, while the no. of days required for complete the grading obtained are 6 day

I. Interior

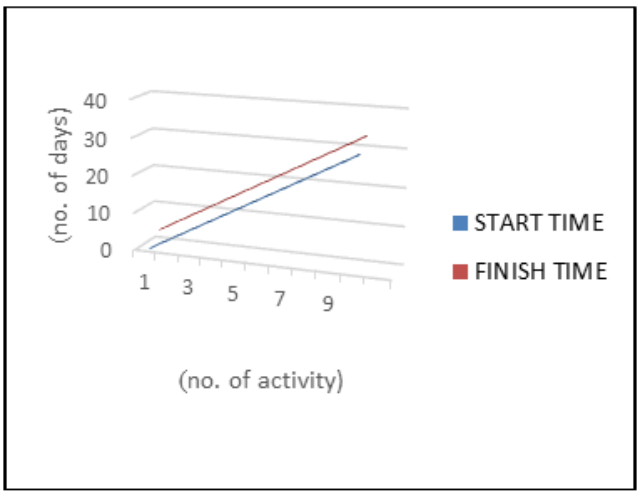

Fig 10:- LOB method graph for interior

Figure 10. shows LOB graph for interior. X-axis shows the no of activities involved in interior and Y-axis shows the duration of activities in number of days. Blue color line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 10, while the no. of days required for complete the grading obtained are 33 days.

J. Exterior

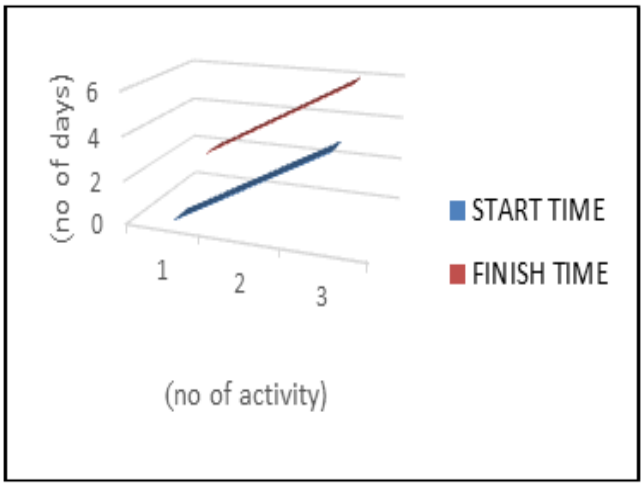

Fig 11:- LOB method graph for exterior

Figure 11. shows LOB graph for exterior. X-axis shows the no of activities involved in exterior and Y-axis shows the duration of activities in number of days. Blue colour line represents start time for activities and red colour show the finish time of activities. Total no. of activities (units) are 3, while the no. of days required for complete the grading obtained are 6 days

VII. CPM FOR BUILDING

Critical path (CPM) is also calculated using primavera software. Using primavera the result is calculated in 247 days. By using CPM the project is completed in 247 days.

VIII. RESULT AND DISCUSSION

The evaluation of performance indicator and strategy formulation is done in previous chapter and the results are obtained.

Activity	Existing (by primavera software)	LOB
Grading	16	10
Foundation	25	20
Construction of column	25	20
Construction of water tank	8	5
Construction of plinth beam	14	13
Construction of beam and slab	43	38
Construction of staircase	13	6
Construction of walls	40	33
Interior	50	33
Exterior	9	6
Total	243	184

Table 3:- Comparison Existing and Lob

➢ *Comparison graphically existing v/s LOB Existing v/s lob*

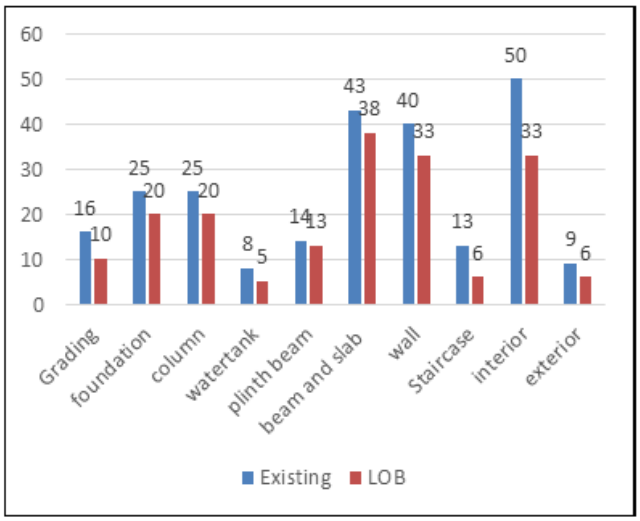

Fig 12:- Comparison of Existing v/s lob

As per the above comparison of graph result LOB is found as optimized scheduling technique. As the days calculated with CPM are 243 days and LOB is scheduling projects in only 184 days.

IX. CONCLUSION

The existing building is first studied and the number of days as per present schedule was 243 days.

The technique LOB is implemented and it is found that the schedule reduces from 243 days to 184 in LOB. There is saving of 59 days with LOB technique with respect to present schedule. As the actual days are 270.

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