

An Investigation on the Impact of Laddering Technique in Project plan: a Case of Road Construction

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Abstract. The use of sequential and parallel activities is suitable for the purpose of most projects. However, in some cases work elements in an activity are progressively released to the next activity thus causing them to be overlapped during their execution. Ladder planning is a method which used in this paper to help the plan with new strategy in assigning resources, in order to minimize the cost and project accomplishment duration. A case problem in road construction is considered to analyse the effect of laddering method in real situations.

Keywords. Project planning, Ladder planning, Overlapped activates, Resource allocation, project cost.

1. Introduction

Laddering technique was invented in Britain in 1964 from ICL (Now Fujitsu) and gained wide acceptance in the scheduling tools developed in the UK, the concept is still an essential element of planning.

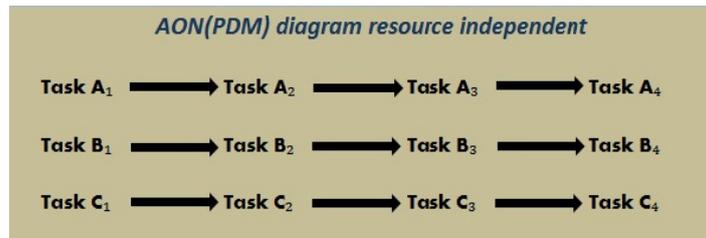
The ladder feed is one of the common components of many project management diagrams, which have recurring assignment. Many of large and construction projects like road, house, and other large urban structure developments are the example of the project with recurring assignment.

There are three main techniques for laddering, start to start, finish to finish, and the combination of the first two methods. FF is the short form of finish to finish that controls the finish relationship; SS stands for start to start that controls the start relationship. Finally, the combination of the SS and FF is the best techniques which control both start and finish events. A ladder takes different approach for the overlapping activities, and it introduces the concept of progressive feed.

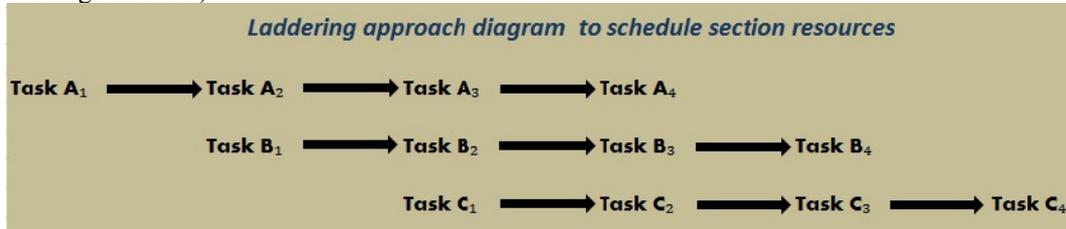
The use of Ladder diagramming method in PDM (Precedence Diagram Method) for road construction project will be discussed in section2.

Comparing the following two parts of figure.1 shows that the classical ladder uses in order to stagger or plan the dependence activities' resources, while in Figure.1(a) there are no dependencies, thus the resource allocation component of CPM scheduling, will level each resource. The result will be a bar chart that shows the stair stepping of the sections. An additional feature is the sequence of section 1, 2, 3, can be determined by the contractor both initially and later, if need to change without changing the PDM network of dependencies, or the computer database.

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(a) A_i, B_i and C_i activities are not using common resources, therefore they can handle simultaneously in CPM, (no laddering is needed)



(b) A_i, B_i and C_i activities are using common resources, therefore laddering is deployed for resource scheduling

Figure 1

The remainder of this paper is arranged as follows. Section 2 provides empirical descriptions about classical method and ladder diagramming technique in the case of road construction. The conclusion accompanied with discussion- on how the cost and project accomplishment duration is affected by laddering technique -are drawn together in Section 3.

2. Case study

Mega Holding SDN BHD is an investment holding company with interest in civil engineering and road construction, infrastructure, and property development.

2.1 Estimating Project times and scheduling the resource

This Company aims to construct a 4km expressway with constraint in time and resources. After the scope of project has been identified, the WBS can be successively subdivided into smaller and smaller work packages. The number of activities in whole project and also in every work package depends on the method which planner use.

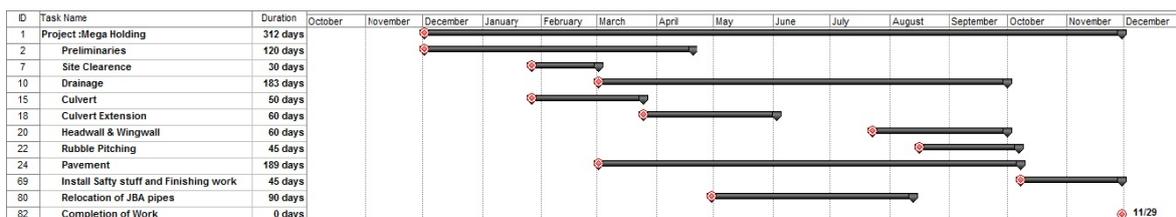


Figure 2. Road construction project Gantt chart

Prior to scheduling the project the most essential questions which are needed to be answered are:

- ▶ Will the assigned equipment be adequate and available to deal with this project?
- ▶ How much flexibility do we have in using resources?

This case study includes 4km road construction and for this type of road we have the simple time table sample for 1 set of resources comes out from technical office. Each activity has its own unique resources except for common labor & tools. So let's say there are 4 activities per section as Figure 3 shows.

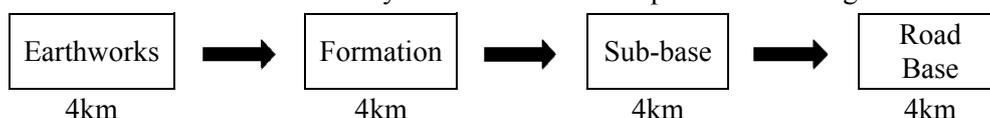


Figure 3. Sequence of project activities in non-ladder method

During this project, potential contribution of each type of planning approaches are examined with respect to diversity in resource availability and indirect costs result from each case.

2.1.1 Non laddering approach

2.1.1.1 1 set of resources available

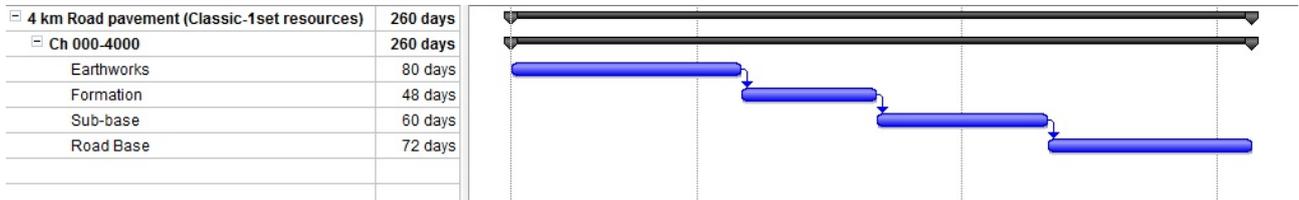


Figure 4. Project summary plan with non-laddering approach and 1 set of resources

a simple calculation shows that the whole time for this part of project is 260days. Actually this type of scheduling won't be occur unless in every special situation to do with company policy or in multiple projects.

2.1.1.1 2 set of resources available

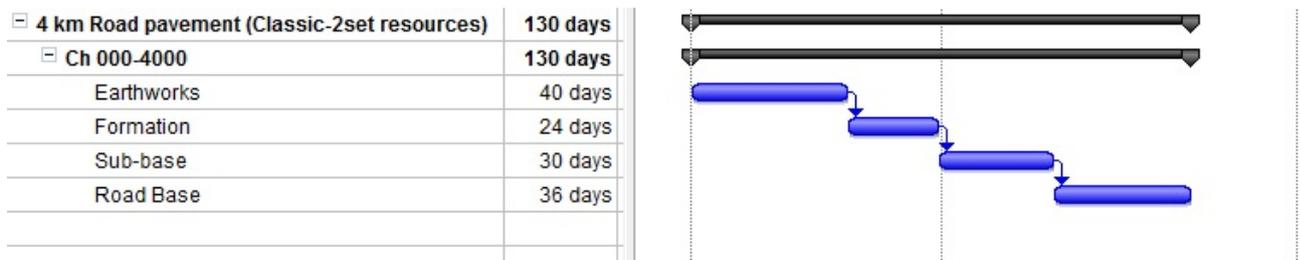


Figure 5. Project summary plan with non-laddering approach and 2 sets of resources

This figure illustrate non- ladder approach with 2sets of resources, which helps the project to be accomplished in 130 days.

2.1.2 Laddering approach and 1 set of resources are available.

By dividing the 4 km to 4 part and consider the activities for each section are diagrammed as 4 sequential activities which we can call a work package. Which those 4 activities can be planned to be completed as a unit without interruption. Each successive enough days the crews move ahead to the next km while the next crew moves in. On the 65th day, there would be 4 unique crews have worked on the 1st km.

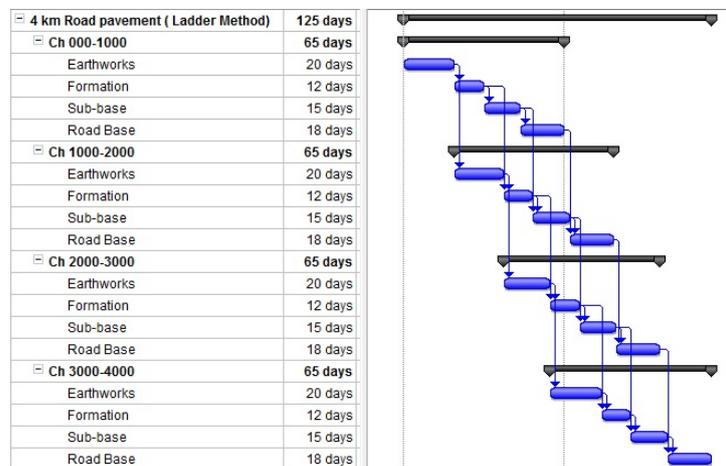


Figure 6. Laddering approach with 1 set of resources

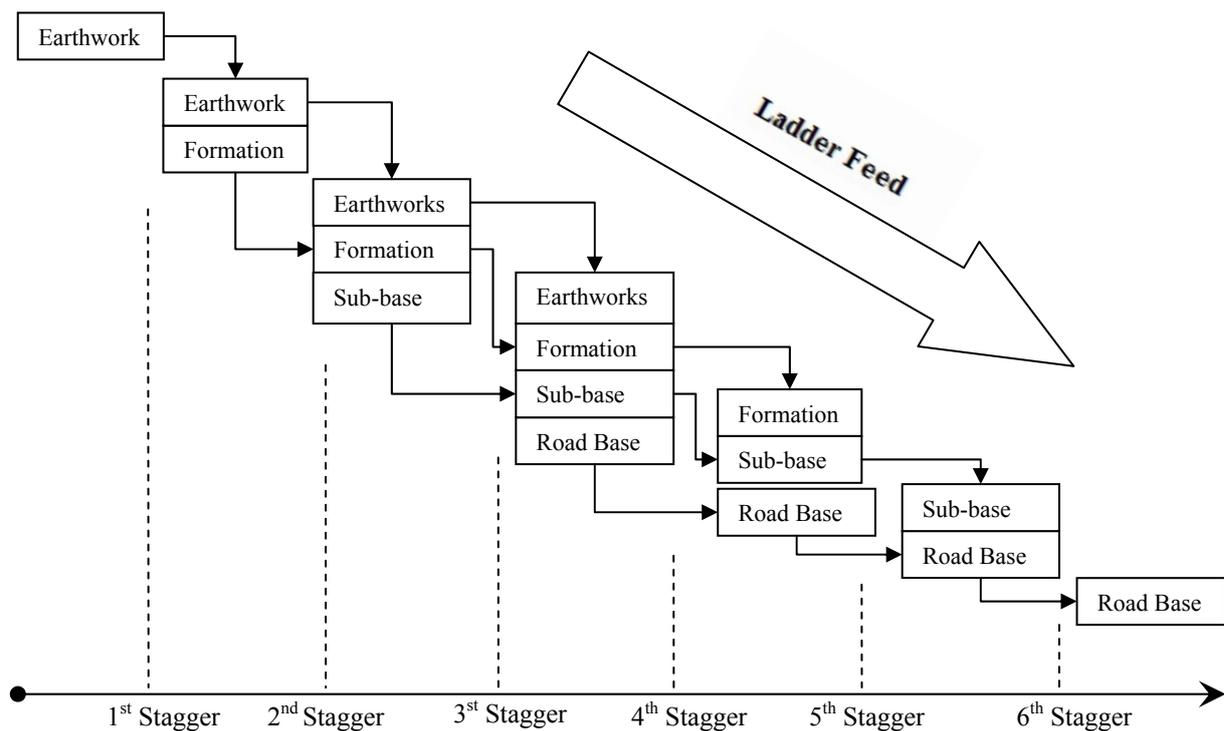


Figure 7. Ladder feed

One of the factors that enforce a high restriction in some of the situations in this practice is the assumption of having any of activities' sequences 100% ready for the next activity. This is a common situation for the activities that follows each other but they have overlap. Also the second activity is relatively long; this scenario will cause delay for the second activity.

Table 1. Cost and duration optimization using ladder method

Activity	Classical Method		Ladder Method
	<i>1set resource</i> Duration	<i>2set resources</i> Duration	<i>1set resource</i> Duration
Earth work	80	40	80
Earthwork1		-	20
Earthwork2		-	20
Earthwork3		-	20
Earthwork4		-	20
Formation	48	24	48
Formation1	-	-	12
Formation2	-	-	12
Formation3	-	-	12
Formation4	-	-	12
Sub Base	60	30	60
Sub base1	-	-	15
Sub base2	-	-	15
Sub base3	-	-	15
Sub base4	-	-	15
Road Base	72	36	72
Road Base1	-	-	18
Road Base2	-	-	18
Road Base3	-	-	18

Road Base4	-	-	18
Overall Duration	260	130	125
Indirect Cost	260000	130000	125000

3. Conclusion

The laddering technique provides solution by dividing the activity into smaller segments and network drowns so that next activity can be started earlier, and it does not hold the work. The technique of segmenting the activities produces the steps on a ladder, and on the network. To have a better understanding, this of this issue the objective of this paper is demonstrated in above table. Table 1 shows the laddering method decreased the overall duration to 125days, while it couldn't be less than 130 days with 2 set of resources. And the indirect cost reached to lowest amount of 125000 by means of laddering technique.

In general, planners use laddering approach for changing the cycle time and for decreasing the project duration. Also as we consider the resources a constraint in any construction project, we can use this method for resource leveling and at the same time; it will shorten the project time.

4. References

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