

Schedule Control of an Apartment Building using Primavera Techniques

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Abstract - Resource management is one of the most important aspects of construction project management in today's economy because the construction industry is resource-intensive and the costs of construction resources have steadily risen over the last several decades. Thus general schedule control techniques are useful in optimizing resource scheduling and project duration. General methods such as crashing techniques, reducing the activity duration, increasing the resources, applying calendar or increasing the working hours of the resources. These techniques help to reduce project duration use of unlimited availability of resources for completion of a project. Through it is observed that resources are limited in real project scenario. It has been observed that the project delays occur due to insufficient supply of resources. In large scale projects, preparing an accurate and workable plan is very difficult. Computer packages like MS Project and Primavera project planner are used in construction industry. Project management techniques can be used to resolve resource conflicts and also useful in minimizing the project duration within limited availability of resources to make the project profitable. The main aim of this study is to analyze the schedule control techniques by constraints and activity types is done using primavera P6 software for an apartment building. The project schedule control decreases the duration due to apply of constraints, level of effort, resource dependent it has an effect on the project duration.

Keywords; *Schedule control, Constraints, Activity types, Level of Effort, Resource Dependent, Primavera.*

1. INTRODUCTION

A resource can be defined as an entity that is assigned to an activity and is required to accomplish the task. It is recommended to create and assign the minimum number of resources to activities. A resource is any quantifiable item in limited supply and of sufficient value to justify tracking and assigning of specific activities for a project.

Every project schedule has its own precedence constraints, which means that each activity can be processed when all its predecessors are finished. In general the purpose of project scheduler is to minimize its completion time, subject to precedence constraints. A more general version assumes that to develop one or more activities, resources such as tools, equipment, machines, or human resources are needed.

Each resource has limited capacity; consequently at a certain moments one activity may not begin their processing due to resource constraints even if all their predecessors are finished. This type of problems is called Resource-constrained project scheduling problem (RCPSP) which involves assigning jobs or tasks to a resource or a set of resources with limited capacity in order to meet some predefined objective.

In this study we can find out the different factors which affect the time and cost of a construction project. The actual cost and time can be also reduced so that the project can be efficient.

2. OBJECTIVES OF STUDY

1. To control the scheduling of project by applying constraints and activity types to reduce the project duration.
2. As it has inbuilt linear programming techniques and where we can give the best schedule or duration to save cost and proper utilization of resources.
3. A study on the optimization of the schedule of resource constrained construction project using primavera techniques is carried out on a residential apartment in this study.

3. PROJECT DETAILS AND ANALYSIS

Table 3.1 Project details

Project name	Columbus Square (residential apartments) consists of 6 towers (A,B,C,D,E,F) each consisting of B+G+12 floors
Total area	4 acres
Project under study	Tower A (B+G+4 floors)
Total built up area (from basement to terrace)	5557.3 sqm (59797.38 sq ft)
Total no of flats	25 flats
Project start date	15 Nov 2013
Project completion date	15 Sep 2015
Total duration of project	568 days
Estimated cost	6,35,41,828.78 Rs

In this study using the features of primavera we have worked out on to reduce the scheduled project duration without using conventional methodology. Schedule control techniques used in primavera are explained below.

In this project it is observed that on a regular schedule using primavera P6 we got the following results.

Table 3.2 Before applying schedule techniques using Primavera

Estimated project duration	568 days
Start date	15 Nov 2013
Completion date	15 Sep 2015
Estimated budgeted total cost	Rs. 6,35,41,828.78

This project deals with the data of one tower construction with 4 floor of 59797.38 sq ft with 5 flats per floor.

3.1 Constraints: Applying date constraints to the activities based on the type of work. Constraints are used to impose restrictions on activities that cannot be realistically scheduled with logical links. Sometimes activities must be accomplished according to specific dates rather than the dates determined by other activities in the project. The need to use a constraint to delay an activity to start as late as possible without affecting any activities after it.

Activity constraints applied for activity ID A1170

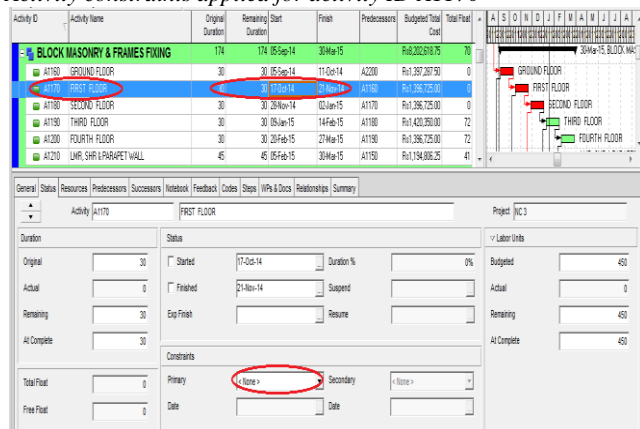


Fig 3.1 Shows before applying constraints in Primavera

Table 3.3 Before applying constraints

Activity ID	Activity name	Start date	Finish date
A1170	FIRST FLOOR	17 Oct 2014	21 Nov 2014
Project start and finish dates		15 Nov 2013	15 Sep 2015
Total duration = 568 days			

Proposed change:

The WBS of block work and frame fixing of an activity first floor was started on 15 Oct 2014 instead of 17 Oct 2014

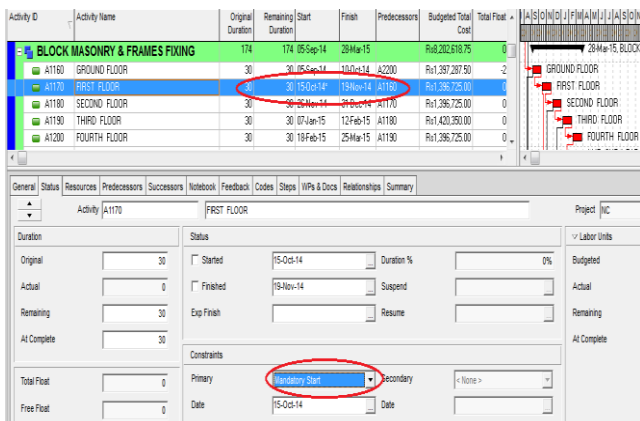


Fig 3.2 Shows after applied constraints in primavera

Table 3.4 After applied constraints:

After rescheduling the changes in the plan is as follows:

Activity ID	Activity name	Start date	Finish date
A1170	FIRST FLOOR	17 Oct 2014	19 Nov 2014
Project dates changing after rescheduling		15 Nov 2013	12 Sep 2015
Total duration – 566 days			

There is an effective schedule control on duration=568-566=2days

3.2 Level of Effort: Level of effort activities gets their dates and durations from their predecessors and successors. It's most common to assign a predecessor with an SS relationship and a successor with an FF relationship. Then when resource is allocated to the activity his/her effort will be spread over the activity duration. The level of effort in primavera optimizes the duration.

LOE applied for activity ID A1610, A1620, A1630, A1640, A1650

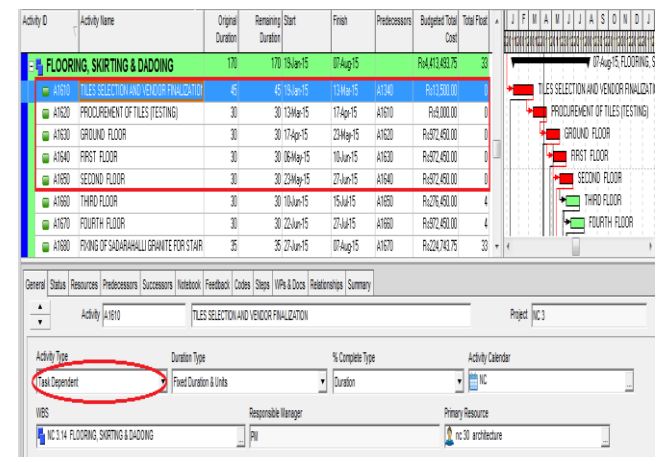


Fig 3.3 Highlighted activities shows to apply LOE

Table 3.5 Before applying LOE:

Activity ID	Activity name	Start date	Finish date
A1610	Tile selection	19 Jan 2015	13 Mar 2015
A1620	Tile testing	13 Mar 2015	17 Apr 2015
A1630	ground floor	17 Apr 2015	23 May 2015
A1640	first floor	06May 2015	10 Jun 2015
A1650	Second floor	23 May 2015	27 Jun 2015
Project start and end date		15 Nov 2013	12 Sep 2015
Total duration = 566 days			

Proposed change:

The WBS of flooring, skirting and dadoing was changing activity type from task dependent to level of effort.

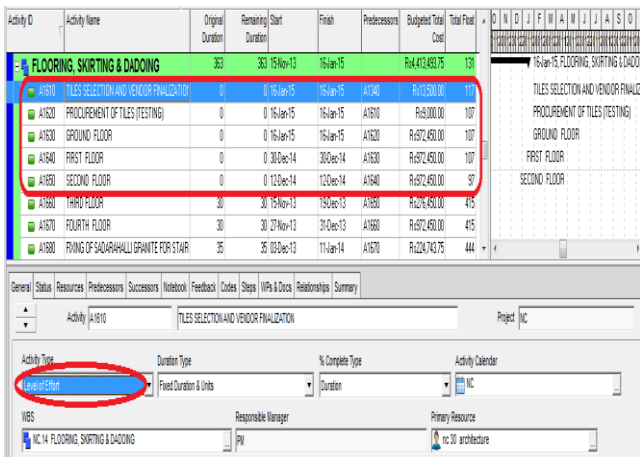


Fig 3.4 Highlighted activities shows LOE is applied

Table 3.6 After applied LOE:

After rescheduling the change in the plan is as follows:

Activity ID	Activity name	Start date	Finish date
A1610	Tile selection	16 Jan 2015	16 Jan 2015
A1620	Tile testing	16 Jan 2015	16 Jan 2015
A1630	Ground floor	16 Jan 2015	16 Jan 2015
A1640	First floor	30 Dec 2014	30 Dec 2014
A1650	Third floor	12 Dec 2014	12 Dec 2014
Project changing dates after rescheduling		15 Nov 2013	28 Jul 2015
Total duration = 527 days			

There is a effective schedule control on duration = 566-527 = 39days

3.3 Resource dependent: By changing the resource calendar and relationships with lag and lead with the available total float. When the scheduled work hours of a particular resource divert from the project default calendar. Primavera has an exclusive feature in which the activity type called Resource Dependent, when applied will use the calendar over riding the activity duration by increasing usage of resource in term of number of hours. This feature can be used where resource utilization is used and can be given more number of working hours, so that we further optimize the schedule.

Resource dependent applied for activity ID A1310

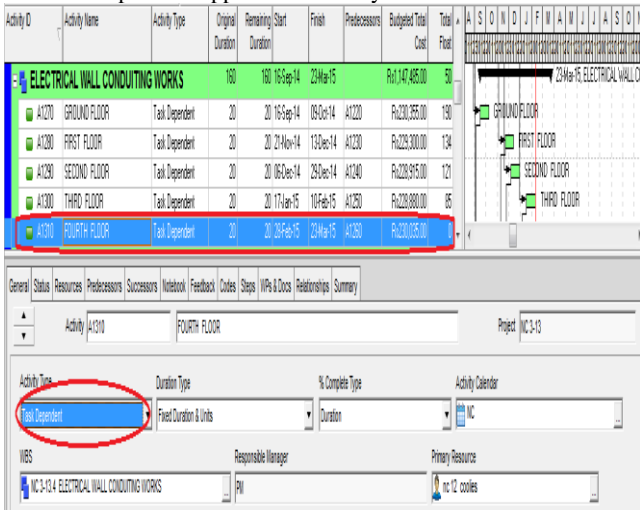


Fig 3.5 Highlighted activity shows to apply Resource dependent

Table 3.7 Before applying resource dependent:

Activity ID	Activity name	Start date	Finish date
A1310	Fourth floor	28 Feb 2015	23 Mar 2015
Project start and end dates		15 Nov 2013	20 Jun 2015
Total duration = 494 days			

Proposed change:

The WBS of electrical conduiting in activity A1310 was changing activity type from task dependent to level of effort.

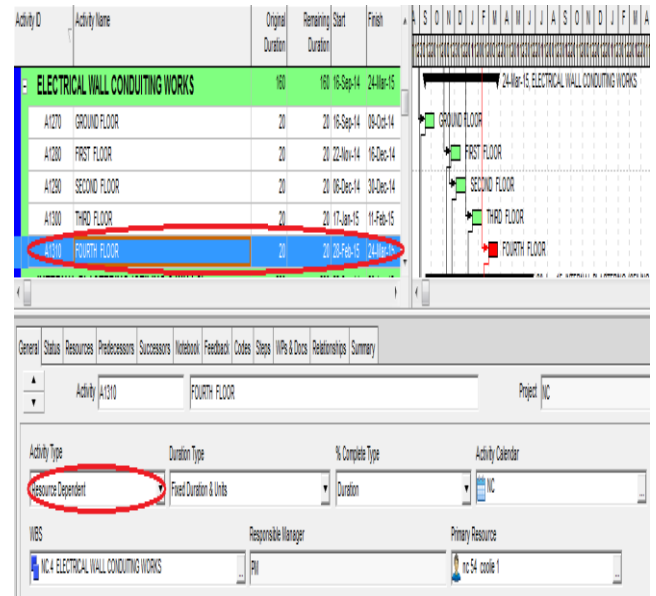


Fig 3.6 Highlighted activity shows resource dependent is applied

Activity ID	Activity Name	Activity Type	Original Duration	Remaining Duration	Start	Finish	Predecessors	Budgeted Total Cost	Total Float
NITESH COLUMBUS SQUARE(BELLARY ROAD)									
A2210	START OF PROJECT	Task Dependent	0	0	15-Nov-13	15-Nov-13		Rs3,000.00	-2
FOUNDATION									
A1000	EXCAVATION	Task Dependent	40	40	15-Nov-13	31-Dec-13	A2210	Rs25,300.00	-2
A1010	RCC FOUNDATION	Task Dependent	90	90	04-Jan-14	18-Apr-14	A1000	Rs3,513,772.80	-2
A1020	RETAINING WALL	Task Dependent	45	45	24-Jan-14	17-Mar-14	A1010	Rs1,574,049.15	389
RCC SLAB									
SUB CELLAR FLOOR SLAB									
A1030	POUR 1	Resource Dependent	32	32	03-Feb-14	11-Mar-14	A1010	Rs2,965,109.55	-2
A1040	POUR 2	Resource Dependent	32	32	14-Feb-14	22-Mar-14	A1030	Rs2,962,400.29	-2
CELLAR FLOOR SLAB									
A1050	POUR 1	Resource Dependent	32	32	26-Mar-14	02-May-14	A1040	Rs1,323,262.83	-2
A1060	POUR 2	Resource Dependent	32	32	07-Apr-14	14-May-14	A1050	Rs1,323,266.99	-2

Fig 3.7 Highlighted WBS shows duration and cost after rescheduling

Table 3.8 After applied resource dependent:

After rescheduling the changes in the plan is as follows:

Activity ID	Activity name	Start date	Finish date
A1310	Fourth floor	28 Feb 2015	23 Mar 2015
Project changing dates after rescheduling		15 Nov 2013	20 Jun 2015
Total duration = 494 days			

There is no effective schedule control on duration = 494 days and there is an effective schedule control on cost = 6,35,44,434.65 rs.

Table 3.9 Schedule control sequence table

Proposed changes	Original duration	Change duration	Remarks
Applying of constraints to WBS of block masonry and frame fixing	568 days	566 days	2 days
Constraints to Groove cutting	566 days	566 days	No changes
Apply LOB to WBS of flooring	566 days	527 days	39 days
Applying LOB to water proofing in balcony	527 days	519 days	8 days
Applying LOB to WBS of block masonry and frame fixing in activity ID A1210	519 days	494 days	25 days
Applying resource dependent to WBS of RCC slab	494 days	494 days	No changes
Applying resource dependent to WBS of electrical conducting in activity ID A1310	494 days	494 days	No changes

Total = 74 days

4. CONCLUSION

Based on study carried out on the best features of primavera in schedule control techniques, it is concluded that primavera can be used to schedule project and reduce project duration in the construction projects by the following reasons:

1. Finally the project compares all the schedule techniques and let us knows the actual performance of the project, so as to take quick decision by the planning engineer/project manager in case of schedule parameters.
2. The project review was carried out to have a complete view of the case study of project and found out the difference in scheduled control against planned schedule.
3. For scheduling control study on constraints and activity types is done using primavera P6 software. The project schedule control decreases the duration due to apply of constraints, level of effort, resource dependent it has an effect on the project duration.
4. In this case study decrease in duration is 13.03% which will increase in project cost also. In a real time project, solving schedule control using primavera P6 software gives the best result can be realized.
5. In this project without touching any resources to optimizing, the total duration using level of efforts, resource dependent and constraint have been reduced.
6. A real time project solved using this optimization software shows that best converging result can be obtained.

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