Scheduling of Residential Building Using Networking Method (CPM) For Time Efficiency

[1]Mahesh M. Parmar, Student of Project & Construction Management Department, MIT College of Management, Pune, India. mikeparmar89@gmail.com

[2]Kenil A. Sejani, Project Engineer - Keshav Krupa Construction Pvt Ltd, Surat, India. kenilsejani@gmail.com

[3]Virendra M. Mattu, Student of Project & Construction Management Department, MIT College of Management, Pune, India. virendramattu@rediffmail.com

"Let our advance worrying become advance thinking and planning."

— Winston S. Churchill

Abstract: - This research Network techniques are often used in scheduling projects. One approach that has been widely used is the critical path method, this method also calculates their starting, float, and finishing times to identify critical activities, and it constructs a time chart to display possible project schedules. We have used this method to make the time schedule for the construction of Rameshwaram Regency under construction residential building to achieve highest time efficiency. In this project work a networking technique of construction management is used for data analysis which is used for preparation of network. WBS is made for data collection by regular visiting construction site for collecting actual time of different activities in project. CPM is used for providing network and comparison is made for actual time vs. Schedule time. Final conclusion is made after analyzing schedule time Vs. calculated time and find out causes of time overrun and. By analyzing the work up to Ground Floor should be finished within 219 days but in actual scenario work running is late 82 days.

Keywords —Project, Construction Management, Primavera, Residential Building, Planning, Scheduling

I. INTRODUCTION

Construction project contains numerous interdependent and interrelated activities. This project employs voluminous resources. The fast-changing environment of the present era imposes numerous times, cost, finance, legal, ethical, environmental and logistic constraints, and includes difficulties, uncertainties and risks. Although the concept of projectising construction is not new, project management is a young and emerging discipline. The studies reveal that most of the construction project face time and cost overruns mostly due to management failure.

The network analysis techniques, which are developed between fifties and sixties era, are now used as an efficient management tool for planning, scheduling and controlling of complex projects. The term project network includes all the network techniques used for scheduling, planning and controlling of projects. This network technique generates time-oriented diagram having activities organized into a logical order. Common features are that they make use of the network model for depicting the time plan of the project, apply the critical path concept for determining project duration and identifying critical activities, and use network analysis techniques for controlling the project-time objectives.

The network analysis methods are utilized in project management where the weather are key activities of the project within the mutual time relation. The network analysis methods specialize in calculating or critical path optimizing between the network-elements. The network analysis method are related to the concept of network diagram, which is a view of the project as a diagram which expresses various links between the project activities. Among basic network analysis method includes

1. Critical path method (CPM)
2. Program Evaluation & Research Technique (PERT)
3. Graphical Evaluation & Review Technique (GERT)
4. Critical Cain Method (CCM)
5. Metra Potential Method (MPM)

II. PROJECT FRAMEWORK

Project management is that the art and science of converting

 DOI : 10.35291/2454-9150.2021.0014

the client's vision into reality by working efficiently, effectively and safely. The British Standard BS 6079: 2000 defines Project management because the planning, monitoring and controlling of all aspects of a project and therefore the motivation of all those involved to achieve the project objectives on time and to the specified cost, quantity and performance.

Project management, consistent with ISO 10006: 1997(E), includes: the design, organizing, monitoring and controlling of all aspects of the project during a continuous process to realize its objectives. Project Management Institute of the USA describes Project management as application of the knowledge, skill, tool and techniques to project activities so as to satisfy project requirements.

2.1 GENERAL MANAGEMENT FUNCTIONS:

- Planning
- Organizing
- Staffing and provisioning resources
- Directing and leading
- Controlling

2.2 IMPORTANCE OF INTEGRATED PLANNING, SCHEDULING AND CONTROLLING OF CONSTRUCTION PROJECTS

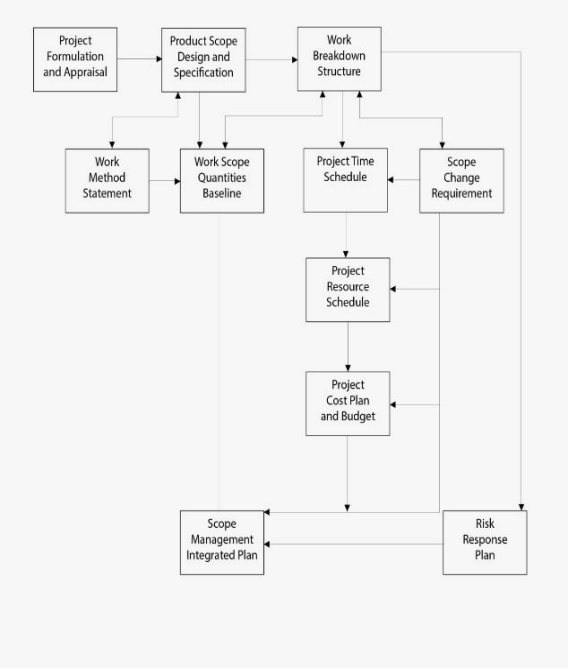


Figure 1 Integrated Planning

2.3 PLANNING BENEFITS

Planning is the process of formulating of a time-based plan of action for coordinating various activities and resources to achieve specified objectives. Planning, in simple words is the process of developing a project plan. The project plan shows how the project is to be directed to achieve the assigned goals. It specifies a pre-determined and a committed future course of action, based on discussions and decisions made on the available knowledge of future trends. "Whatever mode of construction is taken by the client or contractor, sufficient time should be given for construction planning prior to starting of construction. Good planning will get the construction sequence right to avoid delays and rework."

- Project plan clearly defines project's scope of work. It breaks down project objectives into clear, identifiable, quantifiable, attainable and verifiable goals, which are assigned to individuals, and responsibility centers for accomplishment.
- Project plan aids the management in performing its functions efficiently and effectively. It is the spine of the system and at the core of all management activities. It streamlines the project management process and supports the management organizational structure and functioning.
- Project plan forms the basis of project operations and directions and shows how the project is to be run. It also specifies the committed future course of actions on the basis of current decision made with available knowledge of the future.
- Project plan provides the yardstick for measuring progress and evaluating resource performance-it aids in developing information systems and decision making during the implementation stage. It further simplifies and smoothen communication to enable coordination among all those involved in project management.
- Project plans provide the basis for coordinating the efforts of clients, consultants, architects, designers, quantity surveyors, specialists, suppliers, contractors and the project staff.
- A project plan maintains continuity of work, especially when project organization is temporary and its staffing is transient in nature.
- Project plan has built in flexibility in the form of floats to navigate changes in the planned path for meeting fast changing environments
- Project plan creates a healthy environment. It promotes unity of purpose among functional diversities to make people time and cost conscious. It commits individuals to tasks and motivates them to achieve challenging targets.

Therefore, a well-conceived project plan, developed before the commencement of project execution stage, can go a long way to prevent a project collapse on account of management failures. But a Construction Project Plan, howsoever skillfully devised, cannot make up for bad management

2.4 SCHEDULING BENEFITS

Scheduling means putting the plan on a calendar time scale. During the execution stage, monitoring brings out the progress made against the scheduled base line. Work scheduling serves a fivefold

 DOI : 10.35291/2454-9150.2021.0014

- Schedule simplifying a project plan. The bar chart type work schedule provides a simplified version of the work plan which can be easily understood by all concerned with planning coordination execution and control of projects.
- Schedule validates time objectives. Work schedule shows the planned sequence of activities, data wise. It takes into considerations, the reduction in efficiency resulting in climate effects on resources of the task on dates imposed for completion of the project and the achievement of milestones.
- Schedule aids in optimization of resources employed. The work schedule is based on economical employment of the resources of men, materials, and machinery. It avoids abrupt changes from time to time.
- Schedule enabling forecasting of input resources and earned value to indicate the pattern of the financial state of project in terms of investment, expenditure, output and income.
- Schedule brings out implication of time and resource constraints.

2.5 PROJECT SCOPE PLANNING TOOLS AND TECHNIQUES

- Development of designs, drawings and specifications They provide the characteristic features and modes of realization of the deliverables.
- Estimation and structuring of quantities of work. The Bill-of-Quantities (BOQ) coupled with the Statement-of-Costs (SOC) become the project Work scope baseline.
- Work breakdown structure (WBS). It decomposes the project work scope into deliverables and splits up deliverables into various levels such as sub-projects or task groups, tasks work packages and activities.

III. INFORMATION ABOUT CRITICAL PATH METHOD (CPM)

- The critical path method is a project modelling technique developed in the late 1950s by Morgan R. Walker of DuPont company and James E. Kelley Jr. of Remington Rand company.
- Critical Path Analysis is commonly used with all forms of projects, including aerospace and defence, construction, research projects, product development, engineering, and plant maintenance, among others. Any project with interdependent activities can apply this method. The first time CPM was used for skyscraper development was in 1966 while constructing the former World Trade Centre Twin Towers in New York City.
- The essential technique for using CPM is to construct a model of the project that includes the following:

1. A list of all activities required to complete the project (categorized within a work breakdown structure),
2. The time that each activity will take to complete.
3. The dependencies between the activities.
4. Provision of logical end points such as milestones or deliverable items.

Critical Path Method: The critical path method (CPM) is a step-by-step methodology, technique or algorithm for planning projects with numerous activities that involve complex, interdependent interactions.

Advantages: -

- Critical Path Analysis is a very useful method or tool for Project Managers to manage the whole project. It helps manager to focus on the key activities of a project and how they all fit together.
- Critical Path Analysis is a very detailed process of networking. Although, the time spent in putting the plan together was well worth it Careful planning meant the project ran smoothly which led to cost and time savings later on.
- Use of CPM ultimately lead to reduction in cost.

3.1 TERMINOLOGY

The two basic elements used in a network are Activity and Event. In addition, sometimes dummy activities also included.

EVENT TIMING AND ASSOCIATED TERMS: -

Earliest Event Time (EET): It is earliest time at which an event can take place, assuming that all events prior to it had also occurred at their earliest time.

Latest event Time (LET): It is the latest time by which an event can occur, if the project is to be completed within the specific time.

ACTIVITY TIMING AND CONNECTED TERMS: -

Earliest Start Time (EST) This is the earliest time an activity can be started, assuming that all the activities prior to it have taken place as early as possible. The EST of an activity is equal to the EET of the preceding event, that is,

$$EST = EETi$$

Latest start Time (LST) This is the time by which an activity can started in consistent manner, with the completion of the project in the stipulated time. The LST of an activity is determined by subtracting the activity duration from LET of the succeeding event, that is,

$$LST = EETi - d$$

Earliest finish Time (EFT) It is the earliest time by which an activity can be completed, assuming that all the activities prior to it begin at their ESTs. The EFT can be calculated by following formula,

$$EFT = EETi + d$$

Latest finish Time (LFT) It is the latest time by which an activity must be completed to ensure the completion of the project within stipulated time, that is,

 DOI : 10.35291/2454-9150.2021.0014

$$LFT = EETj$$

Float The difference between the Latest Start Time and the Earliest Start Time of an activity is called float.

$$Float = LST - EST$$

IV. METHODOLOGY OF PROJECT

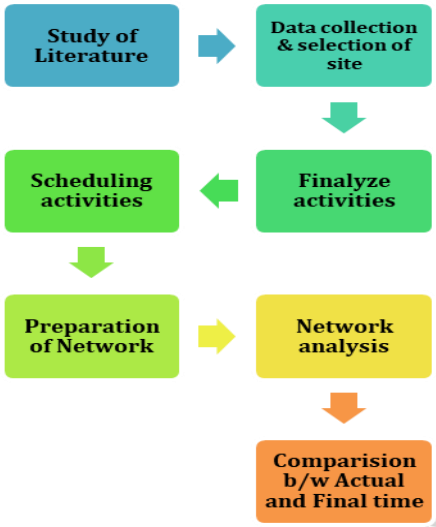
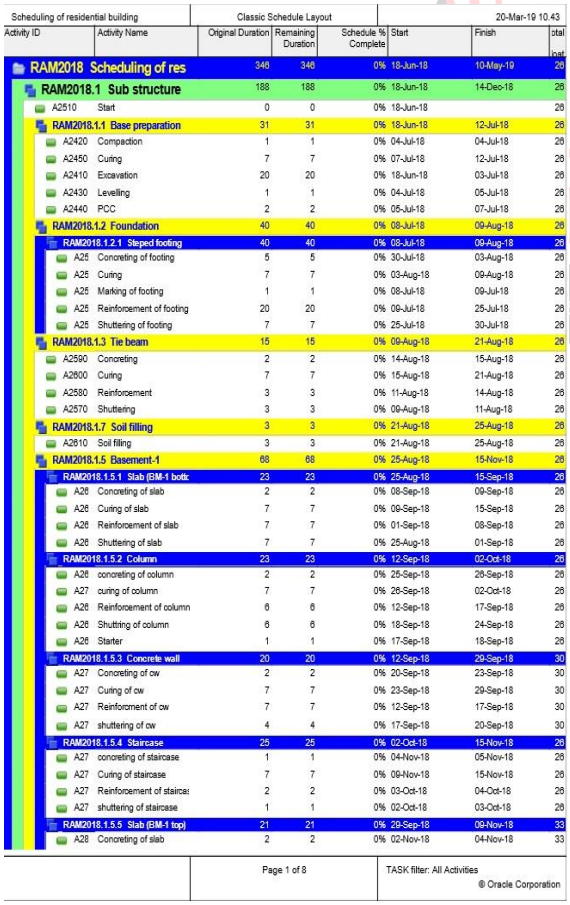


Figure 2 Methodology

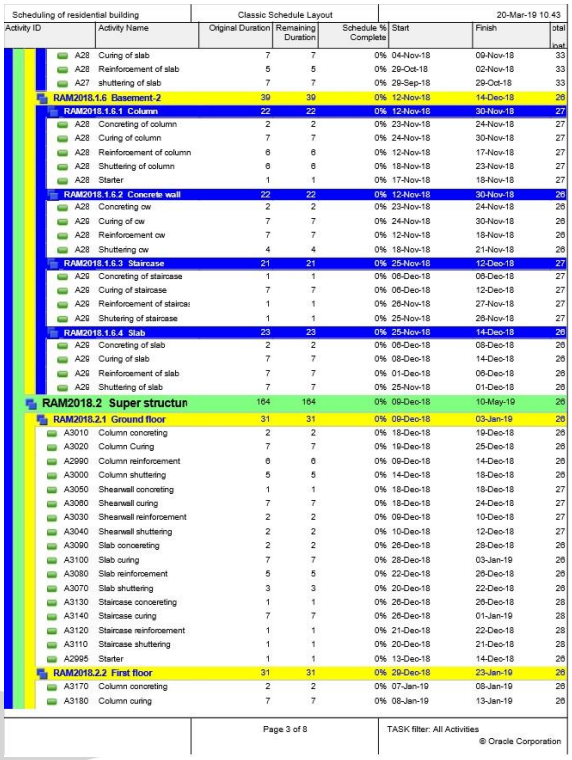
V. PLANNING & SCHEDULING ON PRIMAVERA



Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish
RAM2018	Scheduling of res	346	346	0%	18-Jun-18	10-May-19
RAM2018.1	Sub structure	188	188	0%	18-Jun-18	14-Dec-18
A2510	Start	0	0	0%	18-Jun-18	
RAM2018.1.1	Base preparation	31	31	0%	18-Jun-18	12-Jul-18
A2420	Compaction	1	1	0%	04-Jul-18	04-Jul-18
A2450	Curing	7	7	0%	07-Jul-18	12-Jul-18
A2410	Excavation	20	20	0%	18-Jun-18	03-Jul-18
A2430	Levelling	1	1	0%	04-Jul-18	05-Jul-18
A2440	PCC	2	2	0%	05-Jul-18	07-Jul-18
RAM2018.1.2	Foundation	40	40	0%	08-Jul-18	09-Aug-18
RAM2018.1.2.1	Steped footing	40	40	0%	08-Jul-18	09-Aug-18
A25	Concreting of footing	5	5	0%	30-Jul-18	03-Aug-18
A25	Curing	7	7	0%	03-Aug-18	09-Aug-18
A25	Marking of footing	1	1	0%	08-Jul-18	09-Jul-18
A25	Reinforcement of footing	20	20	0%	09-Jul-18	25-Jul-18
A25	Shuttering of footing	7	7	0%	25-Jul-18	30-Jul-18
RAM2018.1.3	Tie beam	15	15	0%	09-Aug-18	21-Aug-18
A2590	Concreting	2	2	0%	14-Aug-18	15-Aug-18
A2600	Curing	7	7	0%	15-Aug-18	21-Aug-18
A2580	Reinforcement	3	3	0%	11-Aug-18	14-Aug-18
A2570	Shuttering	3	3	0%	09-Aug-18	11-Aug-18
RAM2018.1.7	Soil filling	3	3	0%	21-Aug-18	25-Aug-18
A2610	Soil filling	3	3	0%	21-Aug-18	25-Aug-18
RAM2018.1.5	Basement-1	68	68	0%	25-Aug-18	15-Nov-18
RAM2018.1.5.1	Slab (BM-1 botto	23	23	0%	25-Aug-18	15-Sep-18
A26	Concreting of slab	2	2	0%	08-Sep-18	09-Sep-18
A26	Curing of slab	7	7	0%	09-Sep-18	15-Sep-18
A26	Reinforcement of slab	7	7	0%	01-Sep-18	08-Sep-18
A26	Shuttering of slab	7	7	0%	25-Aug-18	01-Sep-18
RAM2018.1.5.2	Column	23	23	0%	12-Sep-18	02-Oct-18
A26	concreting of column	2	2	0%	25-Sep-18	26-Sep-18
A27	curing of column	7	7	0%	26-Sep-18	02-Oct-18
A26	Reinforcement of column	6	6	0%	12-Sep-18	17-Sep-18
A26	Shuttring of column	6	6	0%	18-Sep-18	24-Sep-18
A26	Starter	1	1	0%	17-Sep-18	18-Sep-18
RAM2018.1.5.3	Concrete wall	20	20	0%	12-Sep-18	29-Sep-18
A27	Concreting of ow	2	2	0%	20-Sep-18	23-Sep-18
A27	Curing of ow	7	7	0%	23-Sep-18	29-Sep-18
A27	Reinforcment of ow	7	7	0%	12-Sep-18	17-Sep-18
A27	shuttering of ow	4	4	0%	17-Sep-18	20-Sep-18
RAM2018.1.5.4	Staircase	25	25	0%	02-Oct-18	15-Nov-18
A27	concreting of staircase	1	1	0%	04-Nov-18	05-Nov-18
A27	Curing of staircase	7	7	0%	09-Nov-18	15-Nov-18
A27	Reinforcement of staircas	2	2	0%	03-Oct-18	04-Oct-18
A27	shuttering of staircase	1	1	0%	02-Oct-18	03-Oct-18
RAM2018.1.5.5	Slab (BM-1 top)	21	21	0%	29-Sep-18	09-Nov-18
A26	Concreting of slab	2	2	0%	02-Nov-18	04-Nov-18

Page 1 of 8 — TASK filter: All Activities — © Oracle Corporation

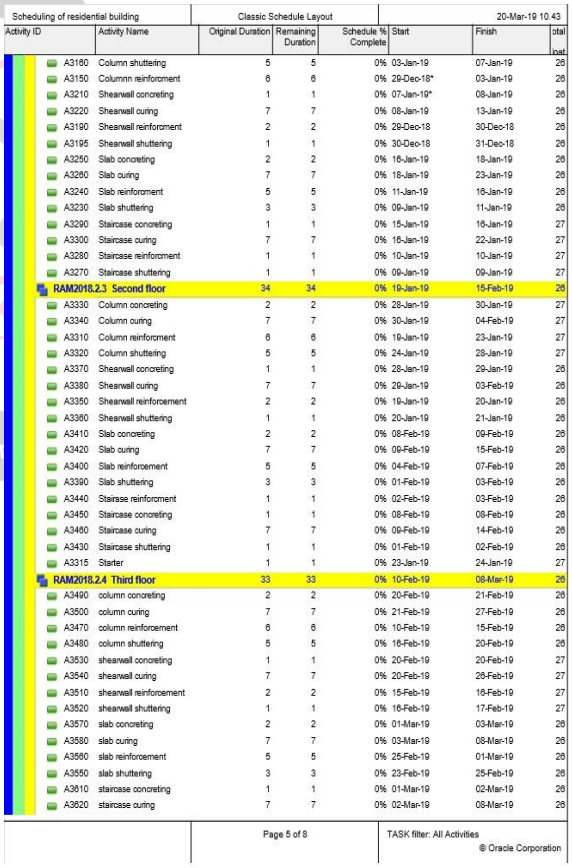
Figure 3 Planning & Scheduling on Primavera



Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish
A28	Curing of slab	7	7	0%	04-Nov-18	09-Nov-18
A28	Reinforcement of slab	5	5	0%	29-Oct-18	02-Nov-18
A27	shuttering of slab	7	7	0%	29-Sep-18	29-Oct-18
RAM2018.1.6	Basement-2	39	39	0%	12-Nov-18	14-Dec-18
RAM2018.1.6.1	Column	22	22	0%	12-Nov-18	30-Nov-18
A28	Concreting of column	2	2	0%	23-Nov-18	24-Nov-18
A28	Curing of column	7	7	0%	24-Nov-18	30-Nov-18
A28	Reinforcement of column	6	6	0%	12-Nov-18	17-Nov-18
A28	Shuttering of column	6	6	0%	18-Nov-18	23-Nov-18
A28	Starter	1	1	0%	17-Nov-18	18-Nov-18
RAM2018.1.6.2	Concrete wall	22	22	0%	12-Nov-18	30-Nov-18
A28	Concreting ow	2	2	0%	23-Nov-18	24-Nov-18
A29	Curing of ow	7	7	0%	24-Nov-18	30-Nov-18
A28	Reinforcement ow	7	7	0%	12-Nov-18	18-Nov-18
A28	Shuttering ow	4	4	0%	18-Nov-18	21-Nov-18
RAM2018.1.6.3	Staircase	21	21	0%	25-Nov-18	12-Dec-18
A29	Concreting of staircase	1	1	0%	06-Dec-18	06-Dec-18
A29	Curing of staircase	7	7	0%	06-Dec-18	12-Dec-18
A29	Reinforcement of staircas	1	1	0%	26-Nov-18	27-Nov-18
A29	Shutering of staircase	1	1	0%	25-Nov-18	26-Nov-18
RAM2018.1.6.4	Slab	23	23	0%	25-Nov-18	14-Dec-18
A29	Concreting of slab	2	2	0%	06-Dec-18	08-Dec-18
A29	Curing of slab	7	7	0%	08-Dec-18	14-Dec-18
A29	Reinforcement of slab	7	7	0%	01-Dec-18	06-Dec-18
A29	Shuttering of slab	7	7	0%	25-Nov-18	01-Dec-18
RAM2018.2	Super structun	164	164	0%	09-Dec-18	10-May-19
RAM2018.2.1	Ground floor	31	31	0%	09-Dec-18	03-Jan-19
A3010	Column concreting	2	2	0%	18-Dec-18	19-Dec-18
A3020	Column Curing	7	7	0%	19-Dec-18	25-Dec-18
A2990	Column reinforcement	6	6	0%	09-Dec-18	14-Dec-18
A3000	Column shuttering	5	5	0%	14-Dec-18	18-Dec-18
A3050	Shearwall concreting	1	1	0%	18-Dec-18	18-Dec-18
A3060	Shearwall curing	7	7	0%	18-Dec-18	24-Dec-18
A3030	Shearwall reinforcement	2	2	0%	09-Dec-18	10-Dec-18
A3040	Shearwall shuttering	2	2	0%	10-Dec-18	12-Dec-18
A3090	Slab concreting	2	2	0%	26-Dec-18	28-Dec-18
A3100	Slab curing	7	7	0%	28-Dec-18	03-Jan-19
A3080	Slab reinforcement	5	5	0%	22-Dec-18	26-Dec-18
A3070	Slab shuttering	3	3	0%	20-Dec-18	22-Dec-18
A3130	Staircase concereting	1	1	0%	26-Dec-18	26-Dec-18
A3140	Staircase curing	7	7	0%	26-Dec-18	01-Jan-19
A3120	Staircase reinforcement	1	1	0%	21-Dec-18	22-Dec-18
A3110	Staircase shuttering	1	1	0%	20-Dec-18	21-Dec-18
A2995	Starter	1	1	0%	13-Dec-18	14-Dec-18
RAM2018.2.2	First floor	31	31	0%	20-Dec-18	23-Jan-19
A3170	Column concreting	2	2	0%	07-Jan-19	08-Jan-19
A3180	Column curing	7	7	0%	08-Jan-19	13-Jan-19

Page 3 of 8 — TASK filter: All Activities — © Oracle Corporation

Figure 4 Planning & Scheduling on Primavera



Activity ID	Activity Name	Original Duration	Remaining Duration	Schedule % Complete	Start	Finish
A3160	Column shuttering	5	5	0%	03-Jan-19	07-Jan-19
A3150	Columnn reinforcement	6	6	0%	29-Dec-18*	03-Jan-19
A3210	Shearwall concreting	1	1	0%	07-Jan-19*	08-Jan-19
A3220	Shearwall curing	7	7	0%	08-Jan-19	13-Jan-19
A3190	Shearwall reinforcment	2	2	0%	29-Dec-18	30-Dec-18
A3195	Shearwall shuttering	1	1	0%	30-Dec-18	31-Dec-18
A3250	Slab concreting	2	2	0%	16-Jan-19	18-Jan-19
A3260	Slab curing	7	7	0%	18-Jan-19	23-Jan-19
A3240	Slab reinforcment	5	5	0%	11-Jan-19	16-Jan-19
A3230	Slab shuttering	3	3	0%	09-Jan-19	11-Jan-19
A3290	Staircase concreting	1	1	0%	15-Jan-19	16-Jan-19
A3300	Staircase curing	7	7	0%	16-Jan-19	22-Jan-19
A3280	Staircase reinforcment	1	1	0%	10-Jan-19	10-Jan-19
A3270	Staircase shuttering	1	1	0%	09-Jan-19	09-Jan-19
RAM2018.2.3	Second floor	34	34	0%	19-Jan-19	15-Feb-19
A3330	Column concreting	2	2	0%	28-Jan-19	30-Jan-19
A3340	Column curing	7	7	0%	30-Jan-19	04-Feb-19
A3310	Column reinforcment	6	6	0%	19-Jan-19	23-Jan-19
A3320	Column shuttering	5	5	0%	24-Jan-19	28-Jan-19
A3370	Shearwall concreting	1	1	0%	28-Jan-19	29-Jan-19
A3380	Shearwall curing	7	7	0%	29-Jan-19	03-Feb-19
A3350	Shearwall reinforcement	2	2	0%	19-Jan-19	20-Jan-19
A3360	Shearwall shuttering	1	1	0%	20-Jan-19	21-Jan-19
A3410	Slab concreting	2	2	0%	08-Feb-19	09-Feb-19
A3420	Slab curing	7	7	0%	09-Feb-19	15-Feb-19
A3400	Slab reinforcment	5	5	0%	04-Feb-19	07-Feb-19
A3390	Slab shuttering	3	3	0%	01-Feb-19	03-Feb-19
A3440	Stairsse reinforcment	1	1	0%	02-Feb-19	03-Feb-19
A3450	Staircase concreting	1	1	0%	08-Feb-19	08-Feb-19
A3460	Staircase curing	7	7	0%	09-Feb-19	14-Feb-19
A3430	Staircase shuttering	1	1	0%	01-Feb-19	02-Feb-19
A3315	Starter	1	1	0%	23-Jan-19	24-Jan-19
RAM2018.2.4	Third floor	33	33	0%	10-Feb-19	08-Mar-19
A3490	column concreting	2	2	0%	20-Feb-19	21-Feb-19
A3500	column curing	7	7	0%	21-Feb-19	27-Feb-19
A3470	column reinforcement	6	6	0%	10-Feb-19	15-Feb-19
A3480	column shuttering	5	5	0%	16-Feb-19	20-Feb-19
A3530	shearwall concreting	1	1	0%	20-Feb-19	20-Feb-19
A3540	shearwall curing	7	7	0%	20-Feb-19	26-Feb-19
A3510	shearwall reinforcement	2	2	0%	15-Feb-19	16-Feb-19
A3520	shearwall shuttering	1	1	0%	16-Feb-19	17-Feb-19
A3570	slab concreting	2	2	0%	01-Mar-19	03-Mar-19
A3580	slab curing	7	7	0%	03-Mar-19	08-Mar-19
A3560	slab reinforcment	5	5	0%	25-Feb-19	01-Mar-19
A3550	slab shuttering	3	3	0%	23-Feb-19	25-Feb-19
A3610	staircase concreting	1	1	0%	01-Mar-19	02-Mar-19
A3620	staircase curing	7	7	0%	02-Mar-19	08-Mar-19

Page 5 of 8 — TASK filter: All Activities — © Oracle Corporation

Figure 5 Planning & Scheduling on Primavera

 DOI : 10.35291/2454-9150.2021.0014

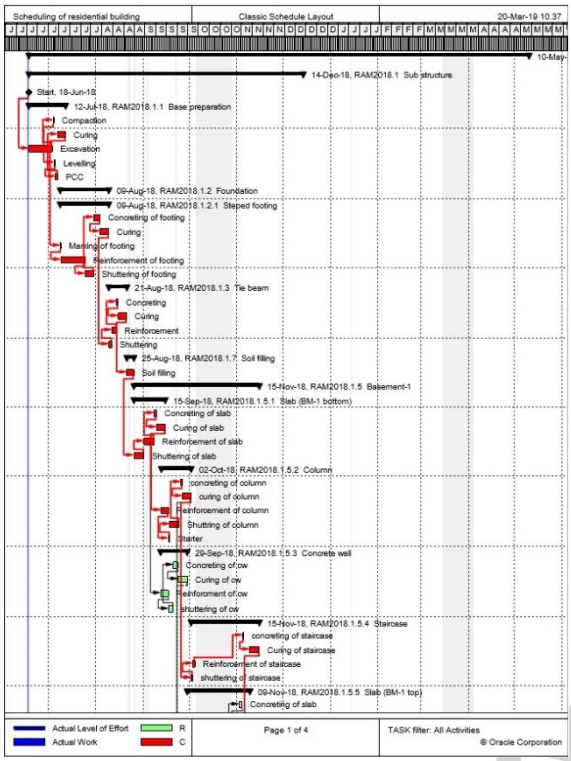


Figure 6 Gantt Bar Chart

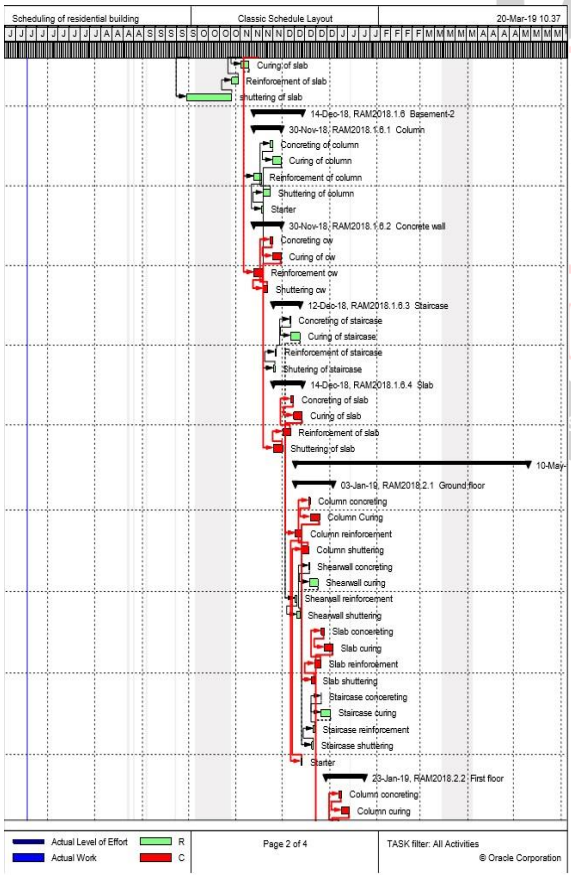


Figure 7 Gantt Bar Chart

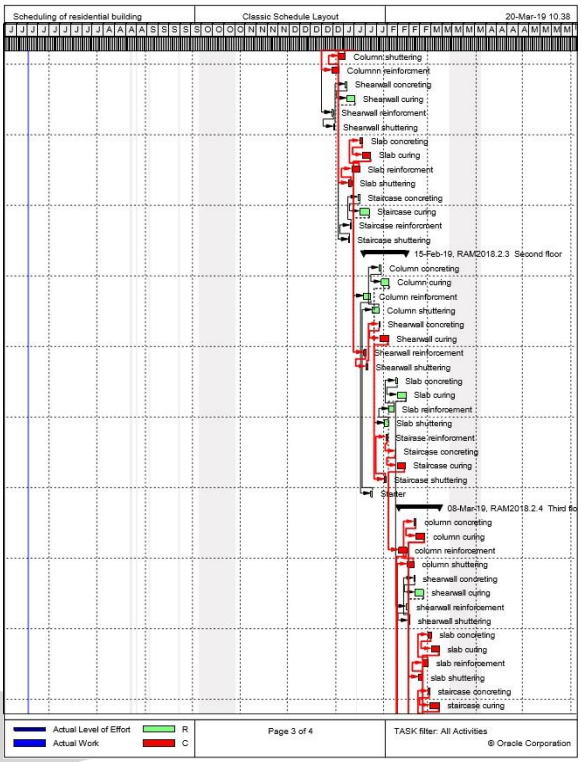


Figure 8 Gantt Bar Chart

VI. RESULT ANALYSIS

6.1 COMPARISON OF ESTIMATE TIME Vs. ACTUAL TIME

Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Sub structure						
A2510	RAM2018.1	Start	18-06-2018 00.00		18-06-2018	
A2410	RAM2018.1.1	Excavation	18-06-2018 07.00	03-07-2018 17.00	18-06-2018	
A2420	RAM2018.1.1	Compaction	04-07-2018 07.00	04-07-2018 15.00	15-08-2018	15-08-2018
A2430	RAM2018.1.1	Levelling	04-07-2018 15.00	05-07-2018 13.00	16-08-2018	16-08-2018
A2440	RAM2018.1.1	PCC	05-07-2018 13.00	07-07-2018 09.00	17-08-2018	18-08-2018
A2450	RAM2018.1.1	Curing	07-07-2018 09.00	12-07-2018 15.00	19-08-2018	23-08-2018

Figure 9 Comparison up to PCC base

Remark:

The completion of PCC base by scheduled time is 12/07/2018 and the actual completion date is 23/08/2018. Cause of delay is the inconsistency of the labor force and water clogging in the excavated area due to heavy rainfall. Actual work is running 48 days late.

Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Foundation						
Stepped footing						
A2560	RAM2018.1.2.1	Marking of footing	08-07-2018 15.00	09-07-2018 10.00	20-08-2018	22-08-2018
A2520	RAM2018.1.2.1	Reinforcement of footing	09-07-2018 10.00	25-07-2018 10.00	23-08-2018	17-09-2018
A2540	RAM2018.1.2.1	Shuttering of footing	25-07-2018 10.00	30-07-2018 16.00	18-09-2018	27-09-2018
A2550	RAM2018.1.2.1	Concreting of footing	30-07-2018 16.00	03-08-2018 16.00	02-10-2018	05-10-2018
A2530	RAM2018.1.2.1	Curing	03-08-2018 16.00	09-08-2018 12.00	06-10-2018	06-10-2018
Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Tie beam						
A2570	RAM2018.1.3	Shuttering	09-08-2018 12.00	11-08-2018 16.00	08-10-2018	09-10-2018
A2580	RAM2018.1.3	Reinforcement	11-08-2018 16.00	14-08-2018 10.00	11-10-2018	13-10-2018
A2590	RAM2018.1.3	Concreting	14-08-2018 10.00	15-08-2018 16.00	14-10-2018	14-10-2018
A2600	RAM2018.1.3	Curing	15-08-2018 16.00	21-08-2018 12.00	15-10-2018	21-10-2018

Figure 10 Comparison of Stepped footing & Tie beam

Remark:

Following the preceding activities delay, the completion of stepped footing is running 58 late. They can recover the delay by increasing the labor force.

 DOI : 10.35291/2454-9150.2021.0014

Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Soilfilling						
A2610	RAM2018.1.7	Soil filling	21-08-2018 12.00	25-08-2018 16.00	21-10-2018	27-10-2018

Figure 11 Comparison of Soil filling

Basement 1						
Slab (Bottom)						
A2620	RAM2018.1.5.1	Shuttering of slab	25-08-2018 16.00	01-09-2018 12.00	29-10-2018	31-10-2018
A2630	RAM2018.1.5.1	Reinforcement of slab	01-09-2018 12.00	08-09-2018 08.00	18-11-2018	21-11-2018
A2640	RAM2018.1.5.1	Concreting of slab	08-09-2018 08.00	09-09-2018 14.00	22-11-2018	23-11-2018
A2650	RAM2018.1.5.1	Curing of slab	09-09-2018 14.00	15-09-2018 10.00	24-11-2018	24-11-2018
Column						
A2660	RAM2018.1.5.2	Reinforcement of column	12-09-2018 16.00	17-09-2018 14.00	25-11-2018	29-11-2018
A2670	RAM2018.1.5.2	Starter	17-09-2018 14.00	18-09-2018 12.00	26-11-2018	26-11-2018
A2680	RAM2018.1.5.2	Shuttring of column	18-09-2018 12.00	24-09-2018 10.00	26-11-2018	29-11-2018
A2690	RAM2018.1.5.2	concreting of column	25-09-2018 08.00	26-09-2018 14.00	30-11-2018	01-12-2018
A2700	RAM2018.1.5.2	curing of column	26-09-2018 14.00	02-10-2018 10.00	02-12-2018	03-12-2018
Cocncrete wall						
A2710	RAM2018.1.5.3	Reinforcment of cw	12-09-2018 08.00	17-09-2018 14.00	26-11-2018	30-11-2018
A2720	RAM2018.1.5.3	shuttering of cw	17-09-2018 14.00	20-09-2018 16.00	28-11-2018	30-11-2018
A2730	RAM2018.1.5.3	Concreting of cw	20-09-2018 16.00	23-09-2018 12.00	30-11-2018	01-12-2018
A2740	RAM2018.1.5.3	Curing of cw	23-09-2018 12.00	29-09-2018 10.00	02-12-2018	03-12-2018
Staircase						
A2750	RAM2018.1.5.4	shuttering of staircase	02-10-2018 10.00	03-10-2018 08.00	18-12-2018	18-12-2018
A2760	RAM2018.1.5.4	Reinforcement of staircase	03-10-2018 08.00	04-10-2018 14.00	19-12-2018	19-12-2018
A2770	RAM2018.1.5.4	concreting of staircase	04-11-2018 16.00	05-11-2018 14.00	01-01-2019	02-01-2019
A2780	RAM2018.1.5.4	Curing of staircase	09-11-2018 14.00	15-11-2018 10.00	02-01-2018	03-01-2018
slab (BM 1 top)						
A2790	RAM2018.1.5.5	shuttering of slab	29-09-2018 16.00	29-10-2018 12.00	18-12-2018	24-12-2018
A2800	RAM2018.1.5.5	Reinforcement of slab	29-10-2018 12.00	02-11-2018 12.00	24-12-2018	31-12-2018
A2810	RAM2018.1.5.5	Concreting of slab	02-11-2018 12.00	04-11-2018 08.00	01-01-2019	02-01-2019
A2820	RAM2018.1.5.5	Curing of slab	04-11-2018 08.00	09-11-2018 14.00	02-01-2019	03-01-2019

Figure 12 Comparison of Basement 1

Basement 2						
Column						
A2830	RAM2018.1.6.1	Reinforcement of column	12-11-2018 16.00	17-11-2018 14.00	04-01-2019	07-01-2019
A2840	RAM2018.1.6.1	Starter	17-11-2018 14.00	18-11-2018 12.00	08-01-2019	08-01-2019
A2850	RAM2018.1.6.1	Shuttering of column	18-11-2018 12.00	23-11-2018 10.00	09-01-2019	11-01-2019
A2860	RAM2018.1.6.1	Concreting of column	23-11-2018 10.00	24-11-2018 16.00	12-01-2019	13-01-2019
A2870	RAM2018.1.6.1	Curing of column	24-11-2018 16.00	30-11-2018 12.00	14-01-2019	15-01-2019
Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Concrete wall						
A2880	RAM2018.1.6.2	Reinforcement cw	12-11-2018 16.00	18-11-2018 12.00	04-01-2018	07-01-2019
A2890	RAM2018.1.6.2	Shuttering cw	18-11-2018 12.00	21-11-2018 14.00	08-01-2018	11-01-2019
A2900	RAM2018.1.6.2	Curing of cw	24-11-2018 16.00	30-11-2018 12.00	14-01-2018	15-01-2019
A2895	RAM2018.1.6.2	Concreting cw	23-11-2018 10.00	24-11-2018 16.00	12-01-2018	13-01-2019
Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Staircase						
A2920	RAM2018.1.6.3	Shutering of staircase	25-11-2018 14.00	26-11-2018 12.00	20-01-2019	21-01-2019
A2940	RAM2018.1.6.3	Curing of staircase	06-12-2018 16.00	12-12-2018 12.00	12-01-2019	12-01-2019
A2925	RAM2018.1.6.3	Reinforcement of staircase	26-11-2018 00.00	27-11-2018 00.00	01-01-2019	03-01-2019
A2920	RAM2018.1.6.3	Shutering of staircase	25-11-2018 00.00	26-11-2018 00.00	30-01-2019	31-01-2019
Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Slab						
A2950	RAM2018.1.6.4	Shuttering of slab	25-11-2018 14.00	01-12-2018 10.00	20-01-2019	24-01-2019
A2960	RAM2018.1.6.4	Reinforcement of slab	01-12-2018 10.00	06-12-2018 16.00	25-01-2019	29-01-2019
A2970	RAM2018.1.6.4	Concreting of slab	06-12-2018 16.00	08-12-2018 12.00	30-01-2019	01-02-2019
A2980	RAM2018.1.6.4	Curing of slab	08-12-2018 12.00	14-12-2018 08.00	02-01-2019	03-01-2019

Figure 13 Comparison of Basement 1

Activity ID	WBS Code	Activity Name	Start date by Schedule	End date by Schedule	Actual start date	Actual finish date
Super Structure						
Ground floor						
A2990	RAM2018.2.1	Column reinforcement	09-12-2018 10.00	14-12-2018 08.00	25-02-2019	01-03-2019
A3000	RAM2018.2.1	Column shuttering	14-12-2018 08.00	18-12-2018 08.00	02-03-2019	06-03-2019
A3010	RAM2018.2.1	Column concreting	18-12-2018 08.00	19-12-2018 14.00	07-03-2019	09-03-2019
A3020	RAM2018.2.1	Column Curing	19-12-2018 14.00	25-12-2018 10.00	09-03-2019	06-03-2019

Figure 14 Comparison up to column of GF

Remark:

From this network analysis the work up to Ground Floor should be finished within 219 days but in actual scenario work running is late 82 days.

VII. OBSERVATION

- From this schedule, prediction of the potential risk that can delay the project within scope of work.
- The network gives a visual map that gives the direction and guidance to managers, contractors and engineers.
- The construction industries apply the method of scheduling using CPM they can meet deadline with maximum time efficiency.
- From this network analysis the work up to Ground Floor should be finished within 219 days but in actual scenario work running is late 82 days.

VIII. CONCLUSION

Due to increasing competition between construction market, construction company should use planning and scheduling software. In today's era client want project completion and hand over in minimum duration. Project management with CPM method provide facility for planning, scheduling and monitoring solution and optimum saving in cost of the project.

REFERENCES

[1]. Agyei, W. (2015, AUGUST). Project Planning And Scheduling Using PERT And CPM Techniques With Linear Programming: Case Study. INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME, 222-227.

[2]. Amit Adate, A. G. (2017, October). ANALYSIS OF PROJECT PLANNING USING CPM AND PERT. International Journal of Computer Science and Mobile Computing, 24 – 25.

[3]. Amy H. I. Lee, H.-Y. K.-T. (2017). Project management model for constructing a renewable energy. Department of Technology Management,Chung Hua University, Taiwan. Hsinchu: Elsevier Ltd.

[4]. Khurana Sunita, B. S. (2013, March). CPM Analysis of Rolai-Rinjlai Road Construction. Research Journal of Mathematical and Statistical Sciences, 7-15.

[5]. Mete MAZLUM, A. F. (2015). CPM, PERT and Project Management With Fuzzy Logic Technique. Istanbul: Mete Mazlum and Ali Fuat Güneri / Procedia - Social and Behavioral Sciences.

[6]. Muhammad Kholil, B. N. (2017). Scheduling of House Development Projects with CPM and PERT Method for Time Efficiency (Case Study: House Type 36). Jakarta: IOP Publishing Ltd.

[7]. Rama.S, S. A. (2017, March). A Study on Project Planning Using the Deterministic and Probabilistic Models by Network Scheduling Techniques. International Journal of Engineering Research and Application, 32-38.

[8]. Tamrakar, P. (2013). Analysis and Improvement by the Application of Network. The International Journal of Engineering And Science, 154-159.

 DOI : 10.35291/2454-9150.2021.0014