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Time Optimization In Road Construction Using CPM

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Abstract - This study deals with managing the resources in effective way and minimizing the days for the reconstruction and maintenance of the road. Due to the bad management of the construction process unnecessary delays occurred which affect the cost to the agency and disturbance among peoples. In this study we suggested the segmental construction process over the continuous construction. We consider the road construction process as a network diagram. In this study we divide the road section in various no. of sections and finding the critical path of construction procedure for *each option*

Key Words: **CPM, Construction process, critical path**

1.INTRODUCTION

Every city people are facing problems due to road project delay. worst management is the main cause for the delays. We always hear headlines like Flyover project get delayed, road will not be ready on given time, gutters will be under construction for more time. When the government, contractors will understand the consequences of this so called project delay thing. People faces lots of problem due to this they will be late for offices, school college students will be late for their lectures, the serious patient will surely die in the Ambulance. In rainy seasons the roads will become rivers which will attract road jams, everywhere there will be water which will affect the daily routine of the citizens , The under construction gutters will flood and they will cause deadly diseases, there will be epidemics in the city.

There will be economic loss due to the delay of projects. The wealth of any country is completely dependent on the performance of infrastructure industries. For developing economy of any county the road construction is major component. Delay in Government construction projects, especially the roads sector, it will have a high impact on the economic activities in country.

In this study we are dealing with the rigid construction procedure and analyzing it with the help of CPM network . critical path is the longest path in the network which compromises of total project duration.

1.1 Objectives of the study

The objectives of the study is to summaries the construction phase analysis of intervention of rigid pavement and execution of work.

- Analyze and study the performance and progress of project using construction management.
- Minimizing the total project duration

2. LITERATURE SURVEY

Impact of Existing Pavement on Jointed Plain Concrete Overlay Design and Performance (Darter, M.I., Mallela, J. and Titus-Glover, L. (2009).)

This paper addresses the impact of the level of condition of the existing pavement on the performance of the concrete overlay. Use is made of the new AASHTO Interim Mechanistic- Empirical Pavement Design Guide to simulate two case studies over a range of conditions and designs. Significant findings were obtained to help guide designers to better consider the condition of the existing pavement in their design. Existing pavements that are candidates for concrete overlays vary widely in design and condition. This paper presents some results using the new AASHTO Interim Mechanistic-Empirical Pavement Design Guide (MEPDG) on how different designs and conditions affect the performance and consequently the design of concrete overlays. This paper first describes the capabilities of the MEPDG to model concrete overlays, outlines the various design considerations for concrete overlays, and describes two case studies: one for JPCP overlay of an existing hot-mix asphalt (HMA) pavement and another for JPCP overlay over an existing JPCP. The paper concludes with a summary of findings and recommendations for design based on the MEPDG results. There is a wide matrix of designs and conditions facing designers of concrete overlays. In addition, site conditions including climate, subgrade, and traffic level also contribute to the challenge of providing an economical and reliable concrete overlay design over a future design period. This paper develops a matrix of designs and conditions of existing pavements and then demonstrates the impact of the existing pavement conditions on the performance of jointed plain concrete pavement (JPCP) overlays using the AASHTO Interim (MEPDG models. Based on the results obtained, recommendations are prepared for assisting designers to provide more reliable concrete overlay designs for widely varying existing pavement conditions.

CPM Analysis of Rolai-Rinjlai Road Construction (Khurana, S. and Banerjee, S. (2013).

In this paper work is based on empirical data of a part of the Rolai-Rinjlai road construction project, in which raw material is available at different quarries providing different options to the contractor. Considering the project as a network, author used CPM technique in an attempt to obtain the critical path of the network and suggested the best approach for acquiring material and construction of road under the stated constraints. The solution suggested by us provide a much shorter completion time as compared to the actual time taken by the project. Researcher have listed out the activities involved in the construction process of the highway stretch selected for the study. Network diagram has been formed by identifying schedule and duration of each activities.

The concrete roads projects are very much time-consuming infrastructure. At the time of road reconstruction, we have to divert the traffic through other routes. Higher time causes chaos in surrounding areas and regular jams. For minimizing this problem the roads should be maintained in minimum time Project management consists of planning, designing, and implementing a set of activities in order to accomplish a particular goal or task. For many years, two of the most popular approaches to project management have been the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT). In CPM network, the whole project consists of a number of clearly recognizable jobs and operations called activities. Activities are usually operations which takes time to carry out, and on which resources are expended. Nodes between activities are termed as events.

In this thesis, we use the standard CPM to make a comparative study of the project time of a road for 1.5 km linear continuous process against the segmental construction process suggested by us. we divide the road section in several patches for the effective use of machineries. We will divide the section in 3, 6, and 12 patches and according the activities we will assign the time taken for each activity provided by the agencies. The total time required for completion of project through each alternative is then compared with the time required for linear continuous working process.

3. METHODOLOGY

The concrete roads projects are very much time-consuming infrastructure. At the time of road reconstruction, we have to divert the traffic through other routes. Higher time causes chaos in surrounding areas and regular jams. For minimizing this problem the roads should be maintained in minimum time Project management consists of planning, designing, and implementing a set of activities in order to accomplish a particular goal or task. For many years, two of the most popular approaches to project management have been the Critical Path Method (CPM) and the Project Evaluation and Review Technique (PERT). In CPM network, the whole project consists of a number of clearly recognizable jobs and operations called activities. Activities are usually operations which takes time to carry out, and on which resources are expended. Nodes between activities are termed as events.

In this thesis, we use the standard CPM to make a comparative study of the project time of a road for 1.5 km linear continuous process against the segmental construction process suggested by us. we divide the road section in several patches for the effective use of machineries. We will divide the section in 3, 5, and 8 patches and according the activities we will assign the time taken for each activity provided by the agencies. The total time required for completion of project through each alternative is then compared with the time required for linear continuous working process.

while drawing the network the overlapping of same activity is avoided for the smooth flow of work.

4. CASE STUDY

Case study is performed on a section of road development project of 1.5 km from Cotton Market square to Ganeshpeth Square. Detailed understanding and development of contingency measures to minimize the effect of unforeseen problems during execution phase of project are analyzed .Various prior studies and execution strategies and technologies performed with the flow of execution of events using construction management techniques are studied and analyzed in this study.

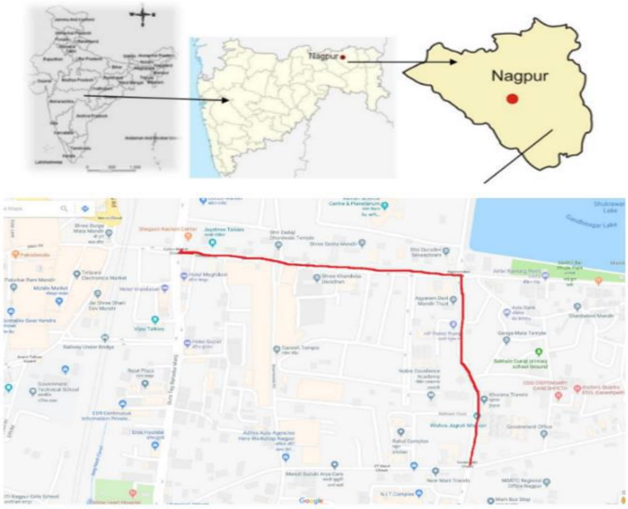

Fig 3.1 Location of site

(duration) that each activity will take to completion † The dependencies between the activities. CPM calculates the longest path of planned activities to the end of the project. The earliest and latest that each activity can start and finish without making the project longer.

5. RESULT AND DISCUSSION

Linear continuous construction process activities and time duration as follows:-

Sr. No.	Activity	Notation
1	Milling	A-B
2	DLC	B-C
3	DLC Curing	C-D
4	M-45 PQC	D-E
5	PQC Curing	E-F
6	Kerb Stone	F-H
7	PCC	G-H
8	PCC Curing	H-I
9	Paver blocks 100 mm in side shoulder	I-J
10	Paver blocks 60 mm in footpath	J-K

Sr. No	Activity	Duration (3 patch) In days	Duration (5patch) In days	Duration (8 patch) In days
1	A-B	3	2	1
2	B-C	5	3	2
3	C-D	7	7	7
4	D-E	7	4	3
5	E-F	28	28	28
6	F-H	13	8	5
7	G-H	13	8	5
8	H-I	7	7	7
9	I-J	10	6	4
10	J-K	12	8	5

In first phase of CPM analysis, activities involved in the reconstruction process has been arranged chronologically and CPM network has been constructed. Durations of each activities are assigned as per the data provided by construction agency.

By calculating LST and EST at each node critical path is identified for the complete activity diagram

- The calculations for this forward step are obtained using the following expression:

$E_J = MAX [E_I + D_{IJ}]$

The Earliest Start is the value in the rectangle near the tail of each activity.

The Earliest Finish is = Earliest Start + Duration

- The calculations for this backward step are obtained using the following expression

$L_I = MIN [L_J - D_{IJ}]$

The Latest Finish is the value in the diamond at the head of each activity

The Latest Start is = Latest Finish – Duration Once the two phases are complete, the activities which comprise the critical path can be identified; these are those which satisfy the following conditions:

1) $E_I = L_I$

2) $E_J = L_J$

3) $E_I - E_J = L_J - L_I = D_{IJ}$

Considering 1.5 km of stretch and dividing in 3, 5 and 8 patches of road as follow.

Considering 1.5km of stretch in 3 similar patches:

Critical path found for the above netwoek diagram for this section as:

A1-B1-C1-D1-E1-F1-H1-F2-H2-F3-H3-I3-J3-K

3+5+7+7+28+13+13+13+7+!0+12

=118 days

Considering 1.5km of stretch in 5 similar patches:

A1-B1-C1-D1-E1-F1-H1-F2-H2-F3-H3-F4-H4-F5-H5-I5-J5-K

2+3+7+4+28+8+0+8+0+8+0+8+0+8+7+6+8

=105 days

Considering 1.5km of stretch in 8 similar patches:

A1-B1-C1-D1-E1-F1-H1-F2-H2-F3-H3-F4-H4-F5-H5-F6-H6-F7-H7-F8-H8-I8-J8-K

1+2+7+3+28+5+0+5+0+5+0+5+0+5+0+5+0+5+0+5+7+4+5

= 97days

From the above table, After analyzing the CPM network and dividing road in 3, 5, and 8 patches the time required for the completion of project 118, 105 and 97 days respectively. While the actual data provided by the authority gives the total project duration as 148 days.

6. CONCLUSIONS

Minimizing the road project duration is major challenge with proper utilization of the resources. This paper reveals the problem in unorganized construction process and states the advantages segmental construction process and efficiency of network diagram for road reconstruction purpose. From the result it is seen that segmental construction process requires 52.2% less time than the time required in linear continuous procedure

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