

Enterprise Project Management using Primavera P6 EPPM

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Abstract – Efficient project management is the need of the hour and it is the sole responsibility of the project manager to ensure the functioning of the project according to its allotted budget and deadlines. For any construction project, proper planning, scheduling, effective resource allocation and updating the activities is extremely essential to optimize the project and establish maximum budget maximization. Improper scheduling, irregular monitoring and poor handling of the ongoing activities increases the project duration and amount with a substantial margin. As a result, it is essential to undertake large-scale management projects efficiently with the help of computer aided software. The primary objective of this paper is to understand the principles of planning, scheduling, resource allocation and levelling along with efficient project management of a construction building. The step by step methodology to undertake a project has been explained and the ultimate usage of Primavera P6 Enterprise Project Portfolio Management (EPPM) has been summarized.

Key Words: Planning, Scheduling, Updating, Project Management, Primavera P6 EPPM, Resource Allocation, Resource levelling, Work Breakdown Structure(WBS)

1. INTRODUCTION

Construction activity has been in existence since the caveman started building his dwellings. It has created many wonders in the world and has produced many facilities for the benefit of the mankind. Construction industry is the essential ingredient for the economy of country and to undertake it efficiently, it is important to carry out effective management of the project. Project management is the planning, monitoring and scheduling of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time and to the specified cost, quality and performance (British Standards (BS) (6079-1, 2000:5). A project is the series of related jobs directed towards some major output and requiring significant time to perform. Creation of a construction facility, with predetermined objectives is defined in terms of quality specifications, time of completion, budgeted cost analysis and many other constraints. Construction project management is the art and science of managing all aspects of the project to achieve the project mission objective, the specified time, budgeted cost and predefined quality specifications; working efficiently and effectively in the changing project environment with due regards to construction worker's safety and health.

Construction planning and scheduling is one of the most important aspect in a construction project. The project involves lots of activities which need to be planned and scheduled properly to ensure the completion of the construction project. Therefore, the study on construction planning and scheduling must be conducted to provide knowledge on this topic and (a view on how it is to be implemented theoretically and in the real case of construction project). This paper has reviewed the concept of sequence of work for building construction project, planning and scheduling techniques used in the Primavera P6 EPPM. The sequence of a construction project can be split into four major categories namely substructure, superstructure, architectural and electrical and mechanical work. The study of this paper reflects information on steps carried out from the start of the project to its end on Primavera software.

With the advancement of global construction, undertaking efficient management of mega-structural projects is pivotal and hence Primavera P6 EPPM software is ideally used to not only manage trifle but also heavy-duty projects and ease out project management.

2. INTRODUCTION TO PRIMAVERA P6 PROFESSIONAL

Primavera launched in 1983 by the Primavera Systems Inc., was acquired by the Oracle Corporation in 2008. The software includes management of any project, control and collaboration capabilities and effectively integrates with other enterprise software such as Oracle and SAP's ERP systems. Primavera is one of the most powerful, robust and easy-to-use solution for globally prioritizing, planning, managing and executing projects, programs and portfolios. P6 provides a single solution for managing projects of any size, adapt to varying levels of complexity across projects and intelligently manage to meet the requirement of all roles, functions or skill levels of any organization's project team.

Primavera P6 Enterprise Project Portfolio Management (EPPM) can function as a planning, scheduling, budget and resource management software that enables organizations to make informed decisions and improve their ability to deliver projects on time and under allocated budget. It also helps to monitor IT Process, determines the estimate completion of telecommunication projects, risk analysis in aerospace engineering and enables precise control in the manufacturing processes. As a result, the scope of Primavera is an ever-changing, ever-growing tool for

simplifying the completion of all project oriented tasks and activities.

2.1 Benefits of Using Primavera P6 EPPM

1. Primavera P6 reduces errors and risks.

When your schedule has inconsistencies, errors, or overrun issues, project expenses will grow. This could mean cutting more vital aspects of the project to compensate for the excess costs. Using Primavera P6 helps identify and mitigate risks while planning, managing, and completing a project.

2. Easy to Use Software.

Although Primavera P6 provides complex analysis and processes; access and management of schedule remains simple. The information has simply to be provided as input and the awaited for the software to determine any existing problems.

3. Optimized Resources.

Careful monitoring of the resource availability to all users and adjustment of resources to meet project demands is enabled. Further, the software can minimize resource cost by analyzing the resource trends.

4. Enhanced Visibility.

Since Primavera P6 allows the data to be entered as inputs, analyzed as well as tracked at a single location, it is ensured that the project does not pose any sort of violations. All the regions are easily accessible to the user and no margin of error is provided to undergo any regulatory violation.

5. Forecasting of Project Activities.

While the project evolves, additional resources, activities and tasks may be required to meet the stakeholder requirements. With due consideration to all demands, Primavera P6 enables project managers to create forecasts for the resources and other needs.

6. Tracking Features.

This feature allows all users to generate project report, ensure the completion of the project as requested and maintain suitable baseline adherence.

7. Enhanced Communication.

While some projects may require a larger geographical area, substantial number of workers and different parties, Primavera P6 enables the executive staff to establish communication with other workers and project managers easily. It enables note creation for all schedules to ensure its access to all the users.

8. Improved Collaboration.

With the advent of enhanced communication throughout the project, improved collaboration is also enabled for large span projects so that other departments and parties may also involve and work simultaneously. For example, energy production projects may require collaboration between many different parties.

9. Gives Employees Responsibility in Schedule Creation.

Scheduling and planning processes are simplified by granting schedule access to all users. Workers may also be allowed to create additional schedules within the software from their existing location. Workers may also make schedule requests, turn in timesheets and perform other functions with respect to the projects schedule.

10. Breakdown Complex Projects.

For mega-projects, the size of the project may be overwhelming and substantially complicated. Oracle Primavera P6 enables the project managers to breakdown such large projects into smaller, achievable tasks and activities which would ultimately result in the total completion of the project.

11. Ease of Access.

The user accessing Primavera P6 EPPM can efficiently carry out scheduling and update the activities from anyplace by logging in the portfolio and accessing the project. The user can create and send reports efficiently and hence P6 EPPM is a user-friendly interface.

3. LITERATURE REVIEW

Unmesh. Y. Polekar, Rohit. R. Salgude (May 2015), investigated the defects in the planning and scheduling procedure of the client organization. The execution of the residential project was carried out by thorough observation of the on-site activities carried out and a proper comparison was surmised between the planned and actual executed schedule. The results revealed that the contractors and subcontractors played a vital role in completion of the project as scheduled. Major reasons are related with the contractor's performance such as lack of manpower, site management, equipment management and lack of supervision during execution. The organization has found that monitoring and tracking of project using software is useful to keep a more precise watch on the contractor's performance. The organization has changed their planning and scheduling methods by, setting weekly targets to the contractors instead of monthly targets and undertaking effective training of the project managers to undertake planning and scheduling efficiently on the software.

Laufer et al. (1993) presented the results of the first phase of a research program that studied how planning is

actually done in the construction company, describing in practical terms, with selected planning measures, the planning process at the pre-bid and preconstruction stages. The present paper adopts a similar approach for the planning process during construction, which typically starts one to two months after mobilization and lasts throughout the rest of the project life. All three planning stages – pre-bid, preconstruction, and on-going construction, are the concern of a complete report on this research.

Ricardo Mendes Jr. and Luiz Fernando, M. Heineck, reported one aspect of a research program devoted to the topic of production control in multi-story building construction. Preplanning using the line of balance technique attempts to solve planning problems by making production process clearer and simpler. A preplanning method, requiring trifle detailed information about the production and volume of work, may rapidly be produced. The plan brings an overall view of the project by grouping the main activities that are highly interdependent. The proposed planning method also supports some lean construction concepts as it eliminates waste embedded on the schedule, minimize variances, visual management, flexible plans and sequence of schedule.

4. OBJECTIVES

The objectives of the paper are as follows:

- To identify construction sequence for building construction.
- To identify technique used in developing planning and scheduling.
- To develop scheduling model using Primavera Software.
- To identify proper execution of the planning and scheduling.
- To know the steps required before and after completion of the project,
- To track the project and analyze the reasons for delays, and increase in estimated budget etc.
- To investigate defects in the planning and scheduling procedure of the organization, and suggest suitable improvements in their methods.

5. STEPS INVOLVED IN OPERATION OF PRIMAVERA P6 EPPM

1. Creating an ideal schedule.

The first step is to collect all the data and summarize it together in order to undertake schedule preparation.

2. Enterprise Project Structure (EPS).

Create a new structure of the company with the branches which is undertaking the execution of the project.

3. Organizational Breakdown Structure (OBS).

After the generation of EPS, OBS is created which directly reflects the persons responsible for the respective project carried out in in the enterprise. All the new and upcoming projects related to the person are directly added under the same OBS.

4. Assigning Calendar.

As per the requirement of the work, a suitable calendar is generated and assigned in the OBS. Specific working hours are determined and the breaks are allotted as specified.

5. Create a New Project.

A new project is created in the respective division of the EPS and is respectively assigned to the person under the OBS. Expected start and finish dates may be given and assigned a calendar which can be global, resource or project oriented. The project is created under the

6. Work breakdown structure (WBS).

WBS is a hierarchy of the total work that must be accomplished to undertake completion of the project. Each project. Each WBS contains different activities associated with it.

7. Define Activities under WBS.

Activities are the fundamental elements of a project and from the lowest level of a WBS as well as the smallest subdivision of a project. An activity is associated with characteristics such as activity ID, activity name, start and finish dates of the activity, activity calendar, activity type and codes as well as constrains, expenses, successor and predecessor relationships, resources, roles etc. associated with the activity.

8. Determination of Activity Duration.

While planning is undertaken, the duration of every activity is entered in the original duration field. It could be in days, weeks or months. The actual duration can only be entered for those activities, which are completed.

9. Activity Dates.

The activity dates available in Primavera P6 for various activities can be categorized as follows;

- Actual Start.
- Actual Finish.
- Planned Start.
- Planned Finish.

10. Activity Relationship.

All the activities must be inter-connected to each other to form a structured work flow. This is achieved by assigning relationships i.e. successors and/or predecessors to every activity. The relationships may further be defined under the following categories,

- Start to Start (SS) Relationship.
- Start to Finish (SF) Relationship.
- Finish to Start (FS) Relationship.
- Finish to Finish (FF) Relationship.

11. Run Schedule.

After defining all activities, assigning duration and relationships to them, the project activities are scheduled and the Gantt chart is obtained along with the network diagram of the project.

12. Resource and Role Allocation.

Different roles of people working in the project can be created and different resources can be assigned to the created roles. The resources are specified certain value per unit and allotted maximum units. These resources fall under the category of labour, non-labour and material.

13. Activity cost.

The cost of all the activities obtained after resource allocation is summed up as the overall activity cost.

14. Baseline creation.

A baseline plan is a perfect copy of the original schedule which provides a target against which a project's performance is tracked and the project activities are updated as per their performance.

15. Updating the Schedule.

If the project is progressing exactly as planned, updating may not be necessary. However, if the project falls behind and many activities undergo out of sequence or actual resource usage exceeds the planned usage, then the activities must be updated to enable on-time completion of the project. Activities may be updated as per their completion percentage, existing lags or leads and the project may be rescheduled as necessary after a given span of time.

16. Tracking.

The tracking window is used for monitoring a project's progress by using different layouts such as labour costs, project cost, resource forecasting as well as resource allocation both unit wise and cost wise.

17. Earned value.

Primavera P6 allows the manager to track the project performance in terms of Earned value. A technique for measuring project performance according to both, project cost and schedule. This technique compares the planned budgeted cost of the project to the actual cost and obtains the following essential parameters, Planned Value, Actual Cost, Earned Value, Budgeted at Completion, Cost Variance, Schedule Variance and Performance Indexes.

18. Claim digger.

The claim digger is a schedule analysis tool which enables any company to create a report that undertakes comparison of the selected data fields in a revised project for the corresponding baseline of the project.

19. Project issues.

Project Issues are known problems within a project plan that require attention or corrective action. Issues can either be manually created or automatically generated. Issues can also be associated with Work Breakdown Structure (WBS) elements, activities or resources.

20. Project thresholds.

Thresholds are created by selecting a parameter, such as start date and setting end values for the threshold. They can be applied to a specific element of WBS or an activity of the project plan. Project thresholds are helpful in monitoring the projects and create issues.

21. Risk Analysis.

Project risk demonstrates uncertainty to any event or condition and may have both positive as well as negative effects on the objectives of the project such as its scope, quality, schedule and cost. The risks are termed as opportunities and threats. The project may be accepted if the risk value is under the threshold value as specified. Positive risks may also be undertaken with threshold limits to create enhanced values.

22. Report Generation and Portfolio access.

Finally, the project report can be generated indicating all applicable parameters as required and the ultimate summary of the project can be viewed in the portfolio section.

6. METHODOLOGY AND PRINCIPLES OF MANAGEMENT

The basic principles of management in a construction project are Planning, Work Breakdown Structure, Scheduling, Resource allocating and Levelling.

6.1 Planning

Planning is the process of creating and developing the project plan. The planned outlines reflect how the project is to be directed to achieve the desired goals. It specifies a predetermined and committed future course of action of the project, based on discussions and decisions made on the current knowledge and estimation of future trends. Planning aims at formulation of a specific plan of action to coordinate various activities and resources in order to achieve specified objectives. Planning, in its broader perspective, involves advance thinking as to what is to be done, what are the activities, how it is to be done, when it is to be done, where is to be done, what is needed to do it, who is to do it and how to ensure that it is done; all of this is channelized to generate and evaluate options for evolving an action plan aimed at achieving the specified goals.

Delivery of a successful project requires that all players work as a team. The team will embrace the scope, schedule and budget and be responsible to keep these three parameters in focus when making decisions regarding the project design are undertaken. In order to achieve a successful project, the design team must get inputs from, and coordinate with, a number of different groups. It is the process of selecting a specific method and the order of work to be adopted for a project from all the possible ways and sequences in which it could be done. It essentially covers the aspects of 'What to do' and 'How to do it'. The construction plan defines the work to be completed and the order in which it will be accomplished. Developing a plan is critical to managing the construction and involves five steps:

- Determination of the general approach to the project.
- Breaking the project into activities.
- Establishing sequential relationships.
- Presenting the plan graphically as a network.
- Endorsement of the plan by the project team forming a construction plan requiring backward reasoning abilities.

The initial state of planning starts with the creation of an Enterprise Project Structure (EPS) in Primavera P6 EPPM and assign the project to a specified manager. The EPS is created by the name "AKSHAY" and the project "BUILDING CONSTRUCTION" has been generated and allotted as displayed below.

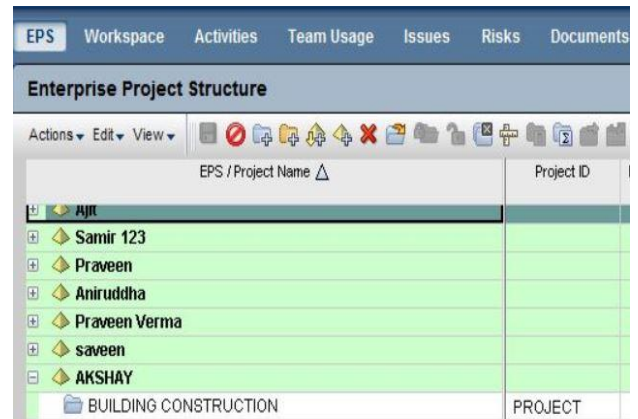


Fig - 1: Project Planning

After creation of the EPS, the project calendar comprising a work schedule of 5 days and 8 hours has been created and assigned to the project "BUILDING CONSTRUCTION".

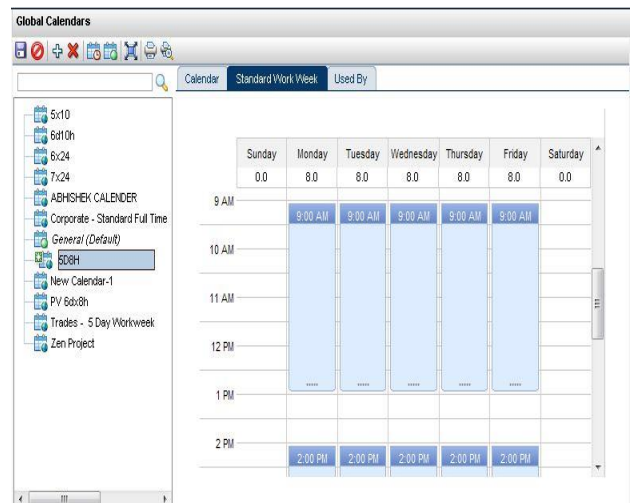


Fig - 2: Calendar Assignment in Planning Stage

6.2 Work Breakdown Structure (WBS)

Work breakdown structure is a process of dividing the project task into smaller manageable components for planning purpose. A complex project is made manageable by first breaking it down into individual component in a hierarchical stature, known as the work breakdown structure (WBS). The WBS defines task, facilitates resources allocation, responsibility assignment and controls the project. The WBS is widely used by the project manager as a tool in the planning activity for the construction project.

The Work Breakdown structure (WBS) is a key planning tool used to define a project in terms of its deliverables, while providing a method for breaking down those deliverables into meaningful work efforts. The WBS enables project managers to clearly describe the hierarchical nature of work to be performed. The WBS also

establishes a foundation for other elements of the formal project plan. Project managers regularly are challenged to clearly describe desired project outcomes to all involved, while they also capture the order and sequence of the work necessary to product those outcomes. Once it is complete, the WBS becomes an essential building block and reference point for other project plan components.

In the following case study of a construction building, the entire construction has been divided into five major categories which is, Foundation, External construction, Internal Construction, Plumbing, Electrical and Yard Access.

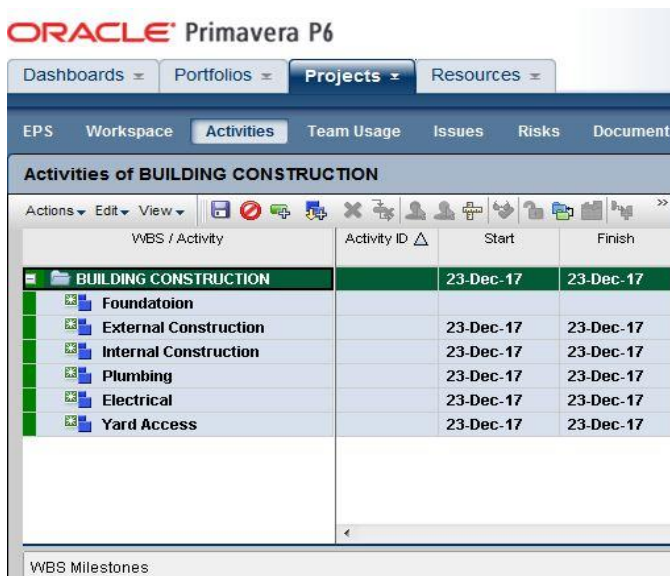


Fig - 3: Work Breakdown Structure

6.3 Scheduling

Construction scheduling is a graphical representation which shows the phasing rate of construction activities with starting and completion dates and sequential relationship among various activities or operations in a project so that work can be carried out in an orderly and effective manner. A schedule, in terms of project management is a structured listing of the milestones, usually with intended start and finish dates. The project schedule includes resource allocation, budget, task duration, and linkages of dependencies and scheduled events. Elements on the schedule may be related to the terminal elements of the work breakdown structure (WBS). Scheduling of projects, therefore, requires the identification of the tasks necessary to complete the project, and the earliest time at which each task can be completed. During schedule creation, a specific amount of time is usually set aside as precautions to any unforeseen events. While creating a schedule, a certain amount of time is usually set aside as a contingency against unforeseen days. This time is called as schedule variance, or float, and is a core concept for the critical path

method. Scheduling of the planning and construction process is a pivotal tool in daily management and project progress report. Scheduling is typically done with the help of network analysis and ideally uses Critical Path Method on the Primavera software to undergo accurate and effective scheduling.

The undertaken project has been scheduled by creating various activities under WBS, assigning the predecessors and scheduling it to obtain the Critical Path Method.

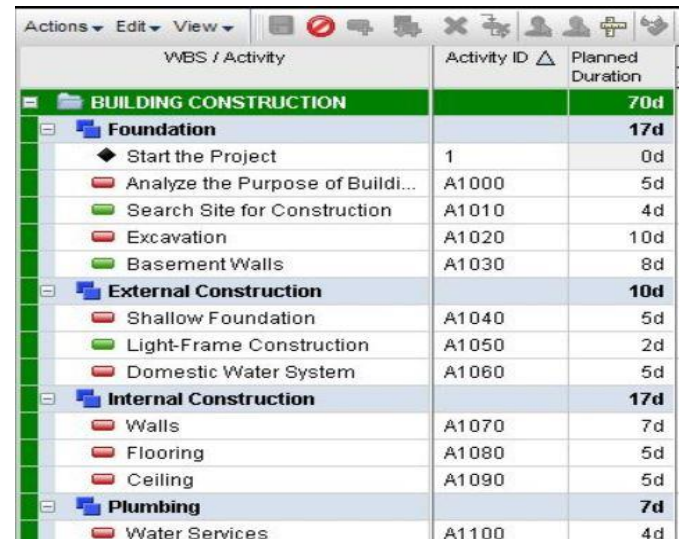


Fig - 4: Activity Lists

Network analysis is the general name given to certain specific techniques which can be used for planning, managing and controlling projects. Primavera P6 generally makes use of the CPM method as stated below.

6.4 Critical Path Method (CPM)

Critical Path Method (CPM) “is a technique for analyzing projects by determining the longest sequence of tasks (or the sequence of task with the least slack) through a project network.” (Newbold, 1998). By concentrating on the most critical tasks it can be ensured that the project is on time and is keeping pace with the schedule set up. The CPM makes use of the work breakdown structure (WBS) to divide the project into individual tasks or activities. Some activities may depend on the completion of the previous ones while others might be independent of the remaining tasks lying ahead and can be undertaken anytime as required. CPM analysis helps decision makers and project execution members to identify the best estimates of the time that is needed to complete the project. Slack or float is defined as the time between the earliest starting time and the latest starting time used for identifying the critical path and gives the total amount of time an activity can be delayed without delaying the overall project completion time. Typically, there is no float built into the activities that lie on the critical path. Therefore, the activities on the

critical path that are subjected to extensive delays will result in ultimate delay of the project.

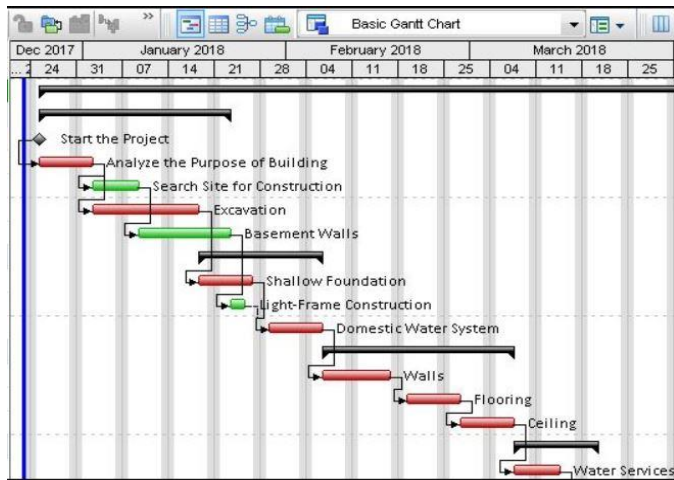


Fig - 5: Project Schedule

The red bars indicate the activities which are critical and cannot be delayed; which would otherwise affect the entire project duration. Critical path method evaluates the minimum possible time for project completion along with the expected start and finish dates for different activities of the project. This method identifies the critical activities to complete them on schedule which otherwise would result in delay of the expected project duration. If the information about costs, crash cost time is available, CPM also helps in determining how long the project will take to complete and which activities should be crashed or expedited up. Following is the outline summary of CPM Method:

- Determine the individual activities.
- Sequence those activities.
- Draw network diagram.
- Estimate duration of each activity.
- Determine the longest path of the network (critical path).
- Update the CPM diagram as the project proceeds.

6.5 Resource Allocation

Resource allocation is issued to assign all the available resources to all the activities in an economic manner. In project management, resources are created under OBS and allocated to the activities as desired. These resources have per unit value and impart the final cost when allotted to individual activities. The resources can be allotted by carrying out efficient market research and undertake planning accordingly. Resource allocation problems can be solved by making use of manual approach, algorithm approach or a combination of both the approaches.

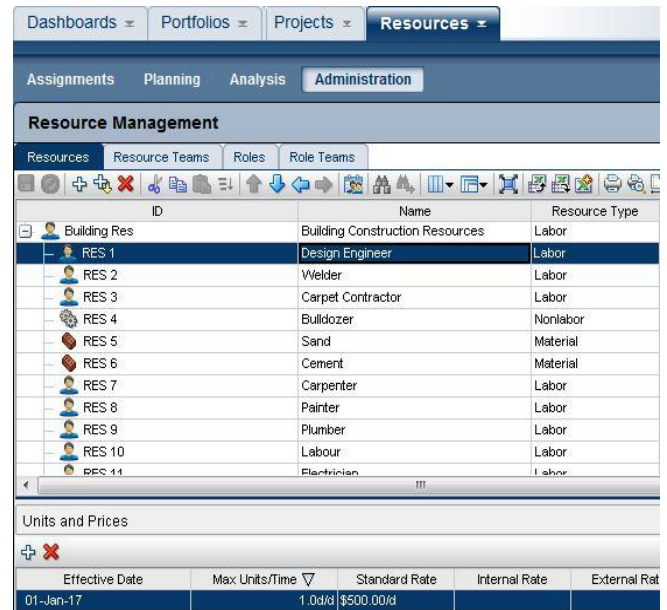


Fig - 6: Resource Allocation

After defining the resources. Every activity of the project is assigned the available resources as required for their completion. The final planned project budget is obtained after complete allocation of the resources as shown below.

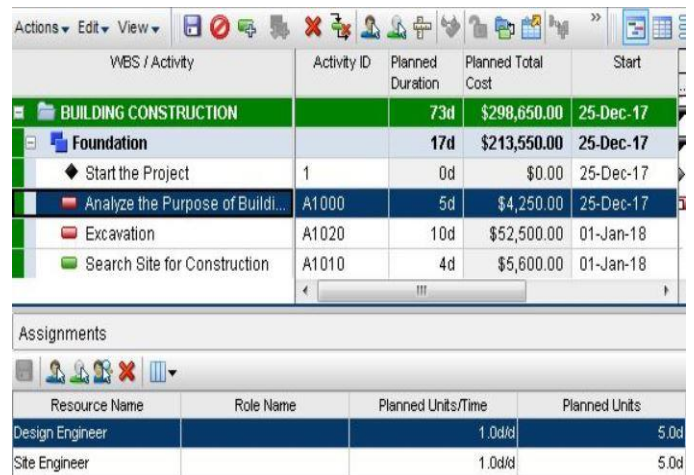


Fig - 7: Total Project Cost after Resource Allocation

6.6 Resource Levelling

Resource levelling is undertaken under the circumstances of limited resource availability. It is a part of the scheduling process where the starting and ending date of the activity is governed by resource limitation. The major objective of project management is to ensure that the resources are not over or under allocated and as a result, resource levelling is undertaken to undergo resource optimization and budget control. In Primavera P6, resource levelling allows us to optimize the use of resources by undertaking activity delay and resource adjustment to reduce the resource peaks in histograms. By

using this feature, the project length may get extended and hence it becomes important to manually level each resource by increasing the resource allocation for that specific duration. Primavera P6 makes use of automatic and manual resource levelling. While automatic levelling makes use of the total project float and may also increase the project duration, manual levelling may be used to increase resource allocation for that specific peak on histogram and level resources. Thus, cost optimization is completely taken care of after efficient resource levelling. After allocating resources to the activities of undertaken building project, it is realized that the Resource – Supervisor has exceeded its maximum available limit for a specific duration. To solve this problem, manual resource leveling is undertaken and the resource limit for that duration is increased to level the resource histogram.

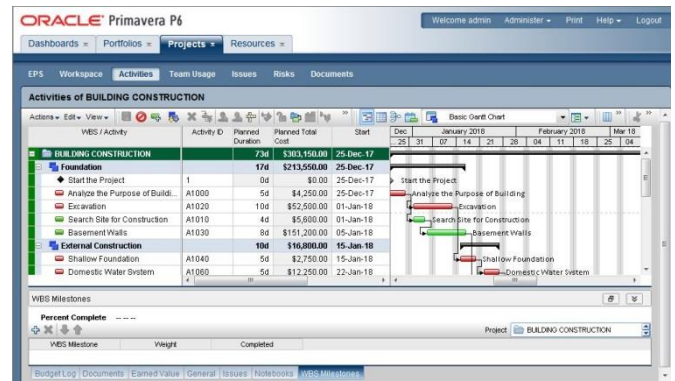


Fig – 10: Primavera P6 EPPM Interface

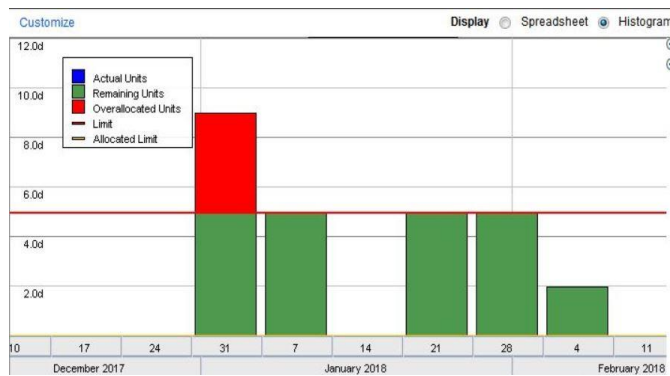


Fig – 8: Resource Over-Allocation

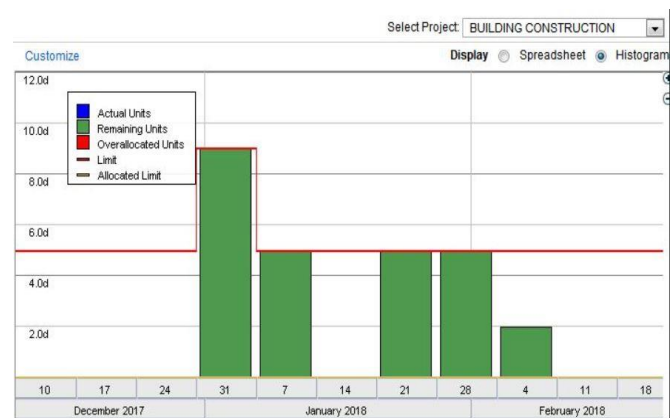


Fig – 9: Resource Levelling

7. CONCLUSION

This paper has provided in depth analysis of project management on Primavera P6 EPPM software and explained all aspects associated with it. The methodology to carry out construction management of the building has been explained with respect to planning, scheduling and resource allocation and levelling. The concepts of budget optimization and updating have been understood and the project has been completed in an efficient manner.

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