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Construction Project Management of Hotel Building using BIM Software Tools

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Abstract: ***There are many steps in the construction process which are very complicated and massive, so there is lots of possibility that errors and reworks often might happen in the section. To reduce this complexity, Building Information Modelling is a new approach regarded as beneficial tool in minimizing error and improving the efficiency of building construction. Building Information Modelling is a computer aided modelling technology for managing and generating building information, with the related processes of producing, communicating, and analyzing building information models. Building Information Modelling is useful to provide 3D animation, environmental analysis, crash detection analysis, quantity & cost analysis, operation and maintenance information. There are many Building Information Modelling software tools like AutoCAD, Revit, 3D Max, sketch up, ETABS and MS-Project etc. which gives plan, 3D model, estimate, scheduling and structural design of all considerable works. In this work, Hotel Building is selected for the study. In which Architectural Planning in AutoCAD software as 2D drawing and 3D modelling using REVIT is done. Analysis and designing of Hotel building has been taken up for G+1 Building in ETABS, thereby depending on the suitability of plan, layout of beams and positions of columns are fixed and structural detailing is prepared for understanding all sub ordinate. According to Architectural Planning and structural detailing Estimation is prepared and for proper cash flow it divided in to six parts. Planning and scheduling have become an essential part for the timely and economical completion of the project which held on MS Project. Critical path, slacks and Network Diagram are inspect and close in report. Earliest Start Time, Latest Start Time, Earliest Finish Time, and Latest Finish Time are calculated Resource analysis, scheduling and Working Slots for all contractor are prepared for continence and better understanding. On the basis of this work it is found that the use Building Information Modelling proves to be more useful for engineer, architects, project managers to achieve their goals, such as decreases unnecessary errors, clash of activates, save both money and time etc. Building Information Modelling will play an important role in every medium and major project. The Building Information Modelling technology allowing better quality of work and lesser staff to operate, that will switch off conventional path which is more costly and time consuming.***

Keywords: BIM (Building Information Modelling), MS PROJECT, CPM, Gantt Chart.

I. INTRODUCTION

These days, a growing number architects, engineers, and contractors are using BIM. Global trends are making AEC (Architect, Engineer and Contractor) projects more complex, while advances in technology are helping industry professionals work more efficiently and effectively. BIM is an intelligent model based process that connects AEC professionals so they can more efficiently, design, build and operate building and infrastructure, through Building Information Modeling. With BIM, designers create digital 3D models that include data associated with physical and functional characteristics. BIM is how it allows architects, engineers, and contractors to collaborate on coordinated models, giving every one better insight into how their work fits into the overall project, ultimately helping them to work more efficiently. BIM provides insight into a design construction ability, improving the efficiency and effectiveness of the construction face and also providing a better understanding of the buildings future operation and maintenance. Owners can use BIM for predictive maintenance, assets, tracking and facilities management and for future revolution or decoration purpose project. When work with BIM experience, that reduced project risk, improve timelines and cost savings and better project outcomes. Power of BIM is growing with cloud connected technologies that let project teams design and work together in all new ways. Driven by global trends, the AEC industry is in a time of transformation. Businesses that want to win more work, deliver projects more efficiently and design better buildings need a powerful solution such as BIM. Applying building information modeling to a design process is a growing trend in the field of construction. The advantages of BIM have been noticed especially in large multimillion design projects. In these large design projects, especially involving many different design fields that use different software, the use of BIM and the changes it will make to the design processes is an area that has not been researched much before. These new processes are now developing as BIM is for the first time implemented in this large scale to a project that has such many different design fields. The actual construction management work will be done of hotel building by using BIM. The construction of hotel building will created By using BIM software such as Revit, AutoCAD, MS PROJECT, E-TABS, etc.

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A. Need of study

To understand the scheduling and planning of a Hotel buildings
To schedule the list of the planned activities using computer applications.

II. REVIEW OF LITERATURE

1) Hidaya Said Najmi [1] concluded that the problems in the construction industry and their causes in general, can be put in three major groups: i) Problems with industry infrastructure, such as the supply of materials, lack of training and inadequate communications. ii) Project problems, including changes in instructions and designs, inaccurate information and problems concerning clients and consultants. iii) Problems created by the team members (stakeholders).

2) Ragavi, S., and Dr RN Uma [2] focused on the scheduling using MSP and earns value analysis for an apartment building. Thereby time required for the process of cost overrun is avoided. Project schedule is considered as core of the project plan, and the purpose of the project schedule is to show the organization how the work will be performed to uncover the mistakes. After completion of project it has been observed that there is more difference between budget cost and actual cost, cost increases as the material price increases. Earned value analysis is carried out in order to find the variance cost of the project.

3) R. Prabhahar and G. Ravichandran [3] analyzed that; Construction planning is an important part of the overall management process. The planning and management includes organizing the work, executing the work, correlating plan and progress information and controlling the work, the three inter-related factors of time, money and quality need to be managed in a proper way. Completion of many of the projects nowadays is not in estimated duration. This will direct to an increase in overheads as well as various other factors. It will not only reduce the expected revenues but also will affect the reputation of the contractor. Scheduling is one of the vital functions in construction project to determine the sequence of activities necessary to complete a project.

4) M. Aliyu [4] concluded that the ability of the network analysis in managing and controlling the project time and cost is not in doubt.critical path methods (CPM) should be embraced in the planning and implementation of public developmental project, in order to overcome the problems of failure and abandonment of public projects.

5) Emad Elbeltagi, Ossama Hosny, Mahmoud Dawood and Ahmed Elhakeem [5]: the model proposed can be used effectively in controlling small to medium projects for evaluating and visualizing construction performance with respect to cost. The main advantage of the system is that it enables nD visualization in progress of work along with the geographical conditions. The integration will add other dimensions to construction progress visualization. The developed framework can be considered as an effective tool to enable decision makers to take cost and progress related decisions in a timely manner.

III. METHODOLOGY

A. ARCH. Planning & Drafting (2D)

As with most Hotels, the architecture, Hotels take on minimalist ideals. The buildings consist of two hall in which 1 for assembly and 1 for dinner at two corner, while the interiors take on a modern industrial feel. The Hotel consists of 12 guestrooms with several public spaces located on the lower floor and upper floor including a lobby. Detailed floor to floor plan, elevation and section are presented in sheet no. 1. The Hotel extended by open sky places on 1st floor. For basics necessity vast kitchen and utilities are provided in planning. For nature view around 75% sites promised to gardening. Site plan is shown in below fig. Drown on AutoCAD.

1) Project Attributes

Name of the project: Construction of hotel Building ‘Rajmahal Hotel and Lawn’
Location of project: Paratwada, Amravati
Number of Story’s: ground floor + first floor
Floor to Floor height: 3 m
Depth of Foundation: 1.50 m below Ground Level.
Height of plinth: 1 m above ground
External Wall: 250 mm thick including plaster
Internal Wall: 135 mm thick including plaster
Parapet Wall: 250 mm thick including plaster

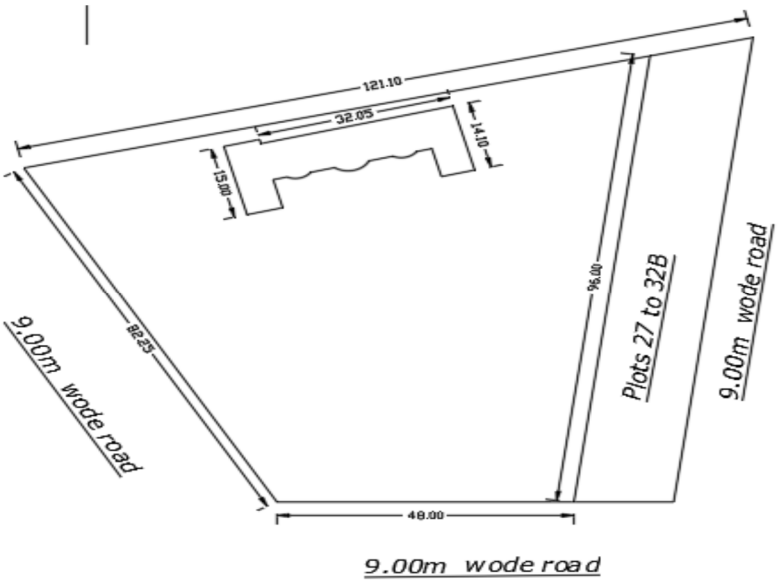


Fig. Site plan of Hotel Building

For case study following software's were used in order to create an intelligent 2D model and 3D model with detailed design, analysis and planning:

Table: Steps used in selected work

STEPS	SOFTWARE USED
Arch. Planning & Drafting(2D)	AUTODESK AUTOCAD
3D modelling	REVIT ARCHITECTURE
Structural analysis and designing	ETABS
Estimate	MS EXEL
Construction management	MSP

2) *2D with Autodesk AutoCAD:* The AutoCAD is used for planning purpose. The plan is drafted as per the requirement of the customer. The below figure shows a section of building which is drafted in AutoCAD with given specific dimension.

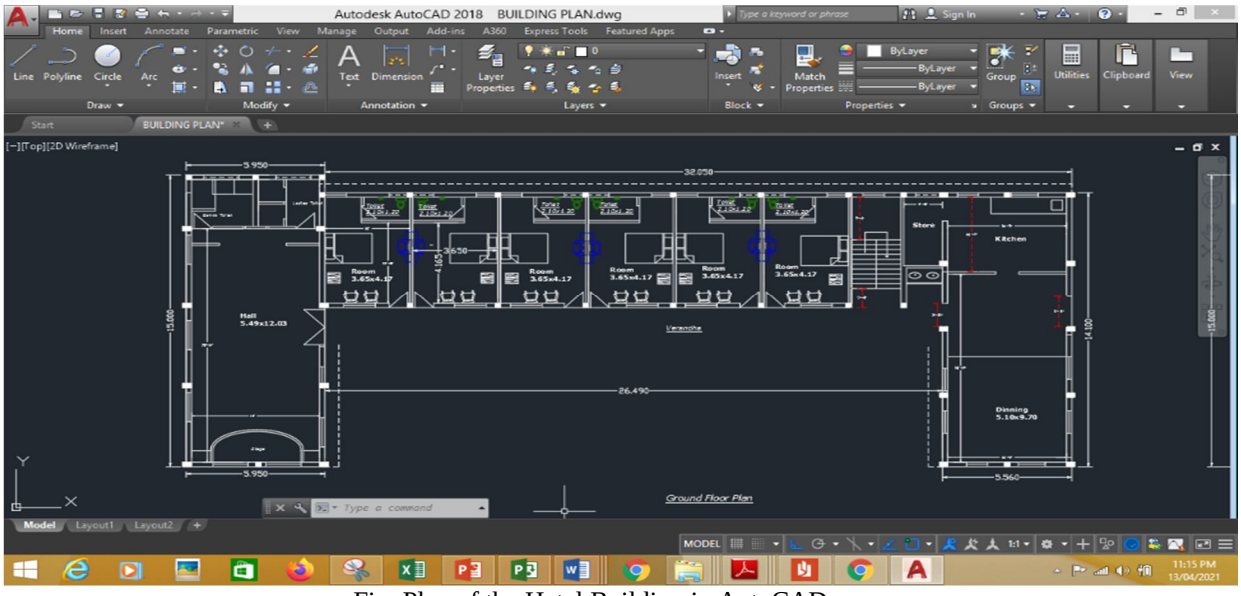


Fig. Plan of the Hotel Building in AutoCAD

3) *3D Modeling:* 3D modelling is done using 'REVIT ARCHITECTURE'. 3D modelling gives the client the clear idea of what he is getting and if there are some changes then he can notify us at the time of beginning. Which can save a lot of money of the client. Our model is prepared is considering that point of view.

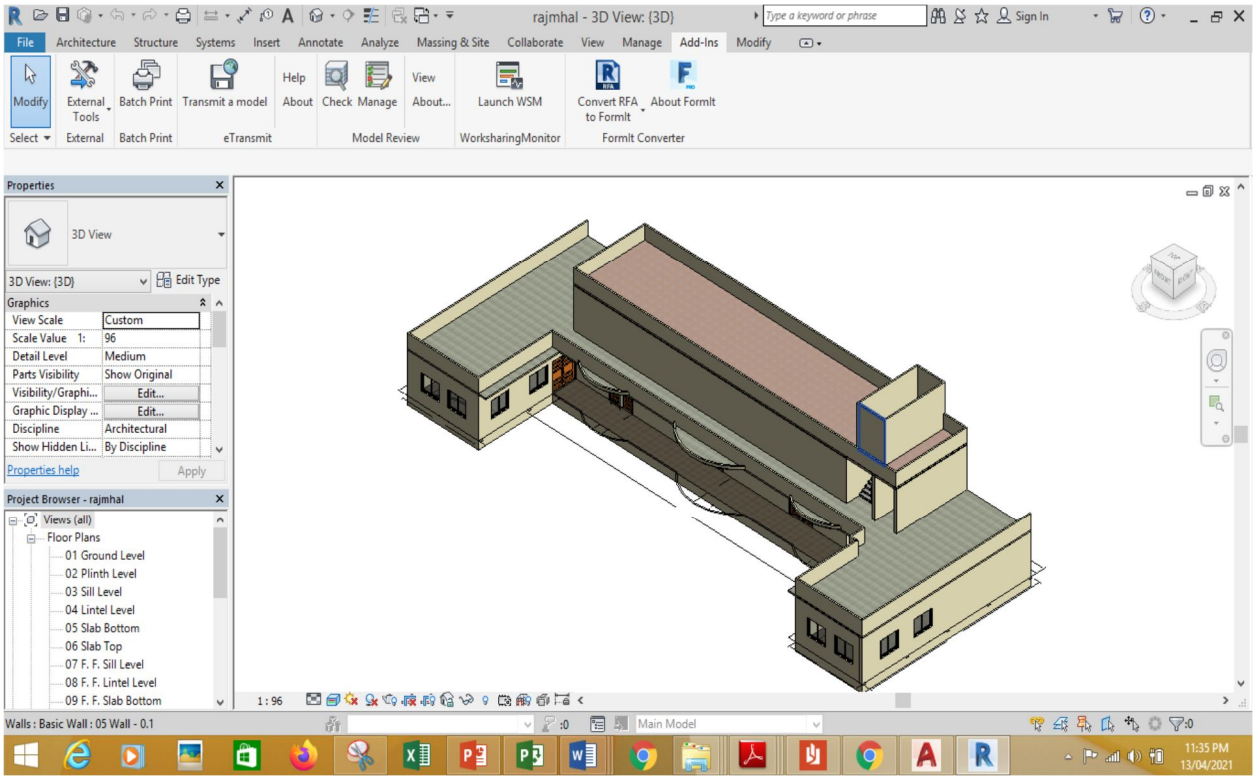


Fig 3D model in Revit

4) *Structural Analysis and Designing:* Structure Analysis is done in ETABS. ETABS offers a single user interface to perform: Modeling, Analysis, Design, and Reporting. The overall goal is to be able to design reinforced concrete structures that are: Safe, Economical and Efficient.

Table: Structural data for Hotel Building

Sr. No.	Description	Size
1	Slab beam	230*300 mm
2	Slab thickness	150 mm
3	Column	230*300 mm
		230*380 mm
4	Plinth beam	230*300 mm
5	Ground beam	230*300 mm
6	Live load	4 kN/m2
7	Wall load	As per AAC blocks weight
8	Grade of concrete	30 kN/m2
9	Grade of rebar	500 kN/m2

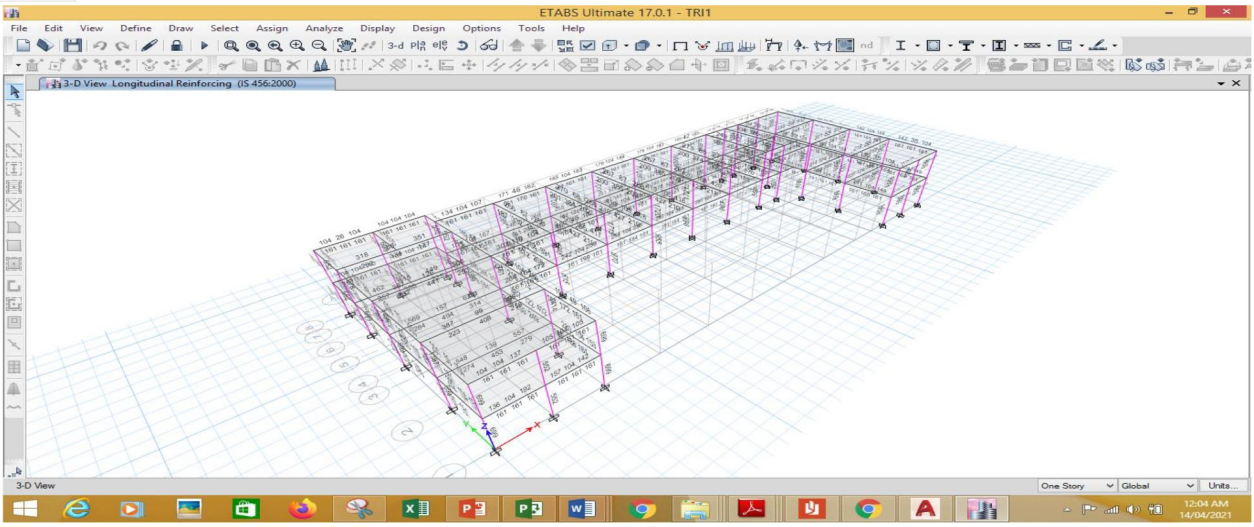


Fig. Design result of the structure in ETABS

5) *Estimation:* Estimation is done using Excel. Quantities of various activities are very essential to calculate direct cost of the project. These quantities are calculated from drawings collected through site. Also using these quantities labor requirement for various activities are calculated. As this case study included pre-planning for hotel so it gives only ideally indirect cost. As we all knows as duration of project increases there is tremendous impact on indirect cost.

Table: Elements with their estimated quantity

Sr. No	Element	Qty	Unit
1	Excavation For Column	124.6	Cum
2	RMC Concrete	250	Cum
3	Rebar Steel	45000	Kg
4	Brick	125	Cum

6) *Planning and Scheduling:* The process of planning primarily deals with selecting the appropriate policies and procedures in order to achieve the objectives of the project. Scheduling converts the project action plans for scope, time cost and quality into an operating timetable. Planning and scheduling and delay analysis have become an essential part of any project for the timely and economical completion of the project. By using construction schedule to predict project completion, contractors can adjust crew size, shifts or equipment to speed or slow the progress. All the projects have time constraint. Delay in completion of project will increase the overall cost of the project. Small projects can be managed efficiently manually; whereas large projects are better handled by the use of computers. Many types of software are available with the help of which project management can be done easily. Large quantities of different kinds of resources are also required for execution and the risk is more in the case of projects. In this study, an effort is made in planning, scheduling and delay analysis updating of various activities, which is done by using MS Project and MS Excel software, manpower of each activity is determined and allocation is done using the software. Labor requirement for each activity is calculated. An updated schedule helps to finish the project well in time with optimum resources and update helps in delay analysis, is under the scope of this study. Microsoft Project is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget, and analyzing workloads. Project creates budgets based on assignment work and resource rates. As resources are assigned to tasks and assignment work estimated, the program calculates the cost, equal to the work times the rate, which rolls up to the task level and then to any summary tasks and finally to the project level resource definitions (people, equipment and materials) can be shared between projects using a shared resource pool. Each resource can have its own calendar, which defines what days and shifts a resource is available. Resource rates are used to calculate resource assignment costs which are rolled up and summarized at the resource level. Each resource can be assigned to multiple tasks in multiple plans and each task can be assigned multiple resources, and the application schedules task work based on the resource availability as defined in the resource calendars.

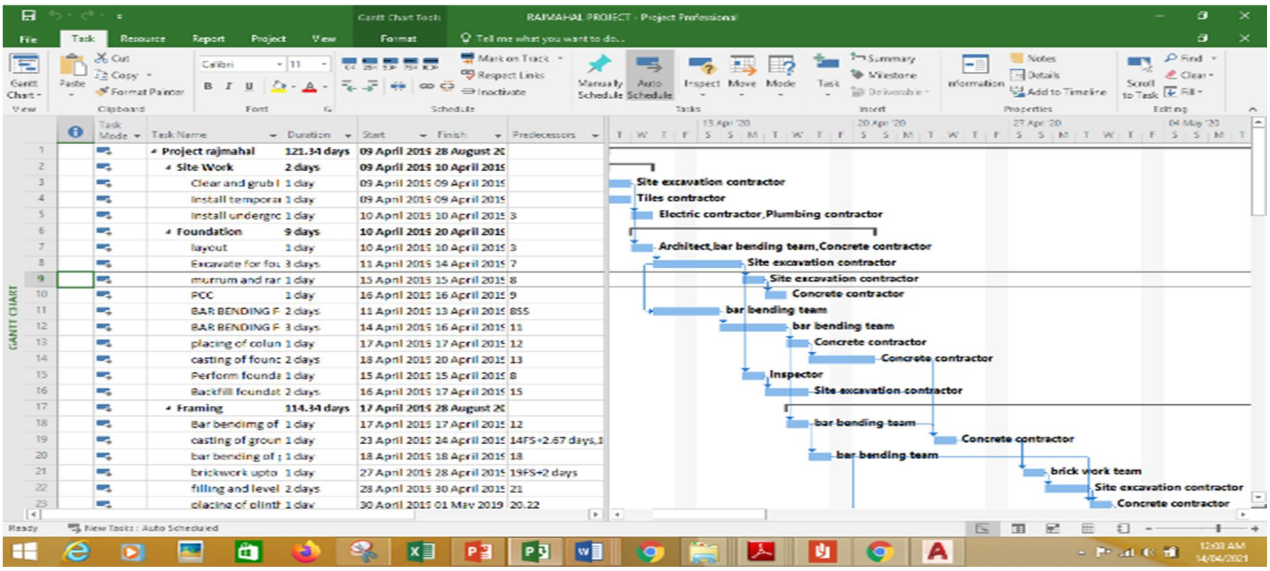


Fig. Network Diagram using MSP

In this work, start date is considered as 9/04/2019. MS Project is used for scheduling all task which are required in construction of hotel building. After all consideration along with all task like site work, foundation, framing, first floor construction and other work the end date found as 28/8/2019 with proper scheduling.

7) Gantt Chart: Gantt charts are helpful for project planning and scheduling. They assist you in determining how long a project should take, determining the resources required, and planning the order in which tasks will be completed. They're also useful for keeping track of task dependencies. It is a pictorial representation specifying the start and finish time for various tasks to be performed in a project on a horizontal time-scale.

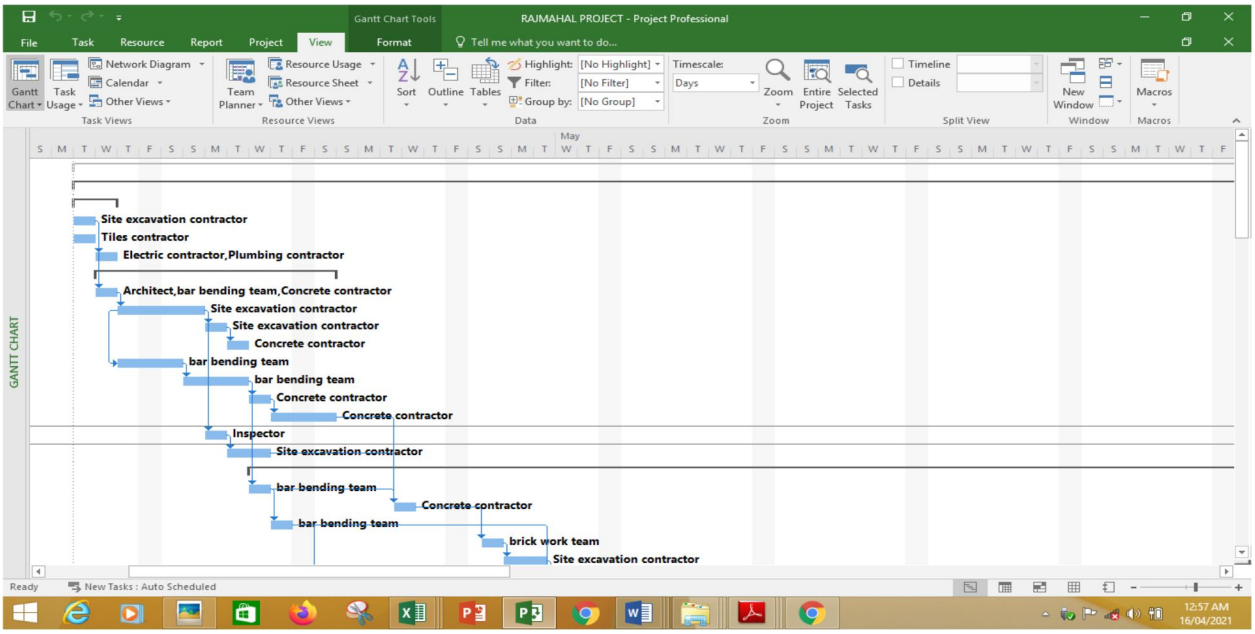


Fig. Gantt Chart for proposed project work

When work begins, the next phase of project management is tracking process. Tracking means recording project details such as work did by whom, when the work was done, and at what cost. Tracking is the process of collecting, entering and analyzing of actual project performance values, such as work on tasks and actual durations. The tracking is the Second major phase of project management

8) *Network Diagram:* Next step is to draw the network diagram of the project. A network diagram is a graphical representation of a project, consisting of a series of connected arrows and boxes that describe the inter-relationships between the project's activities. The description of activities is represented by boxes or nodes, and the relationship between the activities is shown by arrows. PERT network is a schematic model that depicts the sequential relationship among the activities that must be completed to accomplish the project. For this project detailed network diagram is shown below. Early Start, Early Finish, Late Start and Late Finish, slack/float for all activity including in this project is calculated in the project work.

9) *Critical Path:* The critical path time being the shortest project time any delay in completion of any of the activity on the critical path would delay the entire project. Therefore it is the critical activity that needs to be monitored for timely completion of the project. However, the activities with positive event slack could be rescheduled within the available time frame for efficient utilization i.e. smoothing of the demand on the available resources. If the duration of the project requires to be reduced, activities on the critical path will be the ones to be considered for completion at an early date with allocation of additional resources.

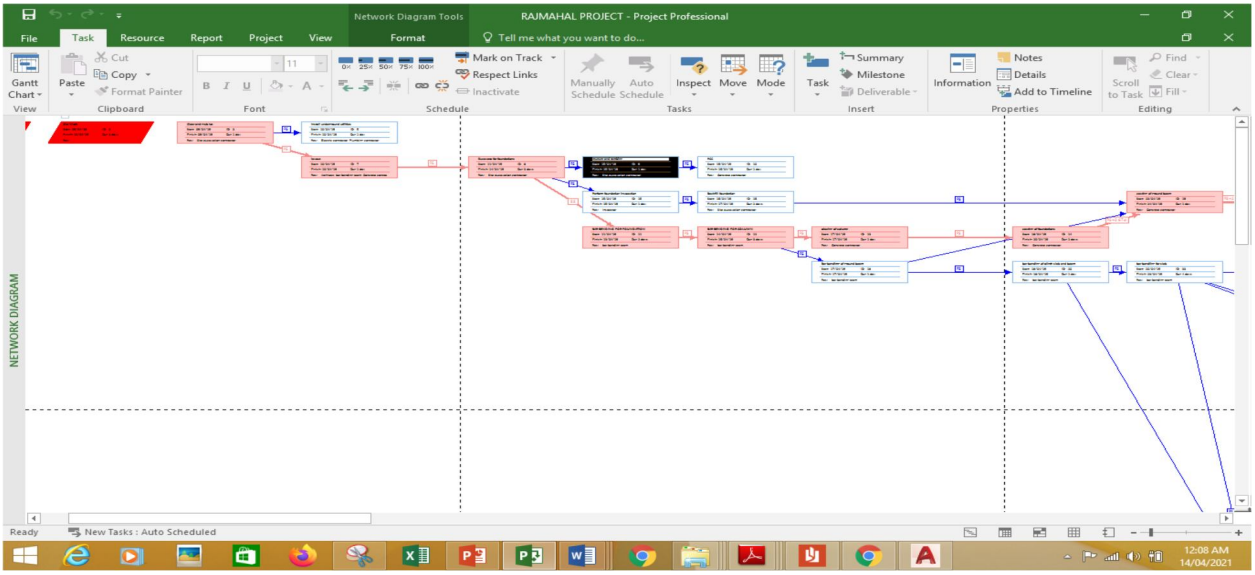
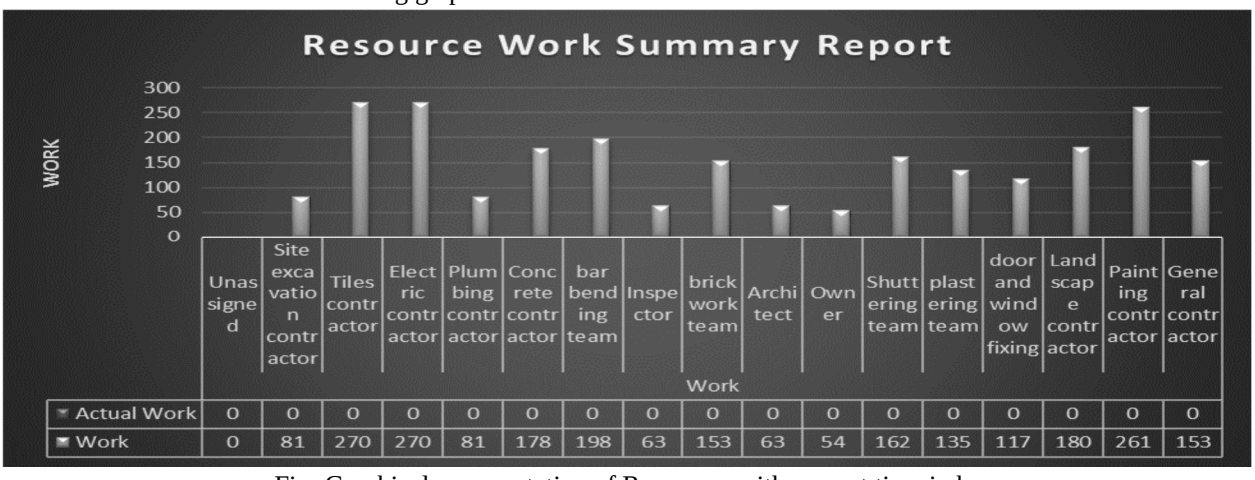


Fig. Network Diagram for proposed work

10) *Importance of Resources:* All activities started by considering resource availability. Resource availability is one factor which may have an important influence on when activities can actually be started. The initial network ignores this factor, and it is at the scheduling stage that the resources have to be taken into account. Activities which could logically be carried out in parallel may have to be done in series and this phasing of activities to meet resource limitations will involve the use of float. The planning of work to balance such requirement against availability may be an overriding factor in deriving schedules and these aspects are discussed in detail. Following graph shows resources vs work in hr.



	Unassigned	Site excavation contractor	Tiles contractor	Electric contractor	Plumbing contractor	Concrete contractor	bar bending team	Inspector	brick work team	Architect	Owner	Shuttering team	plastering team	door and window fixing	Landscape contractor	Painting contractor	General contractor
Actual Work	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Work	0	81	270	270	81	178	198	63	153	63	54	162	135	117	180	261	153

Fig: Graphical representation of Resources with respect time in hr

IV. RESULTS AND DISCUSSION

To recap, BIM can be used by engineers, architects, project managers, etc. in order to achieve these goals:

A. To decrease design errors
B. To reduce clash detection
C. To boost the integration of cost and time
D. To improve the integration of design and construction phase
E. To increase the collaboration between different construction sections and finally to improve recycling.

V. CONCLUSION

Brief summery over the results obtained by the current study leads to the below conclusions:

A. The project completion date according to the planned schedule is 9 April-2019.
B. The progress of the project and the estimated total duration is to be reported.
C. Total of 85 activities are involved with this project from its initiation to delivery of the project with various steps.
D. Planned float at some activities starting or finish is been observed to execute the activity works smoothly without overshooting the budget and resources.
E. The variance issues with respect to the start date or finish date of the project could not be reported, if the threshold variance of start date and finish date are properly monitored.
F. The report of allocation of resources helps in cost and time saving which results in increase of economy.
G. It provides an idea of arranging the required resources for the upcoming activity.

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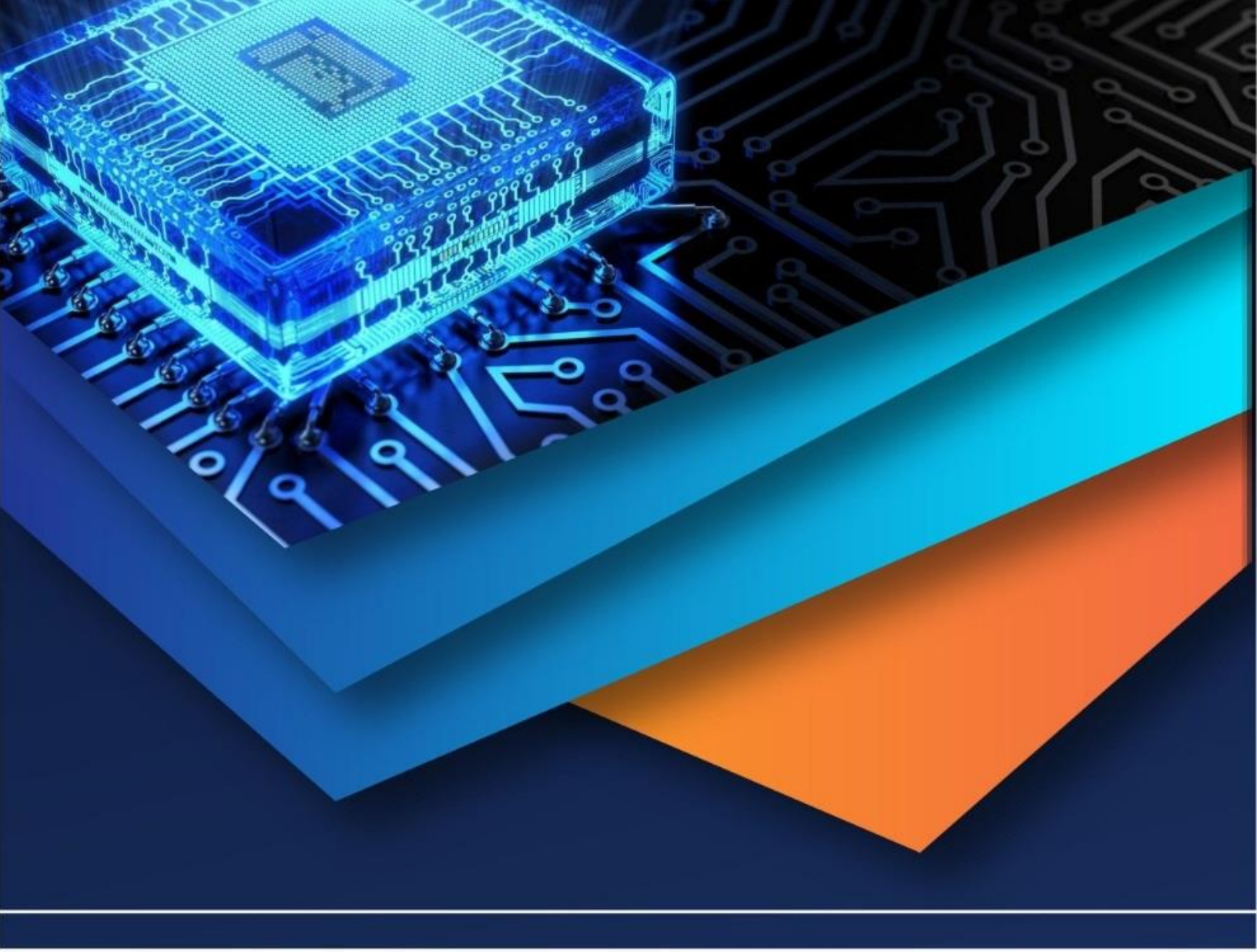

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