Resource Management of Infrastructural Project for Future Cities: A Re Modified Minimum Moment method

Pallavi Patil[1], Karthik Nagarajan[2], Raju Narwade[3]

PG Student[1], Associate Professor[2,3]

ppallavi@mes.ac.in[1], knagarajan@mes.ac.in[2], rnarwade@mes.ac.in[3]

Abstract

Infrastructural industry is facing a global challenge in optimisation from the past few decades in the field of resource management namely man, machine, material, money (4Ms). A well-designed sound scheduling technique for future cities other than normal traditional methods needs to be carried out to keep the country's economic growth well within its boundaries. Various past research experts have shown that the inter dependency of 4Ms and its varying consequences with the increase in duration directly affects the project cost. To overcome this issue, the objective of this research emphasises in identifying a unique approach by real time monitoring of 4Ms and hence providing a optimize solution by a methodology termed as Re-Modified Minimum Moment Method (RMMM) with considering a case study from Mumbai region, stating post project analysis. Results signifies that RMMM gives better results in terms of optimization than traditional method.

Keywords: Resource improvement coefficient, Re modified minimum moment method, Resource levelling.

1. Introduction

Many project-based industries are recognizing the importance of project planning, but the Infrastructural industry depend on scheduling skills. As they are working under changing environmental conditions and being involved in some complex and a unique project, which requires multi-disciplinary collaboration for which they have to develop accurate planning and frequently modernizing in it. Nowadays there is increase in the competition within the industry which ultimately forces the construction companies to provide the products of good quality within limited durations, for lower costs and under the safe working conditions. In infrastructure project preparation, its schedule requires immediate changes in various uncertainties. Scheduling is not a simple concept of determining these quinces and the timings of activities within a project. A planner has to cope with a number of considerations and various constraints. Therefore, while planning a project site availability, lag durations, output rate, working schedule and atmospheric conditions are the measure issues which has to be analysed.

2. Literature Review

Edem O.P. Akpan et al. (2000) [10] He stated that, to remove the changes in peak and valley of project resources there is a need of levelling practices. Generally, the activity having high peak region floats started at lower date are moved and to smooth the resource profile of course to time constraint to fill up the valleys. The process is done till all the floats are getting exhausted. **Mohammed A. Salem Hiyassat et al. (2001) [9]** this paper gives the modification of minimum moment method and to simplified steps to arrange multiple resources by using MMM method. MMM method gives better results than traditional method. **Gomer J. E., et al. (2002) [8]** a very good workforce strategy, known as multi skilling which shows that how to reduce the cost of labour indirectly as well as improve output and reduction in overall project cost. On the basis of capabilities,

knowledge and experience on former projects workers are getting tasks by the foreman. This study discovers the method of allocating a multi-skilled work force in construction project and to optimize the multi-skilled workforce assignment and allocation process in a construction project the study developed a linear programming model to help

3. Methodology

Applying the RMMM method on data which is collected from site. In backward cycle to calculate the improvement factor, skip the activity having free float (FF) zero from CPM network. Select the activity having largest value of resource rate. There is possibility of having same value of R, at that time choose the activity having largest number of FF. If again there is tie, then activity which having largest duration is to be selected. If again there is tie, then choose the first activity in the queue. After calculating Improvement factor, the activity will be shifted to the new position if the calculated improvement factor of that activity will be larger than zero or equal to zero. Still the tie is observed in the value of IF, then the largest value of time unit is selected. No shifting of activity takes place if the value of Improvement factor is negative. If shifting occurs, the resource rate of activity is subtracted from daily resource sum hence the FF, lags, EFD and ESD are updated in the network. Repeating the process for all the activities which can be shifted and hence the backward cycle completes. Again, the process is staring with forward cycle. At the end, when the process gets finished, we will get final outcome. The above methodology is descripted into figure. 1

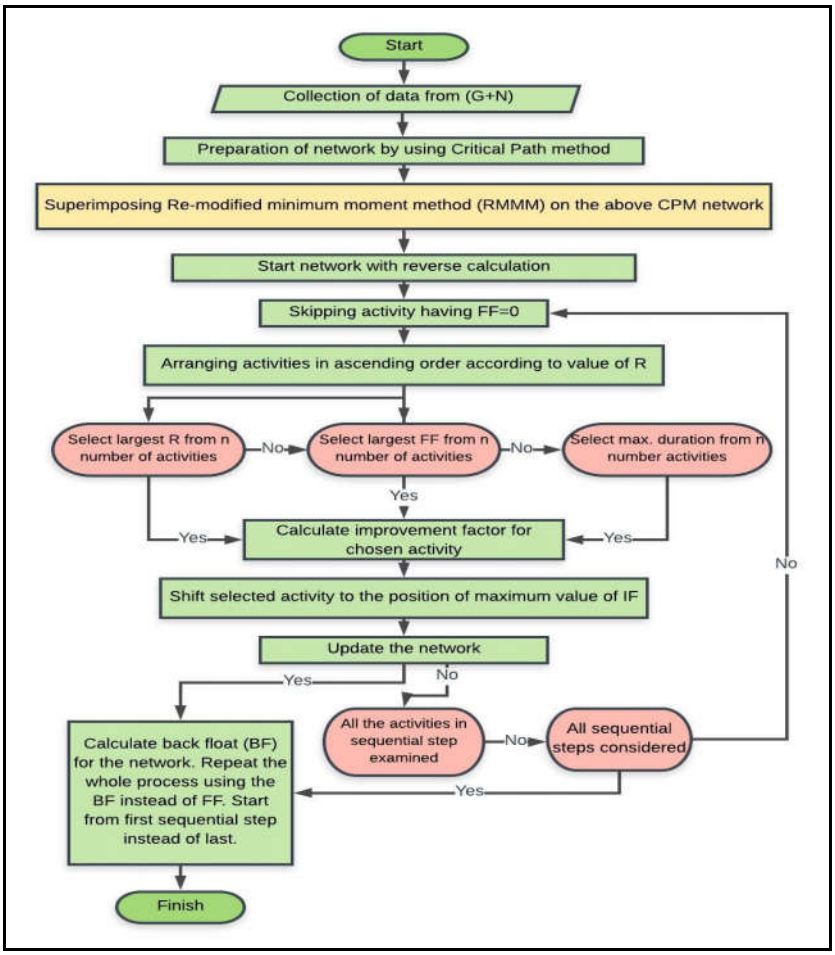

Fig.1 Flowchart on Re modified Minimum Moment Method

3.1 Re Modified Minimum Moment Method

In the sequential step of network to select the criteria of activity, Re modification of minimum moment method is considered. The assumptions are made in the RMMM are same like MM and MMM.

Improvement Factor (activity J, S) = R ($\sum x - \sum w - mR$)

Where,

IF = Improvement factor,

S = Count of shifting days,

$\sum x$ = Daily resources sum of $x_1, x_2, \ldots, xm$, to which deduction of m daily resource rates (R) is to be apply.

$\sum w$ = Daily resources sum of $w_1, w_2, \ldots, wm$, to which addition of m daily resource rates (R) is to be apply;

m = Least of either activity duration (t) or the activity is to be shifted (S) in days;

R = Resources rate.

To get resource improvement factor, minimum moment of the element exists when the histogram is shaped as a rectangle over this interval. This moment is the minimum possible for any resource histogram regardless of the total amount of the resource. [9]

$RIC = n*\sum Y_i^2/(\sum Y_i)^2$

Where $\sum Y_i$= Sum of daily resource sum at i^{th}day

Ideally, the value of this coefficient would be one; hence, the nearer the value of the RIC is to one, the more closely the resource histogram is to a rectangle.

3.2 Study area of the project

Study area located in Fig 2 is having coordinates of proposed site are 19.2813° N, 73.0483°

Figure 2. Satellite view of site

3.2.1 Data collection and Analysis

The data is collected from Residential Construction project at Bhivandi. The activities are arranged according to their inter relationship which are shown in table 1. The proposed Construction project involves the following activities. Table No. 1 contains the activity No., task name and duration. By using these three inputs, a well-arranged CPM network is prepared. According to CPM network, free floats are calculated and critical path is decided. Activity No. 14 is selected to show sample calculation of improvement factor, in which fig. 3 shows the schematic representation of activity no. 14 and fig. 4 shows the bar chart of activity no. 14, in which the FF is 2 therefore activity can be shifted by 2 days.

Table 1: Activities involved in the project

Activity No.	Task Name	Duration
1	Excavation	14
2	Foundation For PCC	6
3	RCC Footing	37
4	Columns Up To Plinth	3
5	Plinth And Ground Beams	4
6	Murum Filling	11
7	Soiling	1
8	PCC Below Flooring	11
9	Columns Up To First Floor Slab	7
10	First Floor Slab	10
11	Ground Floor Brickwork	14
12	Ground Floor Neeru Plaster	16
13	Columns up To Second Slab	7
14	Second Floor Slab	5
15	First Floor Brickwork	14
16	First Floor Neeru Plaster	16
17	Ground Floor Flooring	7
18	Doors & Windows	16
19	First Floor Flooring	7
20	External Sand Faced Plaster	9
21	Painting	12
22	Site Cleaning	14

3.2.2 Network and Bar chart

AON network is drawn for the activities arranged according to their EST, re-modified minimum moment method in figure 3 and 4.

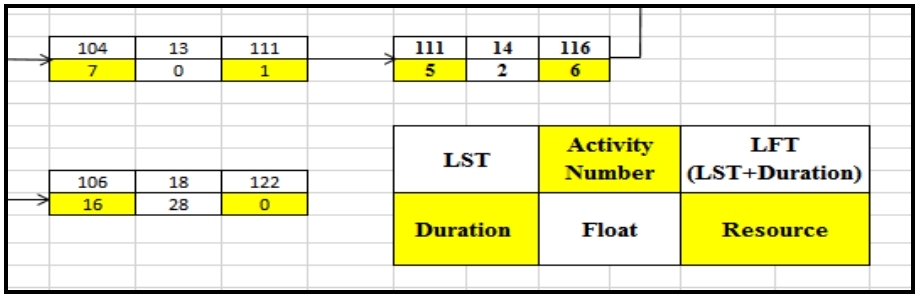

Figure 3. Network of activity No. 14

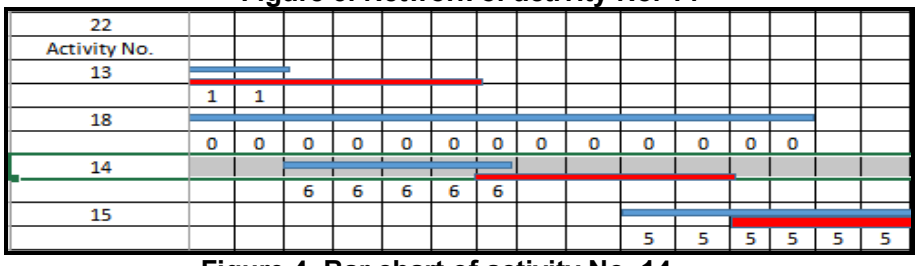

Figure 4. Bar chart of activity No. 14

3.2.2 Calculation

To obtain the minimum moment, improvement factor is needed and for that calculation of each activity is done. Activity no. 14 is explained from all the activities of construction project.

Consider activityno.14

Improvement Factor (activity J, S) = R ($\sum x - \sum w - mR$)

R14=6; F.F.14=4; D14=5

I.F (14, 1) = 11 – 5 – (6*1) =0

I.F (14, 2) = (11*2) – (5*2) – (6*2) =0

I.F (14, 3) = (11*3) – (5*2) – 7 – (6*3) = –2

I.F (14, 4) = (11*4) – (5*2) – (7*2) – (6*4) = –4

Shifting activity 14th by 2 days.

Where, R = resources used for that activity

d = Duration,

f.f. = free float,

i.f. = improvement factor

4. Results and Discussion

Re-modified minimum moment method is helpful to complete the work without any interruption. This can be achieved through proper scheduling of construction activities. Re-modified minimum moment method is helpful to minimize calculation and maximize output in terms of accuracy.

1. The RIC of the project by EST is 2.07 and by Re-modified minimum moment method is 1.93.
2. By using above methodology, the duration of each activity remains constant.
3. By using above concept, the network logic is fixed.
4. By using above concept less calculation is expected with maximum accuracy.
5. According to histograms, Re-modified Minimum Moment Method gives the uniform resource management than EST which is shown in figure 5 and figure 6.

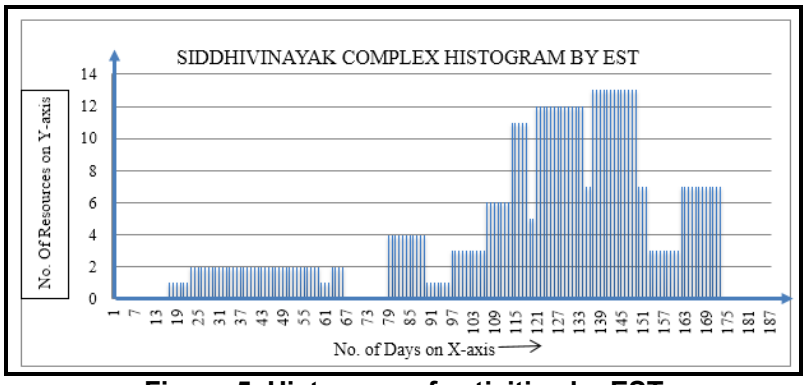

Figure 5. Histogram of activities by EST

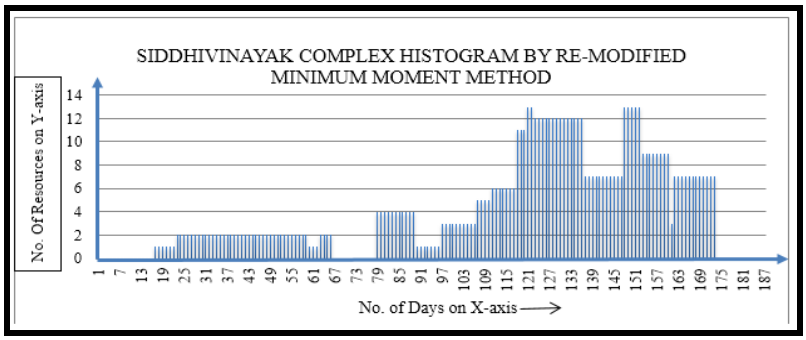

Figure 6. Histogram of activities by re-modified minimum moment method

References

[1] M. Easa (2013) "Resource leveling in Construction by Optimization" Journal of Construction Engineering and Management Vol. 115, Issue 2

[2] R. B. Harris, (2013) "Packing Method for Resource Leveling (PACK)," Journal of Construction Engineering and Management, vol. 116, no. 2

[3] Son J. and Skibniewski, M. J. (2013). "Multiheuristic Approach for Resource Levelling Problem in Construction Engineering: Hybrid Approach." Journal of Construction Engineering and Management, 125(1), pp. 23-31

[4] Abhay Tawalare, Rajesh Lalwani (2012), "Resource Levelling in Construction Projects using Re-Modified Minimum Moment Approach", World Academy of Science, Engineering and Technology, Vol. 125(3).

[5] Dho Heon Jun and Khaled El-Rayes (2009) "Multi-Objective Optimization of Resource Scheduling In Construction Projects" Construction Research Congress 2009 April pp. 5-7

[6] Ming Lu, M.ASCE and Hoi-Ching Lam (2008) "Critical Path Scheduling under Resource Calendar Constraints" Journal of Construction Engineering and Management Vol. 134, Issue 1

[7] Zhang, H., Li, H., and Tam, C. M. (2006) "Particle Swarm Optimization for Pre-emptive Scheduling under Break and Resource-Constraints." Journal of Construction Engineering & Management, 132(3),pp 259-267.

[8] Gomar, J. E., Haas, C. T., and Morton, D. P. (2002). "Assignment and Allocation Optimization of Partially Multiskilled Workforce." Journal of Construction Engineering and Management, Vol. 128(2), pp. 103-109

[9] Mohammed A. Salem Hiyassat (2001) "Applying Modified Minimum Method to Multiple Resource Leveling" Journal of Construction Engineering and ManagementVol. 127, Issue 3

[10] Edem O.P. Akpan (2000) "Resource smoothing: A cost minimization approach" Journal of Production Planning & Control, The Management of Operations Volume 11, 2000 - Issue 8, Pages 775-780

[11] Hegazy, T.(1999) "Optimization of Resource Allocation and Leveling Using Genetic Algorithms." Journal of Construction Engineering and Management, Vol. 125(3), pp. 167-175