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# Application of CPM and PERT On Construction of Rail Tracks

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**ABSTRACT**: As a foundation for project planning, execution, and supervision, management may use the Project Evaluation and Review Technique (PERT) and the Critical Route Method (CPM) to discover the longest time-consuming, or consuming, path across a network of tasks or activities. The solutions assist managers in maximizing the shortest time period feasible in order to save project costs and time in half. The use of project planning on the construction of railway lines is shown in this study article, which uses two project management methodologies. To demonstrate the logical sequence of actions to be undertaken in this research paper in order to fulfill this article's purpose, I used the Project Evaluation and Review Technique (PERT) and the Critical Path Method (CPM). The benefits of utilizing CPM scheduling to build railway tracks are discussed in this work. According to the results, the construction may be completed in 852 days rather than the 900 days initially projected, saving roughly 6%. This will show up the network diagram together with beginning and completion timings with the list of activities related with the target in an effective method so as to accomplish the building on or before a defined time limit with required quality standard.

**KEYWORDS**: Critical Path Method, Construction of Rail Track, Operation Research, Project Planning, Project Evaluation and Review Technique.

## I. INTRODUCTION

Operation research is the field of mathematics where it provides scientific way of managing tasks to take effective and timely decisions. Operation research (OR) gives the facility of decision making and yields the simplest form of the complex problems by using mathematical techniques and tools[1]–[3].

One of the methodologies used in OR for planning, scheduling, and managing large projects is network analysis or network scheduling. These are based on the Project's presentation as a web of activity. The approaches PERT (Project Evaluation and Review Technique) [4]–[6]and CPM (Critical Path Method) may be used to examine a network (Critical path method).

PERT AS WELL AS CPM

PERT (Project Evaluation & Review Technique)

PERT was created by the US Navy in 1958 to aid with the development of the Polaris nuclear submarine project. PERT is a managements tool that may be used to evaluate, organize, and integrate events. It's also known as an event-oriented strategy since the focus is on accomplishing a task rather than the actions necessary to do so [2], [7], [8].

PERT takes up the probabilistic time as it is used for the uncertain Projects or one-one time Project which had never been done. The time assumed is unknown in PERT and thus it uses estimated time. In PERT, three-time estimates are made and they are as under:

Optimistic time (to): This is the quickest time to complete an activity if everything goes well.

The most probable time (tm) is the modal value of activity duration.

Pessimistic time (tp): this is the utmost amount of time that the activity must be completed in if everything goes wrong.

PERT (Project Evaluation and Review Technique)

CPM was created nearly simultaneously by the E.I. DuPont Company and the Remington Rand Corporation in 1956-58. The company's goal was to devise a method for monitoring the upkeep of its chemical facilities. CPM is a step by steps project management approach that focuses on critical activities to keep processes and projects on track. The Critical Route is the quickest way to complete any Project by taking one path across all of the associated activities. For project completion, CPM employs two methods:

Critical activity: It is an activity or path which if delayed would delay the whole Project.

Non-Critical activity: It is an activity which can be delayed.

The critical path is the shortest distance between the start and finish of a project, taking all tasks and time into consideration. In a nutshell, critical path determines the project's real timetable. Time is predictable in CPM since it is utilized for Projects that have been developed before in Project management. As a result, a crucial activity has zero float, where float (slack) is the amount of time a work may be postponed without creating delays to succeeding tasks and the Project completion date.

## II. LITERATURE REVIEW

Wallace Agyei [9] in a The goal of this research was to establish a balance between the cost and the time it would take to finish the construction project. It's difficult to complete an undertaking on schedule and on financial plan. Project arranging and planning are fundamental for ascertaining an undertaking's length and cost. The motivation behind their review was to track down a harmony among cost and the most limited conceivable opportunity to finish the structure project. The expense and length of the exercises were provided by Angel Estates and Construction Ltd., a development organization situated in Ghana's Ashanti district. The basic way strategy and the undertaking assessment and survey procedure were both utilized in the review. The positions were evaluated as far as both time and cost utilizing straight programming, empowering the significant way to be found. Further review uncovered that, rather than the anticipated 79 days, the quickest an ideal opportunity for consummation of the assessed constructing project is 40 days. This implies that attributable to appropriate movement planning, the normal consummation time was diminished by 39 days.

Ali Göksu, Selma Ćatović[10] explained how CPM and PERT were used in a furniture firm called "Dallas." They illustrated the impact of CPM and PERT on the furniture sector as a whole, as well as its competitiveness. In view of the rising consequences of globalization in many economic settings, the manufacturing sector must be productive and efficient. The information will be combined with literature reviews and gathered from the "Dallas" furniture company. The accompanying destinations drive the exploration project: The principal stage is to figure out which exercises are associated with the association's assembling interaction. The subsequent stage is to exhibit both the advantages and disadvantages of such strategies in the organization. A definitive target is to exhibit what CPM and PERT mean for the furniture area in general and its seriousness. The outcomes of this exploration study incorporate the assessment of undertaking consummation time and asset control to ensure that the venture is finished on schedule and on financial plan utilizing the methodologies portrayed. The review's discoveries are relied upon to assist all people and associations with bettering understand the thought of CPM and PERT strategies to diminish project consummation time and expenses.

Mats Engwall,[11] exhibited the general objective of Sapolsky's milestone study on the Polaris Project, distributed in 1972, which talked about the utilization and use of PERT. Reason a definitive motivation behind this undertaking is to fittingly recognize Sapolsky's prestigious Polaris Project study, which was delivered in 1972. Two extra destinations are to talk about the job and utilization of undertaking the executives strategies, for example, PERT in project execution rehearses, and to exhibit the worth of far reaching observational contextual investigations in developing how we might interpret project execution real factors. Plan/philosophy/approach the substance and commitments of Harvey M. Sapolsky's 1972 book The Polaris Systems Development are completely inspected in this article. The fundamental subjects of the book are summed up in this article, and their significance for contemporary undertaking the executive's research is talked about. Discoveries Sapolsky's Polaris Systems Growth is a basic record of the absolute most significant occasions in the creation and advancement of undertaking the executives, outstandingly the improvement of PERT as a venture organizing instrument. Sapolsky uncovers that PERT never assumed the part in Polaris that is by and large idea by digging under the explanatory surface of undertaking the executives.

Steve Phillips [12] offered an application-arranged procedure for settling the issue of undertaking the executives length versus asset compromise. The article exhibits how to utilize an application-situated technique to handle the undertaking the executive's length/asset tradeoff issue. A methodology is accommodated diminishing an undertaking's length from ordinary to crash with minimal measure of new asset consumption under the presumption of straight use capacities. The organization based procedure utilizes a graphical Cut Search Approach to track down the absolute minimum of assets at every decrease in complete undertaking length. There are two sorts of organizations utilized: stream organizations and movement on-circular segment organizations. The substance is introduced for down to earth application and scholarly turn of events, rather than a hypothetical methodology.

## III. METHODOLOGY

### *A. Design*

In this research paper there is an application of mathematical concept on the construction of Railway Tracks. Constructing of railway tracks includes various activities in order to make Rail Road in a given time. Here, we will determine the critical route and create a network of the specified activities using the techniques described above, which will allow us to determines the entire projects completion time and the likelihood of finishing the construction on time.

### *B. Instruments*

The Program Evaluation and Review Technique (PERT) is a strategy for surveying how an undertaking is organized, planned, facilitated, and made due. This program will assist you with understanding the review technique used to achieve an undertaking, as well as decide the least and most time important to finish it. During the 1950s, PERT was created fully intent on anticipating project expenses and schedules.

The Critical Path Method, or CPM, is a notable undertaking demonstrating procedure in project the executives. CPM is to a great extent utilized in undertakings to distinguish indispensable and non-basic activities, subsequently diminishing bottlenecks and forestalling conflicts. Fundamentally, CPM is tied in with picking an undertaking way that will empower you to decide the most limited measure of time expected to finish a responsibility while delivering minimal measure of waste.

### *C. Data Collection*

*a. Network Scheduling*

CPM and PERT are network-based techniques for identifying tasks (planning) and scheduling them. Before proceeding, we will discuss some basics of terminologies related to PERT and CPM (Figure 1). Activity and Events: Some instance of time is called an event and the one which consumes time is activity. Some instance of time is called an event and the one which consumes time is activity.

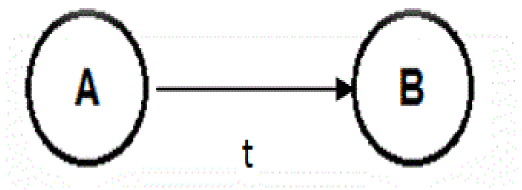


Figure 1: The above figure illustrates the Representation of Activity and Event.

○ denotes event also called as node.
→ denotes activity also called edge.
't' is a time taken by activity.
Rules for Putting Together a Network:
Each action is symbolized by a single arrow.
Each activity must be identified by two distinct end nodes.
Correct precedence relationships consider:
Activities that must immediately precede the current activity.
Activities that follow current one
Activities must occur concurrently (rule 2) with current activity.
Precedence rule: A < B
A is predecessor and B is successor
Precautions To Construct a Network Diagram
Identify the burst element (starting element should not have an incoming arrow as shown in Figure 2).
Identify the merge element (last element should not have an outgoing arrow).
There should be no looping.

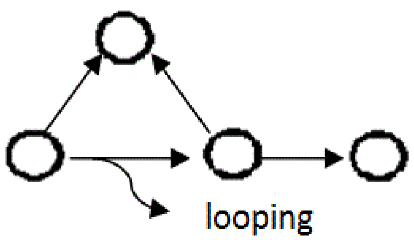


Figure 2: Illustrates the Representation of Looping in Network Diagrams.

There should not be any dangling activity (Figure 3).

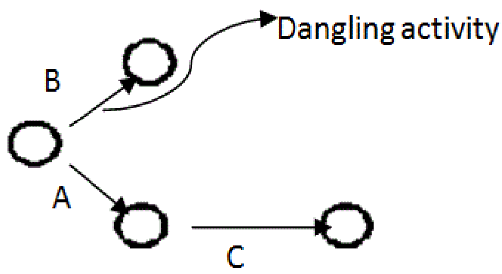


Figure 3: The above figure shows the Representation of dangling activity.

Inserting dummy activity, it is just required to show the Precedence rule of Activities correctly. For eg., A,B<C; A<D as shown in Figure 4.

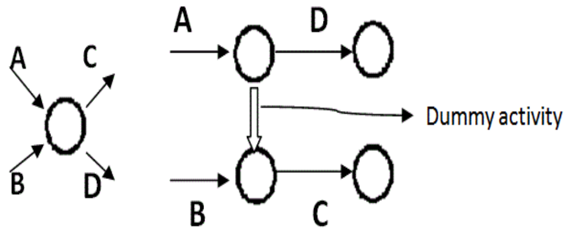


Figure 4: Illustrates the Representation of dummy activity.

The labelling technique used is Fulkerson's rule. Start labelling with the ○ having no head of arrow or incoming arrow. Stop at ○ having no output arrow.
CPM Computations
To finish the assignment or projects in a timely manner, we must calculate the following data.
Total duration to complete Project.
Classification of critical and non-critical activities.
Consider the following notations:
$E_i$ : Initial occurrence time of an event i.
$L_i$ : Newest permissible time of event i.
$ES_{ij}$ : Earliest preliminary time of an activity ( i, j ).
$LS_{ij}$ : Latest preliminary time of an Activity ( i, j ).
$EF_{ij}$ : Earliest final time of an Activity ( i, j ).
$LF_{ij}$ : Latest concluding time of an Activity ( i, j ).
$t_{ij}$ : Duration of an Activity ( i, j ).
Events are numbered consecutively with integer 1,2,…,n $\ni i < j ; \forall_{i,j}$ for any two events i as well as j
For the computations of earliest occurrence and latest allowable time, it involves two methods:
Forward Pass:
It calculates the earliest occurrence time of an event. Let the computations start at node 1 to an end node n.
Set $E_1 = 0$
Calculate the $ES_{ij}$ (i.e., Early starting time of event i to j).
Here ; i=1.
∴ $ES_{ij}$ = Ei, for all activities (i,j) preliminary at event i.
Calculate $EF_{ij}$ which is the summation of $ES_{ij}$ and $t_{ij}$.
i.e.$EF_{ij} = ES_{ij} + t_{ij} = E_i + t_{ij}$.
Now , proceed to next event say j ; j > i.
Calculate $E_j$ , which is maximum of $EF_{ij}$
$E_j = Max\{ EF_{ij}\}$
$E_j = Max\{E_i + t_{ij}\}$; for altogether immediate predecessor activities.
If , j=n (final node/event) , then first occurrence time for the final event say $E_n$ is given by
$E_n = Max\{EF_{ij} + t_{ij}\} = Max\{E_{n-1} + t_{ij}\}$ ; for all terminal activities.
Backward Pass
It calculates latest allowable time of an event.
Once completing the forward pass we will start from end node/event n to the node/event 1.
Set the earliest occurrence $E_i$ of 'n' event ($E_n$) equal to the latest occurrence time ($L_j$) for event 'n' ($L_n$).
i.e., $E_n = L_n$ ; j=n
Calculate $LF_{ij}$ ( latest finishing time of event ends at j ). This will be equal to the $L_n$ .
i.e., $F_{ij} = L_n$ , for all activities ( i,j) ending at j.
Calculate $LF_{ij}$ which is

$LF_{ij} = L_j$ and $S_{ij} = LF_{ij} - t_{ij} = L_j - t_{ij}$ , for all (i,j) ending at j
Proceed backward to the event in sequence.
Calculate $L_i$ , which is minimum of $LS_{ij}$ i.e.,
$L_i = Min\{LS_{ij}\} = Min\{L_j - t_{ij}\}$; for all immediate succesor activities.
If j = 1 , (initial event) , then
$L_1 = Min\{LS_{ij}\} = Min\{L_{j-1} - t_{ij}\}$; for all immediate succesor activities

The float (slack) or available energy is the time allotment wherein a non-basic movement or an occasion can be postponed or stretched out without deferring the absolute Project consummation time. In short the permitted postpone time in Non-basic exercises is called float.
Thus float (slack) is denoted by

$$S_{ij} = L_j - E_i - t_{ij}.$$

Pert Computations:
As PERT is probablistic , there are three time estimates for PERT.
$t_p$= pessimistic time(max)
$t_m$ = most likely time (normal time)
$t_o$ = optimistic time
PERT assumes a beta probability distribution (three-point distribution technique) for the time approximations [5].
The estimated time of an activity for a beta distribution is $t_e = \frac{t_p+4t_m+t_o}{6}$

For beta distriution , the variance for each activity is calculated by

$$\sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$$

Thus , the standard deviation for the Project is

$$\sigma_p = \sqrt{\sum \sigma_{CA}^2}$$

where CA is critical activities.
Beta distribution is known as the durations of activity to follow a probability distribution [2].
Following are the steps to compute it:
Using $t_o, t_p$ $and$ $t_m$ , the expected time $t_e$ is calculated .
To determine the variation in activity duration in PERT, the standard deviation is expressed as the one-sixth of the range assumed by the variate ,
i.e., standard deviation , $\sigma = \frac{t_p-t_o}{6}$
and variance , $\sigma^2 = \left(\frac{t_p-t_o}{6}\right)^2$
Estimation of Project completion time.
The Normal distribution may be used to estimate the probability distribution of times for computing an occurrence. As a result, the likelihood of finishing the project on time; t S is given by:
$Prob\left(Z \leq \frac{t_S-t_E}{\sigma_i}\right)$.
Where t E is the Project's estimated completion time.
Z stands for the number of standard deviations.
$\sigma_i^2 = \sigma_1^2 + \sigma_2^2 + \sigma_3^2 + \cdots +$
$\sigma_n^2$ $is$ $the$ $sum$ $of$ $variance$ $of$ $critical$ $activities$(1).
As a result, t S may be computed as t S=Z i+t e, where Z is the probability of Project completion time.

### *D. Data Analysis*

*a. Subgrade drainage*

The railway is protected from flooding by a subgrade drainage system. Water may quickly wash away the railway track's subgrade, roadbed, and slope. If proper subgrade drainage techniques are not done, subgrade diseases will emerge. Before the railway can be built, drainage must be provided. It mainly employs drainage pipelines, carrier drains, and attenuation ponds in some places, as depicted in Figure 5.

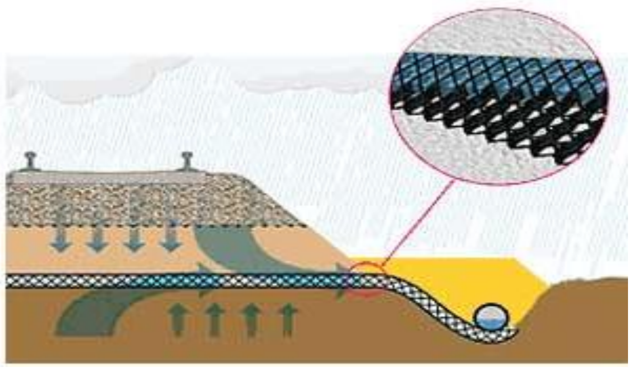

Figure 5: The interception as well as evacuation of water from, upon, or under the track is known as track drainage.

*b. Laying bottom ballast bed*

According to building methods, the ballast bed is divided into two parts: base counterbalance and top counterweight. Between the arrangement of base and top counterbalance, there are further activities (Figure 6).
Determine the depth of the bottom ballast.
Appropriate the rail route sleepers: Place sleepers uniformly on one or the other side of the rail route track.
Physically laying rail route sleepers on the track.
The base counterbalance is shipped to the track and stored consistently, true to form. The earth is compacted by manual spreading and a little street roller.

Figure 6: The track geometry is also more durable with a consistent ballast bed, while uneven ballast increases the danger of buckling.

*c. Anchorage*

The technique of securing a railroad spike to a railroad sleeper is known as anchorage. This process needs the following items: Sulphur, sand, cement, paraffin, screw spike (Figure 7).

Figure 7: The Procedure for Securing a Railroad Spike to a Railway Sleepers.

*d. Laying steel rails*

Rail apolegamy as well as track laying are the most widely recognized sorts of steel rail laying.
Rail apolegamy is a critical piece of the track-laying process. Measure the length of each rail and use it to choose rail apolegamy. Rails with a comparative length assortment are extraordinary. Additionally, the length deviation is under 3mm, and the total deviation is under 15mm. Start laying rails from the turnout's back end. The arrangement of protection joints might be utilized to ascertain the length of non-standard rails. Pass steel rails on to the rail ditch utilizing the monorail vehicle, then, at that point, genuinely raise them to the rail ditch as demonstrated in Figure 8. At the point when the steel rails are set up, utilize the rail attaching framework and rail parts like rail joints to interface them to the rail route sleepers.

Figure 8: Rail apolegamy as well as track laying are the most widely recognized kinds of steel rail laying.

*e. Top ballast*

Top counterbalance laying involves putting counterweight on the rail route and redesigning it to come by the ideal result. The arrangement wherein top counterbalance is set is as per the following: track lifting-track lining-filling counterweight packing completing track bed transport stabilizer spread balance track lifting-track lining-filling balance packing completing track bed.
The 1st top ballast laying
Appropriate counterbalance along the rail route.
Monitor your lifting. Each rail is raised to the appropriate tallness and padded with counterbalance. Keep up with a similar degree of steel rail at all places.
Packing. The packing machine will work after the top counterbalance is prepared. The packing is rehashed an aggregate of multiple times.
Counterbalance filling Adding counterweight to the lodging.
Second top ballast laying:
After a couple of trains have passed, the subsequent top counterbalance arrangement starts. Most activities are equivalent to the underlying top counterbalance putting, except for track redesign.
Rail brace and Rail anchor:
To keep the rail course away from crawling, a rail anchor is used. Rail latches and nuts associate the rail backing to the steel rail. Both the rail anchor and the rail support are relied upon to stay aware of steel rail set up while furthermore ensuring rail prosperity (Figure 9).

Figure 9: Illustrates the Rail anchor and rail brace.

## IV. RESULTS AND DISCUSSION

Implementation Of CPM And PERT:
Assumptions: Labour = 20 men and Length of a track = 50 km and expected completion time = 900 days. Here in Table 1, list of various activities and duration along with the predecessors.

Table 1: The below Mentioned Table Illustrates the Activities and Duration.

| Activity | Description | Duration (Days) | Predecessors |
|---|---|---|---|
| A | Subgrade drainage | 250 | _ |
| B | Set thickness | 40 | _ |
| C | Laying bottom ballast | 30 | A,B |
| D | Spreading railway sleepers | 50 | C |
| E | Anchorage | 60 | D |
| F | Laying steel rail | 90 | E |
| G | Rail apolegamy | 75 | E |
| H | Connectors | 55 | F,G |
| I | Joining rails and sleeper | 80 | H |
| J | Laying top ballast | 105 | I |
| K | Rail anchoring | 125 | J |
| L | Rail bracing | 125 | J |
| M | Trial | 7 | K,L |

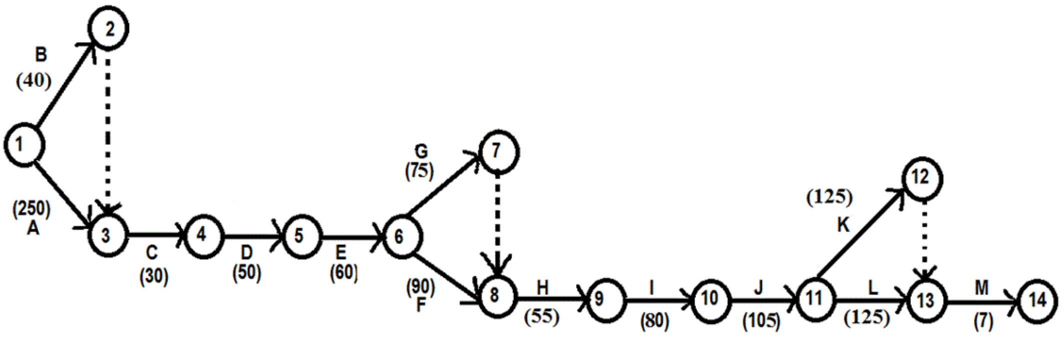


Figure 10: Illustrates the Network diagram for the table 1.

**CPM calculations:**

Starting with the steps to compute the Earlist occurrence time and Latest occurrence time by the two methods

Forward pass method

$$Set\ E_1 = 0$$

$$E_2 = E_1 + t_{1,2} = 40$$

$$E_3 = Max\{E_1 + t_{1,3}, E_2 + t_{2,3}\}$$

$$= Max\{0 + 40, 250 + 0\} = 250$$

$$E_4 = E_3 + t_{3,4}$$

$$= 250 + 30 = 280$$

$$E_5 = E_4 + t_{4,5}$$

$$= 280 + 50 = 330$$

$$E_6 = E_5 + t_{5,6}$$

$$= 330 + 60 = 390$$

$$E_7 = E_6 + t_{6,7}$$

$$= 390 + 75 = 465$$

$$E_8 = Max\{E_6 + t_{6,8}, E_7 + t_{7,8}\} = Max\{390 + 90, 465 + 0\} = 480$$

$$E_9 = E_8 + t_{8,9}$$

$$= 480 + 55 = 535$$

$$E_{10} = E_9 + t_{9,10}$$

$$= 535 + 80 = 615$$

$$E_{11} = E_{10} + t_{10,11}$$

$$= 615 + 105 = 720$$

$$E_{12} = E_{11} + t_{11,12}$$

$$= 720 + 125 = 845$$

$$E_{13} = Max\{E_{12} + t_{12,13}, E_{11} + t_{11,13}\}$$

$$= Max\{845 + 0, 720 + 125\} = 845$$

$$E_{14} = E_{13} + t_{13,14}$$

$$= 845 + 7 = 852$$

Backward pass method

$$L_{14} = E_{14} = 852$$

$$L_{13} = L_{14} - t_{13,14}$$

$$= 852 - 7 = 845$$

$$L_{12} = 845 - 0 = 845$$

$$L_{11} = Min\{L_{12} - t_{11,12}, L_{13} - t_{11,13}\}$$

$$= \{845 - 125, 845 - 125\} = 720$$

$$L_{10} = 700 - 100 = 615$$

$$L_9 = 615 - 80 = 535$$
$$L_8 = L_9 - t_{9,10} = 480$$
$$L_7 = L_8 - t_{7,8} = 480$$
$$L_6 = Min\{L_8 - t_{6,8}, L_7 - t_{6,7}\}$$
$$= 390$$

$$L_5 = L_6 - t_{5,6} = 330$$
$$L_4 = L_5 - t_{4,5} = 280$$
$$L_3 = L_4 - t_{3,4} = 250$$
$$L_2 = L_3 - t_{2,3} = 250$$
$$L_1 = Min\{L_j - t_{1,j}\}$$
$$; j = 2,3 = 0$$

For finding float for the activities, the below formula is used:

$$S_{ij} = L_j - E_i - t_{i,j}$$

For eg, if we need to find,

$$S_{8,9} = L_9 - E_8 - t_{8,9} = 535 - 480 - 55 = 0.$$

Similarly, we can find all the float values for the critical activities which are going to be zero. Hence, the diagram below shows all the values we had find above in Figure 11.

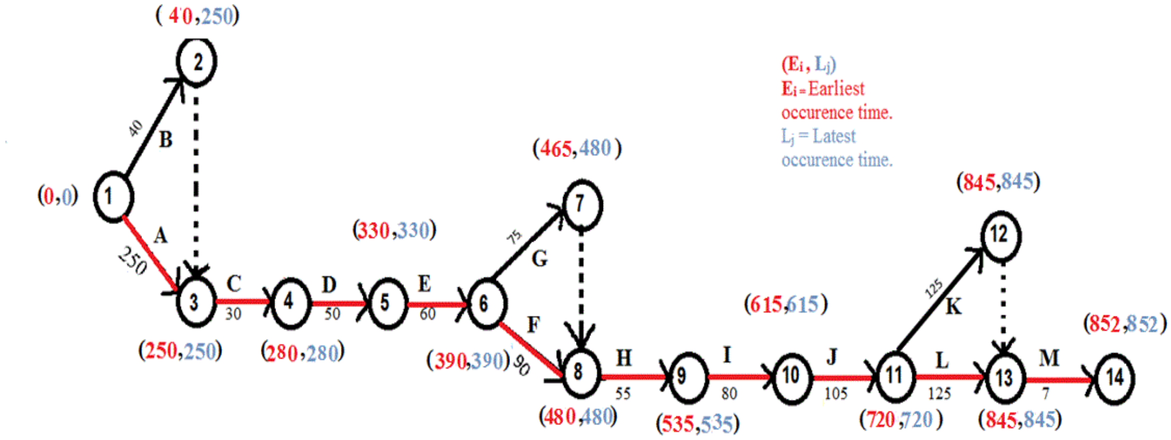


Figure 11: Illustrates the Critical path in network diagram and earliest and latest times.

From figure , the critical path is (1,3)-(3,4)-(4,5)-(5,6)-(6,8)-(8,9)-(9-10)-(10-11)-(11-13)-(13-14). Hence, the completion time of our Project is 852 days.

PERT calculations:

The three time estimates for the same problem are in the following table:

Table 2: Illustrates the Three time estimates of each activity.

| Activity | Description | Predecessors | Duration (Days) $(t_o, t_m, t_p)$ |
|---|---|---|---|
| A | Subgrade drainage | _ | (200,250,300) |
| B | Set thickness | _ | (20,40,60) |
| C | Laying bottom ballast | A,B | (20,30,40) |
| D | Spreading railway sleepers | C | (30,50,80) |
| E | Anchorage | D | (40,60,80) |
| F | Laying steel rail | E | (60,90,120) |
| G | Rail apolegamy | E | (50,70,120) |
| H | Connectors | F,G | (30,50,100) |
| I | Joining rails and sleeper | H | (50,70,150) |
| J | Laying top ballast | I | (80,100,150) |
| K | Rail anchoring | J | (70,120,200) |
| L | Rail bracing | J | (70,120200) |
| M | Trial | K,L | (7,7,7) |

Now, we will compute the expected time by using the formula:

$$t_e = \frac{t_p + 4t_m + t_o}{6}$$

And variance by using formula:

$$\sigma^2 = \left(\frac{t_p - t_o}{6}\right)^2$$

along with the standard deviation $\sigma = \frac{t_p - t_o}{6}$.

Table 3: Illustrates the Expected time and variance calculations.

| Activity | i – j | Expected time (days) ($t_e$) | Variance ($\sigma^2$) |
|---|---|---|---|
| A | 1-2 | 250 | - |
| B | 1-3 | 40 | 44.44 |
| C | 3-4 | 30 | 11.11 |
| D | 4-5 | 50 | 69.44 |
| E | 5-6 | 60 | 44.44 |
| F | 6-7 | 90 | - |
| G | 6-8 | 75 | 136.11 |
| H | 8-9 | 55 | 136.11 |
| I | 9-10 | 80 | 277.78 |
| J | 10-11 | 105 | 136.11 |
| K | 11-12 | 125 | - |
| L | 11-13 | 125 | 469.44 |
| M | 13-14 | 7 | - |

Thus , $\sigma^2 = \sum \sigma_{CA}^2$ = 1324.98

$$\boldsymbol{\sigma = \sqrt{1324.98} = 36.4}$$

We know, $t_s(estimated\ time) = 900$

$$t_e = 852\ (calculated)$$

Then,

$$Prob\left(Z \leq \frac{t_S - t_E}{\sigma_i}\right)$$

$$Prob\left(Z \leq \frac{900 - 852}{36.4}\right)$$

$$Prob(Z \leq 1.31)$$

$$\boldsymbol{P_r = 90.32\%}$$

Thus, the probability of the construction that could be completed in given scheduled time is 90.32%.

## V. CONCLUSION

This paper details the advantages of using CPM scheduling to construct railway rails. The findings reveal that the construction may be finished in 852 days rather than the 900 days originally planned, a savings of around 6%. Reduced Project length might save money, resources, and energy without compromising the quality of the final product. In the face of any variability in the activities time of any critical activities, the PERT analysis shows that the Project may still be completed in the planned Project length with a probability of 90.32 percent without extending the scheduled Project duration. As a consequence of this finding, it is expected that the use of CPM scheduling in the administration of railway track construction of any length with limited resources would be encouraged and promoted.

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