

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Analysis of Planning and Scheduling Using Traditional and Primavera Approach

Yash Pandit¹, Swaroop Kulkarni¹, Yash Choulwar¹, Soumitra Kher¹, S.D.Marawar²

BE Students, Department of Civil Engineering, TSSM's PVPIT Bavdhan Pune, Savitribai Phule Pune University,
Pune India.¹

Professor, Department of Civil Engineering, TSSM's PVPIT Bavdhan Pune, Savitribai Phule Pune University,
Pune India.²

ABSTRACT: Project monitoring and control is the process of collecting, recording, and reporting information concerning project performance. Project controlling uses the data from monitor activity to bring actual performance to planned performance. The present study deals with the project monitoring process of a tenstoreyed (G+9) building whose construction is in progress at Tathawde, Pune. A comparison between the planned progress of construction work and actual progress is performed in this study using project management software Primavera P6. Despite well-established principles and policies of project monitoring the process itself may not be efficiently accomplished in a project, because of those practical problems existing or arising in the project. Such an attempt in realizing the practical problems in implementation of project monitoring and control will contribute to proper recognition of the problem areas and putting in place the control process to rectify the deviations.

KEYWORDS: Planning, Scheduling, Project Planning Software, Primavera.

I. INTRODUCTION

Construction industry is an integral component of a nation's infrastructure and industrial growth. Even though construction industry is the second largest industry in India, the growth of this industry has been differential across the nation. The rural regions need tools for economic development, land use and environment planning to cope with the status of development in urban areas. The time available to achieve this goal is shrinking. Here arises the need for effective project management. Many issues are being faced by construction industry that must be taken care of. They include time and cost overruns due to inadequate project formulation, poor planning for implementation, lack of proper contract planning and management and lack of proper management during execution. It has been estimated by analysts that average cost of a project goes up by 30 percentage compared to the budgeted cost. Observations show that proper skilful management is imperative for the timely completion of the project within estimated budget and with allocated resources. Projects with good planning, adequate organizational machinery and sufficient flow of resources cannot automatically achieve the desired result. There must be some warning mechanism, which can alert the organization about its possible success and failures, off and on. Project monitoring is the process of collecting, recording, and reporting information concerning project performance that project manager and others wish to know. Monitoring involves watching the progress of the project against time, resources and performance schedule during execution of the project and identifying lagging areas requiring timely attention and action whereas project controlling uses data from monitor activity to bring actual performance to planned performance.

The main objectives of this study are

- To suggest the importance and purpose of monitoring the construction work.
- To suggest guidelines to contractors for updating the project.
- To present an ideal schedule for the factory construction process.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

- To suggest a layout for updating the schedule.
- Earned value analysis and tracking for the Project construction work.

This study is mainly done using Primavera P6, project management software. All activities and their sequence of occurrence, duration, resources required and costs involved are studied. The organizational breakdown structure of company and work breakdown structure of the project are noted. Tracking of the completed activities and earned value analysis are done. This gives an idea about the resources involved and financial aspect of the completed work. "Project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements" (PMBOK, 2008). K KChithkara (1998) has defined project management as an art and science of mobilizing and managing people, materials, equipment and money to complete the assigned project work on time within budgeted costs and specified technical performance standards. Mainly project management process comprises five process groups (PMBOK, 2008). They are initiating, planning, executing, monitoring and controlling. Monitor and control of project work is the process of tracking, reviewing and regulating the progress to meet the performance objectives defined in project management plan. Monitoring is an aspect of project management performed throughout the project. It includes collecting, measuring, distributing performance information, and assessing measurements and trends to affect process improvements (PMBOK, 2008).

TABLE I. CASE STUDY DETAILS

Name of the Building: Sai Apartment

Description: Row House

Address: Tathawade Pune. 411033

MH, INDIA.

Society Name: Sai Apartment

Contact Person: Mr. Shailesh Jagtap

Tel No: +91 9579670950

Main steps involved in factory construction work apart from initial planning are

1. Mobilisation
2. Piling
3. Column & beam concreting
4. Slab & stair concreting
5. Post concreting works
6. Masonry work
7. Plastering
8. Flooring, dadoing
9. External wall plastering
10. Finishing

II. METHODOLOGY OF MONITORING THE PROJECT WITH PRIMAVERA

The construction projects have become so vast and complex that the application of information technology has become inevitable. Companies started developing softwares for project management such as Primavera P6, P3, Suretrack, MS project, etc.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

This study involves monitoring and controlling the project using Primavera P6. The progress at site must be incorporated in the Primavera schedule and updated. These updates need to be thoroughly monitored using Primavera. Tools and techniques involved in this process are:

- Earned value management (EVM)

Earned value management is a commonly used method of performance measurement. It integrates scope, cost, and schedule measures to help the project management team assess and measure project performance and progress. This technique requires the formation of an integrated baseline against which performance is measured for the duration of the project. This can be effectively done in Primavera. The project performance baseline is used to measure, monitor, and control overall cost performance on the project.

- Work performance measurements

The calculated cost variance, schedule variance, CPI, values for WBS components, in particular the work packages and control accounts, need to be documented and communicated to stakeholders.

Steps involved in monitoring and control of this project are

- 1) Creating an ideal schedule

To create a schedule for any project, first step is to collect data available for the project. Subsequently the following steps can be followed in Primavera.

- 2) Enterprise project structure (EPS)

Create the structure of the company with its branches, which is executing the project. This is known as Enterprise project structure (EPS).

- 3) Organizational breakdown structure (OBS)

After the EPS, OBS is created which is a hierarchy that reflects the persons responsible for the projects in the enterprise.

- 4) Creating new projects

A project is a set of activities and associated information that constitutes a plan for creating a product or service. The project is created under the respective divisions in EPS and assigned the person in charge from OBS to it. The project can be given planned start and must finish dates. The project is assigned a calendar which can be global, resource or project calendar.

- 5) Work breakdown structure (WBS)

WBS is a hierarchy of work that must be accomplished to complete a project. Each project has its own WBS hierarchy with top level WBS element being equal to that of each EPS node or project. Each WBS element may contain more detailed WBS levels, activities, or both.

- 6) Defining activities

Activities are the fundamental work elements of a project and form the lowest level of a WBS and, are the smallest subdivision of a project. An activity has the following characteristics like activity ID, name, start and finish dates,

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

activity calendar, activity type, activity codes, constraints, expenses, predecessor and successor relationships, resources, roles etc.

7) Relationship between activities

To form a network, the activities should be connected to each other, which is done by assigning preceding and succeeding activities with significant relationship to the activities.

- Finish to start (FS) relationship.
- Finish to finish (FF) relationship.
- Start to start (SS) relationship.
- Start to finish (SF) relationship.

8) Determining activity duration

When planning the work, the duration is entered in the original duration field. The actual duration can only be entered for the activities, which are completed.

9) Activity dates

The following are the types of activity dates available in the primavera; actual start, actual finish, planned start, planned finish.

10) Activity cost

The activity cost is the sum of all the cost incurred to complete the activity.

11) Creating baselines

A simple baseline plan is a complete copy of the original schedule which provides a target against which a project's performance is tracked.

12) Updating schedule

- If the project is progressing exactly as planned, then only needed to estimate progress.
- If the project is not progressing as planned many activities are starting out-of-sequence, actual resource use is exceeding planned use, and then update should be done for activities and resources individually.
- Most projects contain some activities that progress as planned and some which do not. In this case, the best method is to combine the two updating methods.

13) Tracking

Tracking window is used for monitoring a project's progress using different types of layoutssuch as labour costs, project cost, resource forecasting, resource allocation unit wise and cost wise.

14) Earned value

Earned value is a technique for measuring project performance according to both project cost and schedule. The technique compares the budgeted cost of the work to the actual cost.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

15) Claim digger

The claim digger is a schedule analysis tool that enables a company to generate a report that compares selected data fields in a revised project and a corresponding baseline.

16) Project thresholds

Project thresholds consist of parameters assigned to WBS elements; they are used to monitor projects and generate issues.

17) Project issues

Project issues are the problems within a schedule that must be addressed before the project can be completed. They can either be created by thresholds or manually.

Preliminary steps to be done in updating

Choose *project*. *Maintain baseline*. Then add and save a copy of current project as a new baseline B1. Then choose project baseline as B1 and assign primary baseline as B1.

Daily updates to be made:

a) Start date and end date

Choose the activity to be updated. Then in the activity details window, select *status* tab. Then tick mark *started* if the activity has been started and select the date. Tick mark *finished* if the activity has been finished and select the finish date.

b) Resource

In activity details window, select *resource* tab. Then select the resources which are to be added to the particular activity

c) Code

In activity details window, select *code* tab. Then select the activity code for each resource.

d) Notebook

In activity details window, select *notebook* tab. Select the topic which we want to note and write the details in notebook topic.

e) Steps

In activity details window, select *steps* tab. Then if the activity has any steps update the activity in percentage complete and put a tick mark if the activity has been completed.

f) Feedback

In activity details window, select *feedback* tab. Then the details for the resources have to be mentioned in feedback.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

g) Work products and documents (WPs & Docs)

In activity details window, select the *WPs & Docs* tab. Then the drawings, documents, specifications have to be uploaded here.

Weekly updates to be made:

a) Threshold

In directory bar choose *threshold* tab. Then 3 variances are to be monitored regularly; finished date variance, start date variance and cost variance.

b) Issues

In directory bar choose *project issues*. The values which fall outside the threshold values are indicated in the issues. Contractor also has to add issues if there are any.

c) Reports

Choose *tools*. Then choose the data date which we want to update the progress. All the activities done in that week has to be selected. Then select *update progress*.

Schedule analysis and forecasting

Schedule variance (SV)

It determines whether a project is behind or ahead of the schedule. It is calculated by subtracting planned value from the earned value.

$$\text{Schedule variance} = \text{Earned value (EV)} - \text{Planned value (PV)}$$

The Schedule Variance can be expressed as a percentage by dividing the schedule variance (SV) by the planned value (PV):

$$\text{SV\%} = \text{SV} / \text{PV}$$

Schedule performance index (SPI)

It indicates efficiency with which the project team is using its time.

$$\text{Schedule performance index} = \text{Earned value} / \text{Planned value}$$

Time estimate at completion {EAC(t)}

We can generate a rough estimate of when project will be completed

$$\text{Estimate at complete } \{EAC(t)\} = (\text{BAC}/\text{SPI}) / (\text{BAC}/\text{months})$$

BAC = Budget at completion

Cost analysis and forecasting

Cost variance (CV)

It shows whether a project is under or over budget.

$$\text{Cost variance (CV)} = \text{Earned value (EV)} - \text{Actual cost (AC)}$$

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

This number can be expressed as a percentage by dividing the cost variance (CV) by the earned value (EV). $CV\% = CV / EV$

Cost performance index (CPI)

It is one of the clearest indicators of the cumulative cost efficiency of the project.

$$\text{Cost performance index (CPI)} = \text{Earned value (EV)} / \text{Actual cost (AC)}$$

III. RESULTS AND DISCUSSIONS

Ideal baseline for Project

An ideal baseline B1 was created in Primavera for the this case study. The work breakdown structure, activities and steps for activities are being discussed here. The structure for the baseline is presented from the WBS levels. In WBS a level may be again sub divided. Activities come under the WBS.

Gantt chart

1. The time scale of the Gantt chart should be weekly basis.
2. All relationships should be clearly given in the Gantt chart.

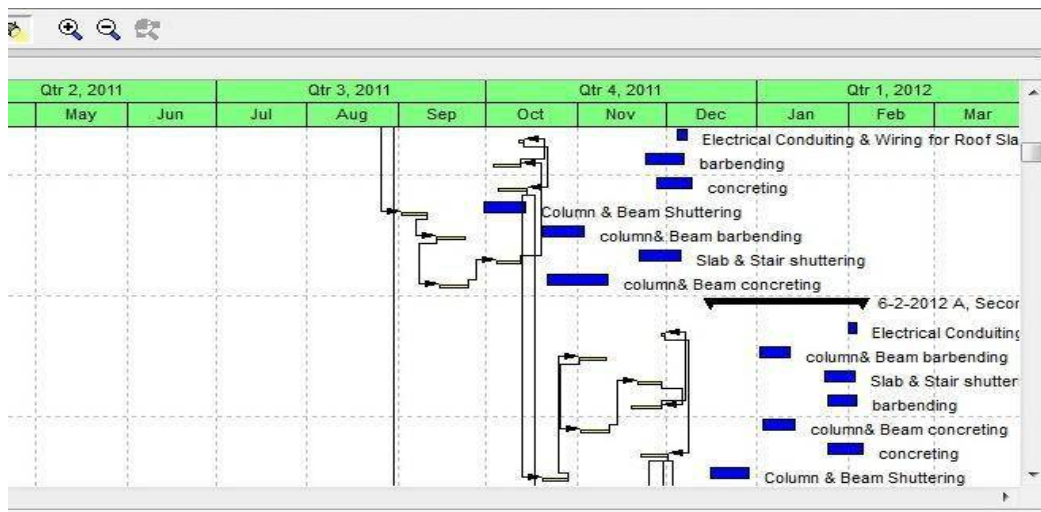


Fig.1 Gantt chart window(Source: Google)

Calendar

The work is carried out in 6 days per week. So the standard 6 day workweek calendar is made with necessary holidays in it.

A break of one hour is given in the afternoon.

Activity usage spreadsheet and resource usage spreadsheet

These two spreadsheets reflect the usage of resources and progress of activities at any stage of the construction project. This is based on classic WBS layout

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017



Fig. 2 Activity usage spreadsheet window(Source: Primavera)

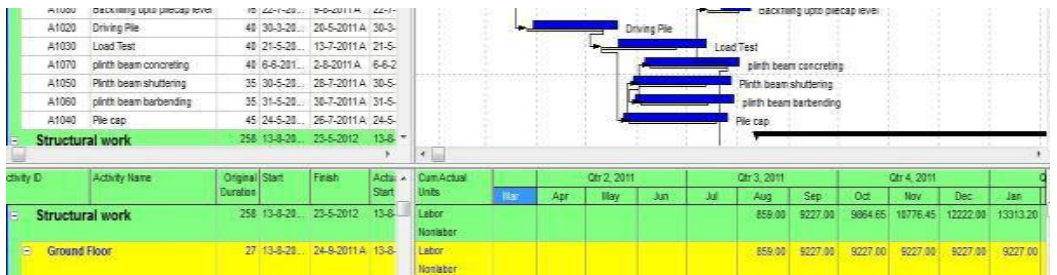


Fig. 3 Resource usage spreadsheet window(Source: Primavera)

Activity usage profile and resource usage profile

These show graphical representation of cumulative values activity usage and resource usage at any stage of the construction project. This is based on classic WBS layout.



Fig.4 Activity usage profile window(Source: Primavera)

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

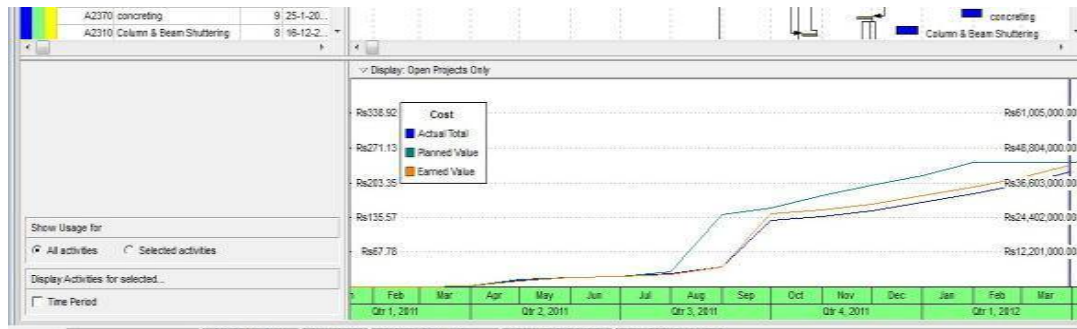


Fig. 5 Resource usage profile window(Source: Primavera)

Based on the guidelines from literature review and methodology described, it was possible to monitor the progress of this construction project. Till now we have gone through step by step procedure followed in monitoring the project using Primavera P6. The numerical results obtained after following the previously mentioned methodology is discussed in the following sections.

Master schedule with key dates

A schedule is being created using the key dates of the activities. The baseline project start date is on 9th March 2016 and baseline project finish date is on 12th July 2018. The actual start of project was on 15th March 2016. It shows that the actual start of project was as per baseline schedule. After knowing the dates of all key activities, all the constituent activities are arranged sequentially and logically to form a schedule. This schedule shows a slow and ever increasing gap between baseline schedule and actual work progress. The actual progress started shifting from planned schedule, from the second activity mobilisation of resources itself.

Resource assignments and usage

The resource assignment window shows all the resource assignments, grouped by resource for the project. An approximate rate analysis was done to arrive at rates of individual resource groups, considering the various component resources. Most of the resources are taken as *material*. Machines are taken as *non-labour* and human involvement is listed as *labour*.

The resource usage profile obtained using Primavera P6 shows that there has been a slight variation in the quantity of each resource used during the project life cycle.

Tracking of the Project

Tracking a project is very important in mega projects. While updating the schedule time to time, it was reviewed and the revised allocation of resources and the budgeted cost is estimated. All the associated resources of a project are tracked and kept record.

Threshold calculation

The parameter which is checked in the threshold is *start day variance* and *finish day variance* for the started activities. Threshold calculation of the factory project shows that 88 activities show start date variance and 88 activities show finish date variance. All these thresholds which fall outside are reported as issues. Hence 88 issues are identified for finish date variance and 88 issues are identified for start date variance.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Delay analysis

The following reasons were observed during this thesis work, which can be held responsible for delays;

- Lack of knowledge about advanced tracking methods and softwares.
- Insufficiently skilled staff.
- Lack of proper fund flow throughout the project progress
- A major portion of labour force was from West Bengal and Orissa. Regional festivals in these areas cause sudden delays in work progress.
- Even though delay due to monsoon rain was already accounted in the baseline schedule, unexpected extension of monsoon caused further delay in project progress.
- Sand unavailability due to legal restrictions.
- Late delivery of resources.

Comparison of revised project schedule with baseline using claim digger

The revised project is compared with the baseline of the project. The output of Claim digger shows that 43 WBS have been added to and 45 WBS have been deleted from the project.

Earned value analysis

The earned value of the work has been calculated after including the actual cost of each activity inclusive of expenditures. The following details were obtained from calculations using data obtained from Primavera P6

TABLE II. RESULTS OBTAINED FROM PRIMAVERA

Project budget (BAC)	Rs. 6,07,81,495
Planned value (PV)	Rs. 4,79,17,756
Earned value (EV)	Rs. 4,26,24,087
Actual cost (AC)	Rs. 4,05,63,038
Schedule variance (SV) = EV-PV	Rs. 52,93,669
SV % = SV/ PV	- 11.05 %
Schedule performance index (SPI) = EV/ PV	0.89
Total duration	21 months
Estimate at Complete { EAC(t)} = (BAC/SPI)/(BAC/months)	23.6 months
Cost variance (CV) = EV- AC	20,61,048
CV % = CV/ EV	4.84 %
Cost performance index (CPI) = EV/AC	1.05
Estimate to complete	Rs.1.82 crores

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

S Curve

It is graphical representation of financial cash flow of a project. It is derived from activity usage profile, and it shows an “S” like shape, flatter at the beginning and end and steeper in the middle. This shows that costs involved in the project is low in the beginning as well as in the end, whereas it increases at a rapid rate when the project is in its middle stage.

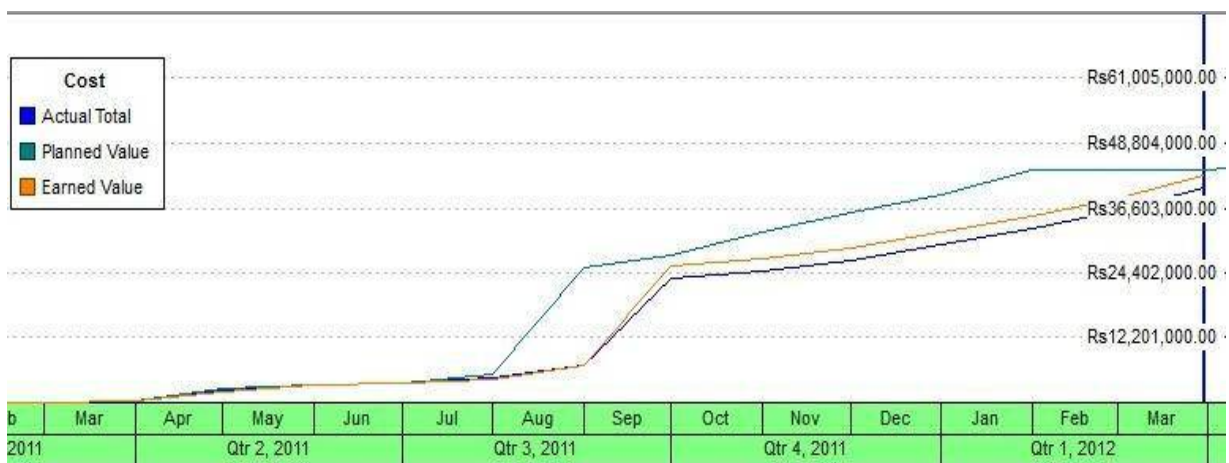


Fig.6 S-curve of this project(Source: Primavera)

Financial Calculation of Traditional and Proposed System-

SR	PARTICULAR OF ITEM	QUANTITY DONE PER DAY BY ONE PERSON (LABOUR)		
		M ²	M ³	
1	Brick work in lime or cement mortar in foundation & plinth		1.25	
2	Brick work in lime or cement mortar in super structure		1	
3	Coursed rubble stone masonry including dressing		0.8	
4	Cement concrete 1:2:4		5	
5	R.C.C work		3	
6	12mm cement plaster	8		
7	White washing or color washing	200		
8	Painting or varnishing doors and windows (1 coat)	25		
9	Painting large surface 1 coat	35		
10	Distempering 1 coat	35		
11	2.5 cm Thick Cement Concrete Flooring	7.5		

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

12	Timber framing Sal of teak wood		0.07	
13	Door and window shutter panel or glazed	0.7		
14	Single Allahabad tilling	6		
15	Double Allahabad tilling	4		
16	Ashlar stone dressing		0.7	
17	Flag stone dressing	1.5		
18	Earthwork in---			
	ordinary soil		3	
	hard soil		2	
	rock		1	
19	Number of brick laid by mason in brick work up to a height of 10"			600
20	Amount of work done by helper per day			
	1) mix			3 m3 of mortar
	2) Deliver bricks			4000 no's at distance of 15 m
	3) Deliver mortar			5.5 m3 per day

IV. CONCLUSIONS

The main objective of this study was to understand the role of monitoring and control in the progress and timely completion of a construction project. This objective was achieved through revision of literatures and methodologies involved in monitoring and control. The case study proved to be a guideline in understanding the progress of this construction work and also to identify the specific problems arising during the process. Results of this study show the drawbacks of the present project management system in this project and the importance efficient planning, monitoring and controlling, as well as the need and effectiveness of project management software like Primavera P6 in a construction project.

REFERENCES

1. Satinder Chopra "Developing an Efficient Schedule in Primavera P6: Significance of Activity ID & Descriptions" International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 7, July 2014.
2. RAJ SARAN "PLANNING AND SCHEDULING OF A TWO STOREY BUILDING USING PRIMAVERA P6" Proceedings of 26th IRF International Conference, 12th June, 2016, Bengaluru, India, ISBN: 978-93-86083-38-8
3. S M Abdul MannanHussain "SCHEDULING OF AN RESIDENTIAL BUILDING USING PROJECT MANAGEMENT TECHNIQUES" IJARSE March 2017.
4. Lekshmi A L "Work Breakdown Structure Scheduling for Repetitive Construction Projects with Soft Logics" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391
5. P.Arunadhevi "Optimization of Construction Project Scheduling by International Journal of Advanced Research Trends in Engineering and Technology (IJARTET) Vol. 3, Special Issue 2, March 2016Using Linear Programming"
6. Ch. Chowdeswari "OPTIMAL PLANNING AND SCHEDULING OF HIGH RISE BUILDINGS" International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 1, January 2017, pp. 312-324, Article ID: IJCIET_08_01_035
7. Mohamed Abd El razeq "RISK FACTORS IN CONSTRUCTION PROJECTS CASH-FLOW ANALYSIS" IJCSI International Journal of Computer Science Issues, Vol. 11, Issue 1, No 2, January 2014 ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
8. SushantPradhan "PLANNING, SCHEDULING AND RESOURCE OPTIMISATION OF MULTIPLE PROJECTS USING ORACLE PRIMAVERA P6" IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
9. SUNIL SHARMA "Transportation Project Planning and Modeling" Recent Researches in Circuits, Systems, Mechanics and Transportation Systems
10. Arthur W T Leung "SCHEDULING FOR HIGH-RISE BUILDING CONSTRUCTION USING SIMULATION TECHNIQUES" Department of Building and Construction, City University of Hong Kong 2008