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Application of Critical Chain Project Management over Critical Path Method in Construction Industry

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ABSTRACT: The main aim of this project is to analysis the critical chain project management and critical path method to improve the performance of the construction project. The critical chain project management was developed by Dr. Eliyahu M. Gold rate in 1990, and this method is based in the theory of constraints. In order to optimize the project schedule performance the critical chain method used because the traditional critical path method fails sometimes. The critical chain management achieves it's goal through buffer management. These buffer management in construction project reduces the wastage of time. The project delay is face by many countries , so CCPM is used to optimize the project performance. The main advantage of using CCPM is, it save the project from time and cost overrun.

KEYWORDS: Theory of constraints, Critical chain method, Buffer management, Critical path method

I. INTRODUCTION

In construction industry often the problem occurs due to delay of handovering the project, in order to avoid that the project manager arrange a schedule for necessary activities. To minimize this conflicts critical chain project management is used instead of critical path method. CCPM method used for planning,executing and for managing the project. By aplying theory of constraints concept the CCPM is carried out. In CCPM the duration of time is taken as 50% time of CPM and along with that buffers are inserted by using two buffer sizing method.

1. Cut and paste method
2. Root squared error method(RSQ)

Three common types of buffers used in CCPM are,

- 1) **Project buffer-** Between the last task and due date the project buffer is added, and this is added along the critical line.
- 2) **Feeding buffer-** This is added in non critical line between last task on feeding path and critical chain
- 3) **Resource buffer-** Act as remainder for all resources that must needed when their predecessor is complete.

In CCPM the network diagram is drawn first and then scheduling is carroed out, finally the resource dependencies are also added. The main advantage for using CCPM is if there is no mandatory dependency between the activities, sometimes the same resources perform the activities. The main reason for using CCPM is the drawback like Students syndrome, Parkinson's law, Murphy's law, multitasking etc can be avoided. Here the comparison of CPM and CCPM is done manually.

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II. LITERATURE REVIEW

The study about critical path and critical chain method were carried out from various literatures. The CCPM works based on the theory of constraints. In paper “Monitoring of construction project through buffer management”, the author proves that the CPM is based on the guess work, So that CCPM is used. The 50% of task duration is reduced and then buffer is added. In multi project also CCPM is used, this was clearly explained by the author Krystyna araszkievicz in paper “Application of criticalchain management in construction project schedules in a multiprojet environment”. The problem associates with traditional CPM is clearly studied and the method to overcome those problem is also studied. The buffer management is explained in the paper “Project management using the buffer of time and resources”, this paper tells about the types of buffer used in CCPM. From various case studies in the literature review it is clearly stated that CCPM reduces the time duration and the cost is also reduced.

III. METHODOLOGY

The step by step method used for executing the project is,

1. Data collection
2. Prepare a schedule from collected data using CPM.
3. Draw a nerwork diagram for CPM
4. Estimate 50% time duration for CCPM
5. Draw network diagram for CCPM
6. Identify critical path
7. Allocate buffer by various buffer sizing method.
8. Compare the results of both CPM and CCPM.

IV. CRITICAL PATH METHOD VERSUS CRITICAL CHAIN METHOD

1) DATA COLLECTION

The data’s of residential building construction was collected, the activities and corresponding duration involved in the residential building is given in table 1. By using these data’s both CPM and CCPM methods are carried out.

Table : 1 Tasks and their duration

S.No	Activities	Duration days (CPM)	Duration days (CCPM)
1	Site clearance	3	2
2	Marking	1	1
3	Earth work excavation	4	2
4	Concrete work in foundation	10	5
5	Damp proof course	2	1
6	Sand filling	3	2
7	Ground floor Brickwork	8	4
8	Lintel	3	2
9	Centering	4	2
10	Reinforcement laying	13	6
11	Concreting	1	1
12	Curing	7	3
13	De shuttering	3	2
14	First floor Brickwork	10	5

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15	Lintel	3	2
16	Centering	4	2
17	Reinforcement laying	13	6
18	Concreting	1	1
19	Curing	7	7
20	De shuttering	3	2
21	Plastering and pointing	20	10
22	White wash	14	7
23	Colour wash	20	10
24	Fixing doors and windows	2	1
25	Laying floor	15	7
26	Fixing wall tiles	3	2
27	Electrical and lighting fixing	4	2
28	Interior design	10	5
29	Plumbing and sanitary works	4	2
30	Boundary wall and gate	7	4
31	Final clean up	3	2

2) RESULTS BY CPM

From the above collected data the network diagram is drawn and their critical path is founded. The critical path is highlighted with red colour in the figure 1.

The maximum time required to complete the project by CPM=168 days.

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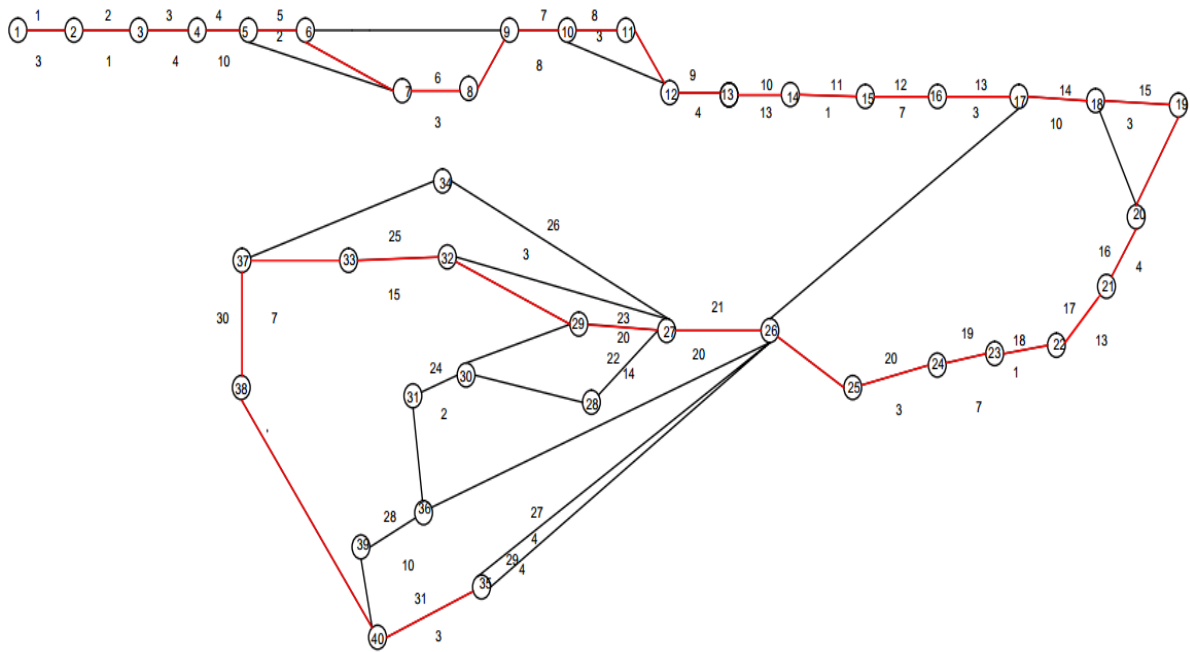


Fig:1 Network diagram

3) RESULTS BY CCPM

In CCPM the duration obtained along critical line is 85 days, so the maximum duration is 85 days then the buffers are inserted by buffer sizing.

1. Cut and paste method

$$\text{Project buffer} = 1/2 (\text{duration of critical path}) \\ = 43 \text{ days}$$

$$\text{Feeding buffer} = 1/2 (\text{duration of non critical path}) \\ = 14 \text{ days}$$

$$\text{Total time required to complete the project is} = 85 + 43 + 14 \\ = 142 \text{ days}$$

2. Root squared error method(RSQ)

$$\text{Project buffer} = \text{Square root of sum of squares of difference between original and aggressive duration of critical path} \\ = 22 \text{ days}$$

$$\text{Feeding buffer} = \text{Square root of sum of squares of difference between original and aggressive duration of non critical path} \\ = 20 \text{ days}$$

$$\text{Total time required to complete the project is} = 85 + 22 + 20 \\ = 127 \text{ days.}$$

COMPARISION OF RESULTS

From the result obtained from CPM and CCPM, the CCPM with buffer sizing root squared error metho(RSQ) gives minimum duration to complete the project. The duration by CPM is high compared to both buffer sizing in CCPM. Thus CCPM with RSQ gives optimum result.

Table:2 Comparison results

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Maximum duration	CPM	CCPM	
	168 days	Cut and paste method	RSQ
	142 days	127 days	

V. CONCLUSION

The critical path and critical chain were determined from the above data. The maximum time required to complete the project by CPM is 168 days, and by CCPM the maximum time required to complete the project is found by adding two types of buffers like cut and paste method and root square error method. From the result obtained the CCPM with root square error method buffering give optimum and best duration. Thus from the result given below, it is proved that CCPM give best result.

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