

OPTIMUM RESOURCES UTILIZATION IN CONSTRUCTION INDUSTRY

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Abstract : Proper management of resources in construction projects can yield substantial savings in time and cost. Construction companies are facing numerous challenges of managing project schedules, budgets, safety and quality to meet the requirements stipulated by the client and/or architect/engineer. This study provides a guide for necessary steps required to improve construction productivity and consequently, the project performance. It can help improve the overall performance of construction projects through the implementation of the concept of benchmarks.

Material waste in construction contributes approximately 30-35% of project cost; thus leading to material loss and project cost overruns. Construction stage major sources of material wastage are design changes during construction and re-working due to incorrect use of material and labour. While at procurement stage the major source of materials waste are the lack of possibility to order small quantity and waste encountered during loading/transportation. The study also revealed that lack of adequate security in the country and inadequate knowledge of recycling are the main challenges that occur more frequently in resources management.

I. INTRODUCTION

Today, construction projects are more complex than ever before. Thousand of tasks must be precisely controlled if a project is to run smoothly, on time, and in budget. The completion of a construction project requires the judicious scheduling and allocation of available resources. Manpower, equipment, and materials are important project resources that require close management attention. The supply and availability of these resources can seldom be taken for granted because of seasonal shortages, labour disputes, equipment breakdowns, competing demands, delayed deliveries, and a host of associated uncertainties. Nevertheless, if time schedules and cost budgets are to be met, the work must be supply with the necessary workers, equipment, and materials when and as they are needed on the job site. The basic objective of resource planning and resource allocation is to supply and support the field operations so that established time objectives can be met and costs can be kept within the construction budget.

If the project plan and schedule are to be achieved, it is necessary to assure that the required material, labour, and equipment will be available when needed in the require quantities. Despite the wide spread utilization of network scheduling techniques such as the Critical Path Method (CPM) and Precedence Diagram Method (PDM) in the construction industry, they have a number of important limitations including the inability to minimize fluctuations in resource utilization, availability limits of construction resources during various periods of the project, consider the uncertainties and risks involved in construction scheduling and cost estimate. Inefficient management of construction resources can result in low productivity. To achieve the income expected from any construction project in general, it is important to have a good controlling hand on the productivity factors that contribute in the integrated production composition, like labour, equipment, cash flow, etc.

1.1 PROJECT OBJECTIVES

- i. To study the concept of resources utilization in construction project.
- ii. Planning and management of materials and labours for as per the requirement and availability.
- iii. Effects to analyse the resource utilization for construction project by actual case study.
- iv. Results and discussions based on study and provide suggestions, remedies for effective resources utilization.

1.2 PROJECT METHODOLOGY

In order to achieve the objectives, this research is organized into following main research tasks:

- (1) Conduct a comprehensive literature review of the latest research developments in resource-driven scheduling.
- (2) To study and collect data for resource fluctuation so as to maximize resource utilization efficiency.
- (3) To conduct a case study which includes data about site for materials, manpower, equipment and direct cost of project.
- (4) Based on above work finding will be drawn and recommendation will be given on each factors causes resources utilization.

II. STUDY THE CONCEPT OF RESOURCES UTILIZATION IN CONSTRUCTION PROJECT

2.1 Below are distinct benefits of an automated resource management program:

- Better productivity – Automated systems help ensure that tools and equipment for a project are going to the right place, maximizing employee efficiency.
- Better accountability – if a tool or piece of equipment goes missing, managers can pinpoint the last employee to handle the item using automated tracking systems.
- Decreasing human error – when inventory is proscribed barcodes and RFID tags, management no longer has to rely on verbal communication or memory to know exactly where all of the warehouse items are and how many of each item management has. Making mistakes in inventory can otherwise be extremely costly.
- Maintenance – beyond tracking where items are and how many of them are there, automated systems can track safety information. These programs can tell management what tools and equipment are due for calibrations or inspections without having to rely on manual or physical verification.
- Reduce cost – having the proper tools and equipment at the right place and the right time will drastically reduce project interruptions and increase productivity. These factors unequivocally decrease cost.

- Better knowledge of inventory – when management is determining assets and necessities in making purchases, the automated resource management systems can quickly and accurately provide all the information needed to make the best decision possible.

2.2 PROJECT SCHEDULING IN MSP

2.2.1 Entering task in Microsoft Project

- Tasks are the engines that propel the progress of a project. If you have done a good job of project planning, you should already have an idea of what you need to do to accomplish your project's goals.
- Type the task's name in the Task Name field, and press <Enter>. Repeat as desired for additional tasks.
- When entering a task, pick a name that clearly identifies the purpose of the task.

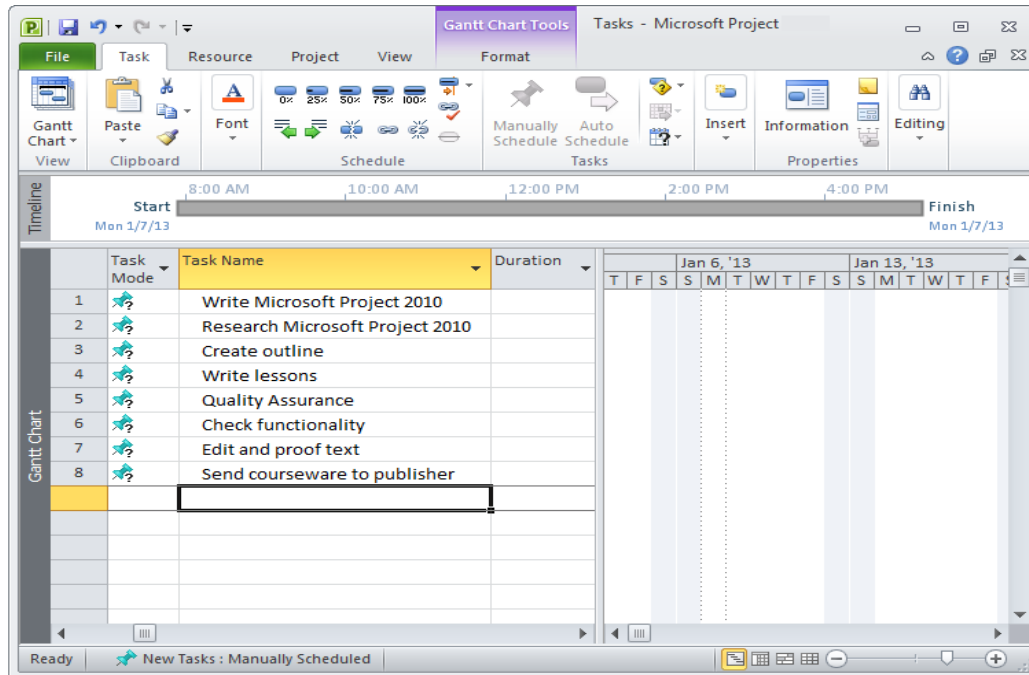


Fig 2.1 Entering tasks in a project.

2.2.2 Entering Task Duration

- Once you've entered tasks in the project, you need to tell the program how long each task will take. This allows Project to use the durations you enter to calculate the amount of time the project will take as a whole.
- i. Enter a duration amount in the Duration field. Repeat as necessary.
- Notice that there is already a value entered in the field. This indicates that the number is an estimate, which is what Project automatically enters in the task field until you assign a more definite duration.

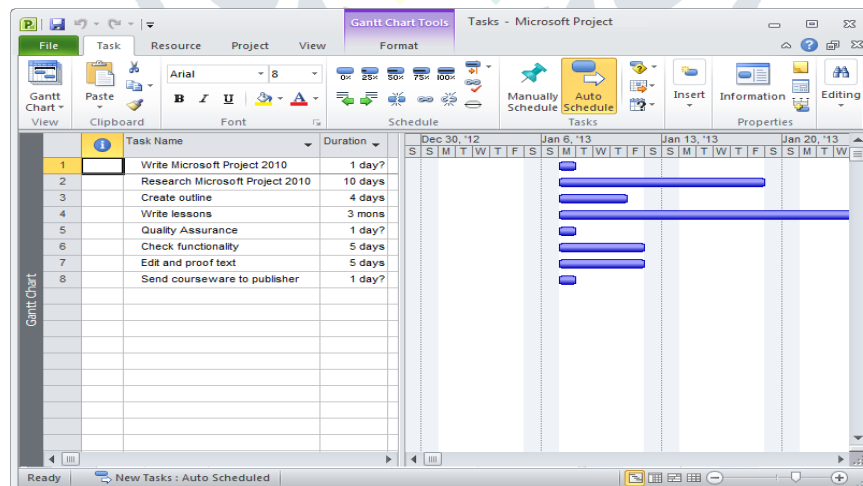


Fig 2.2 The project updated with task durations in Gantt Chart view.

2.2.3 Entering A Milestone

- i. Enter a duration of 0 (zero) days for a task in the duration field.
- A milestone marker appears on the calendar part of the screen.
- Other Ways to Enter a Milestone: Click the Information button in the Properties group of the Task tab on the Ribbon, or, double-click the Task Information cell next to the task you want to milestone—this cell is found in the column with the blue (i) information icon. Click the Advanced tab, check the Mark task as Milestone check box, and click OK.
- Milestones are very easy to use. Don't be afraid to use them as markers for the beginning or ending of a task.

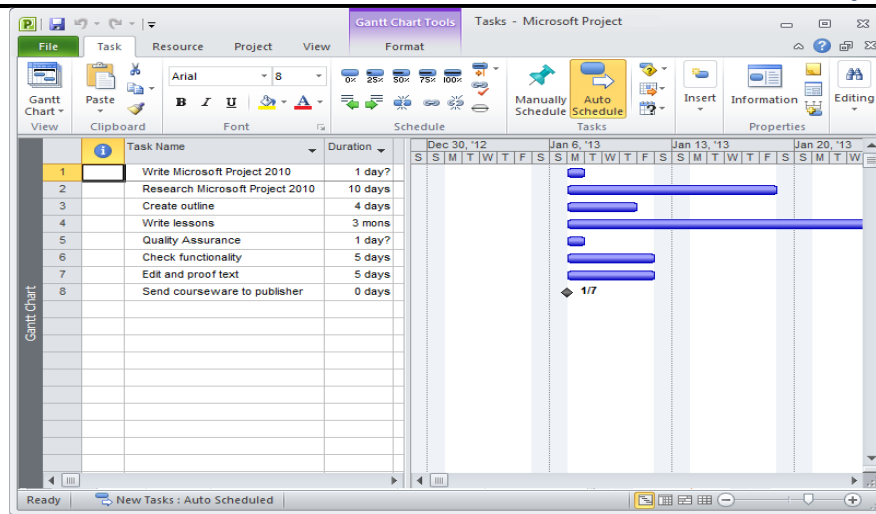


Fig 2.3 Enter a duration of (zero) days to turn a task into a milestone.

2.2.4 Editing Task Links

- i. Double-click the link line between the linked tasks.
- The Task Dependency dialog box appears.
- Tip: Click the Information button in the Properties group of the Task tab. Click the Predecessors tab and change the dependency for the desired task link.
- Tip: Click the Zoom Selected Tasks button in the Zoom group of the View tab on the Ribbon to view the task bars of a selected task in the chart area of Gantt Chart view.
- ii. Click the Type list arrow and select the type of link you want to use.
- The dialog box displays which tasks the link is from and to.
- iii. Click OK.

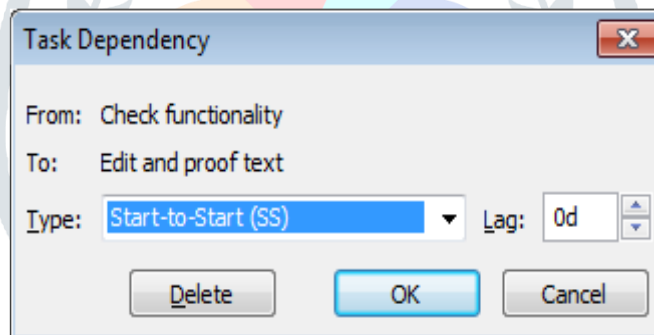


Fig 2.4 The Task Dependency dialog box.

2.2.5 Inserting And Deleting A Task

- This lesson will show you how to insert new tasks, and how to delete tasks you no longer need.
- Insert a task
 - i. Select the task you want your new task to appear above.
 - ii. Click the Insert Task button in the Insert group of the Task tab on the Ribbon. A new task is added to the project.
- Other Ways to Insert a Task: Right-click the task and select New Task from the contextual menu. Or, press the <Insert> key.
- Tip: The Insert group may be collapsed into a menu if your Ribbon is narrow. In this case, simply click the Insert button and select Task.
- Mark a task as inactive
- Tasks that you no longer want to be part of the project can be marked as inactive. Inactive tasks remain in the project, but they do not affect the task scheduling or resource availability. Tasks can be reactivated later on to be part of the project once again.
- i. Select the task you want to make inactive.
- ii. Click the Activate/Inactivate Selected Tasks button in the Schedule group of the Task tab on the Ribbon.
- The task is made inactive.
- Tip: Click the Activate/Inactivate Selected Tasks button to reactivate selected tasks.
- Delete a task
- If you definitely don't want a task in a project any more, you can delete it. Make sure the task you are planning to remove does not affect any other tasks.
- i. Click the task ID of the task you want to delete.

- Clicking the task ID selects the entire task, not just the contents of a cell. For example, simply clicking the task name and pressing <Delete> will clear the data for the task; it won't delete the task itself.
- ii. Right-click the task and select Delete from the contextual menu.
- The task is deleted from the task list and the remaining tasks are automatically renumbered.

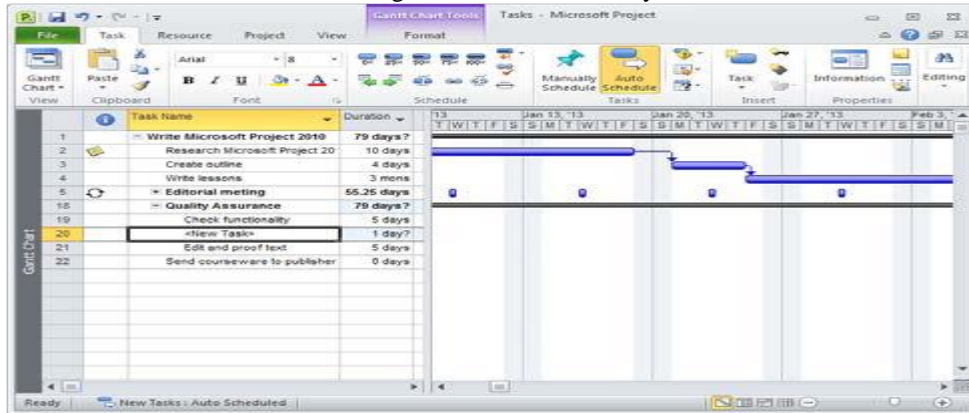


Fig 2.5: Inserting a new task in the project.

III. ANALYSIS OF CASE STUDY

TABLE 3.1- comparison between Planned and actual Scheduling prepared in MSP:

Task Name	Duration	Start	Finish	Predecessors	Planned Cost	Task Name	Duration	Start	Finish	COST
BLDG - B	356 days	Thu 7/2/15	Tue 6/21/16		₹ 33,822,804.00	BLDG - B	407 days	Wed 7/8/15	Wed 8/17/16	₹ 37,162,700.80
▫ SUB STRUCTURE	50 days	Thu 7/2/15	Thu 8/20/15		₹ 5,406,169.00	▫ SUB STRUCTURE	60 days	Wed 7/8/15	Sat 9/5/15	₹ 6,111,948.80
▫ RCC	124 days	Sun 8/16/15	Thu 12/17/15		₹ 8,548,260.00	▫ RCC	141 days	Tue 9/1/15	Tue 1/19/16	₹ 9,491,045.12
▫ BRICK WORK	45 days	Sat 11/14/15	Mon 12/28/15		₹ 1,673,100.00	▫ BRICK WORK	67 days	Mon 12/14/15	Thu 2/18/16	₹ 2,213,685.12
▫ WINDOW GRILL / SUBFRAME	38 days	Wed 12/9/15	Fri 1/15/16		₹ 1,800.00	▫ WINDOW GRILL / SUBFRAME	46 days	Tue 1/19/16	Fri 3/4/16	₹ 13,680.00
▫ CONCEALED ELECTRIFICATION	30 days	Sun 11/29/15	Mon 12/28/15		₹ 210,000.00	▫ CONCEALED ELECTRIFICATION	35 days	Tue 1/5/16	Mon 2/8/16	₹ 245,000.00
▫ BACK COAT FOR TOILET	30 days	Wed 12/9/15	Thu 1/7/16		₹ 135,000.00	▫ BACK COAT FOR TOILET	38 days	Tue 1/19/16	Thu 2/25/16	₹ 171,000.00
▫ TOILET WATER PROOFING	38 days	Tue 12/29/15	Thu 2/4/16		₹ 216,000.00	▫ TOILET WATER PROOFING	38 days	Mon 2/15/16	Wed 3/23/16	₹ 216,000.00
▫ INTERNAL PLUMBING	30 days	Mon 1/18/16	Tue 2/16/16		₹ 180,000.00	▫ INTERNAL PLUMBING	35 days	Tue 3/8/16	Mon 4/11/16	₹ 210,000.00
▫ INTERNAL GYP PLASTER (with material)	57 days	Mon 12/14/15	Mon 2/8/16		₹ 435,000.00	▫ INTERNAL GYP PLASTER (with material)	67 days	Mon 1/25/16	Thu 3/31/16	₹ 507,500.00
▫ FABRICATION (with material)	23 days	Tue 2/2/16	Wed 2/24/16		₹ 324,000.00	▫ FABRICATION (with material)	21 days	Thu 3/24/16	Wed 4/13/16	₹ 310,500.00
▫ EXTERNAL PLASTER	10 days	Thu 2/25/16	Sat 3/5/16 73,24		₹ 2,972,475.00	▫ EXT PLASTER	10 days	Thu 4/14/16	Sat 4/23/16	₹ 2,972,474.88
▫ TERRACE WATER PROOFING	19 days	Sun 1/24/16	Thu 2/11/16		₹ 89,000.00	▫ TERRACE WATER PROOFING	28 days	Sun 3/13/16	Sat 4/9/16	₹ 110,657.14
▫ FLOORING	22 days	Fri 1/29/16	Fri 2/19/16		₹ 4,050,000.00	▫ FLOORING	29 days	Sat 3/19/16	Sat 4/16/16	₹ 4,443,750.08
▫ INTERNAL PAINTING	45 days	Tue 2/16/16	Thu 3/31/16		₹ 6,090,000.00					
▫ FIRE FIGHTING	7 days	Thu 2/18/16	Wed 2/24/16 88		₹ 100,000.00					
▫ LIFT ERECTION	5 days	Thu 2/25/16	Mon 2/29/16 97		₹ 100,000.00					
▫ EXTERNAL PLUMBING	10 days	Tue 3/1/16	Thu 3/10/16 98,82		₹ 40,000.00					
▫ TERRACE LOOPING	6 days	Fri 3/11/16	Wed 3/16/16 99		₹ 25,000.00					
▫ DOWN TAKES	12 days	Thu 3/17/16	Mon 3/28/16 100,74		₹ 60,000.00					
▫ DOORS/AL WINDOWS	38 days	Fri 3/18/16	Sun 4/24/16		₹ 252,000.00					
▫ CP/SANITARY FITTINGS	48 days	Tue 3/29/16	Sun 5/15/16		₹ 900,000.00					
▫ SWITCH BOARD FIXING/WIRE	50 days	Wed 4/13/16	Wed 6/1/16		₹ 540,000.00					

3.1 Stepwise procedure for m s project

Step 1: Open New project and create new calendar as per the requirement and set calendar as new work load per day.

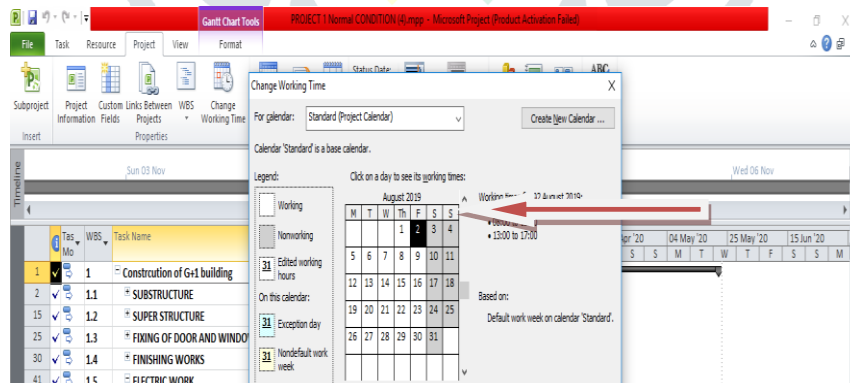


Figure Showing New Calendar created for project.

Step 2 Set Work breakdown structure with number of activities.

Step 3 Enter all the activities in task column along with duration required for the project.

Step 4: Preparation of resource sheet s per the requirement of project.

Step 5 Apply the Resources to all the task and activities

Above process completed and shown the same process in screen shot of project below highlighted in red in circle :

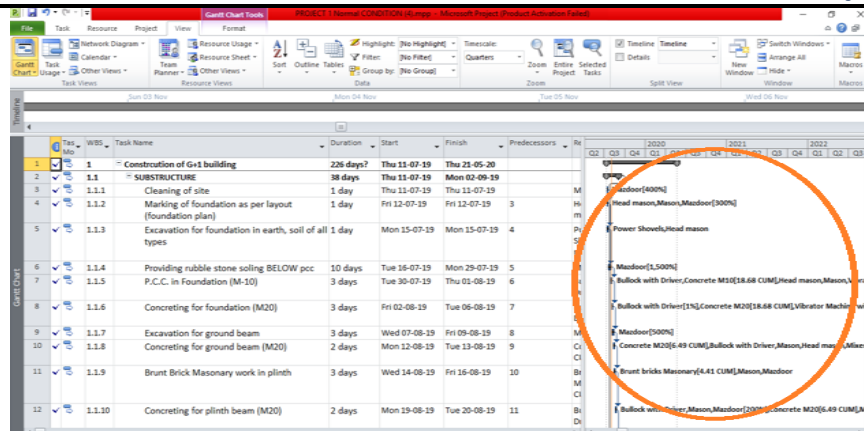


Figure showing allotment of resources completed in each activity.

Step 6 Give predecessors as per the each activity

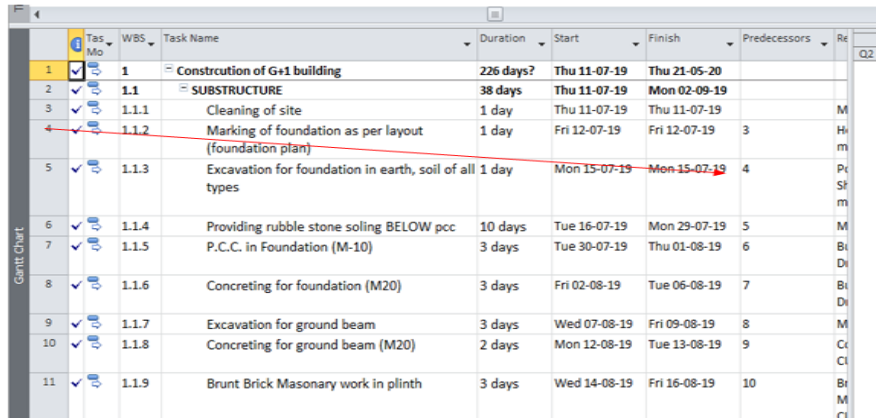


Figure showing predecessors allotted in each activity.

Step 7: Set all the activities to auto schedule, it allows ease in the shift of particular activity and project.

Step 8: Gantt Chart View for activities to check critical activities and float, it is easy to detect float visually seeing the gantt chart.

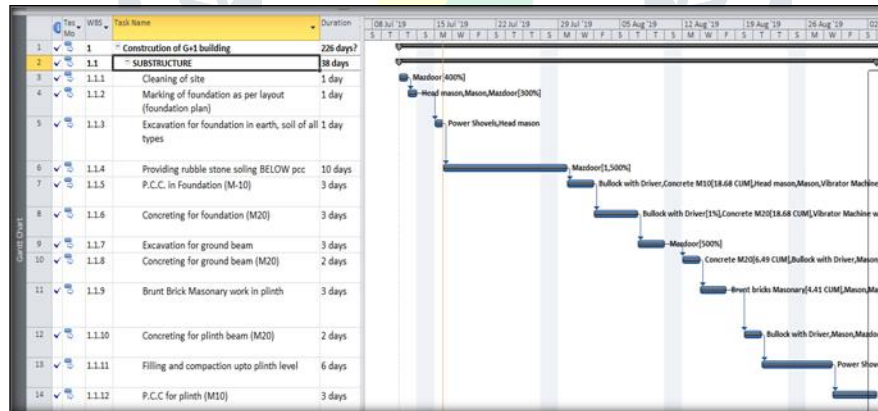


Figure Showing Gantt Chart

VI. RESULTS AND DISCUSSIONS

General discussions on case study conducted relating with manpower management.

1. The positive changes include creating a healthy working environment among those involved directly in the construction industry. The major players in the are architects, engineers, town planner, developer, contractor and the supplier or manufacturer have to play their roles in enhancing their working system, management and administration to enable the modernization in the industry.
2. The software Microsoft Project 2013 is the popular tool in modern days to manage the project efficiently. The software also helps to enhance project manager’s efficient performance towards wastage of resources and its minimization during construction process.
3. Project is scheduled from second week of July toThird week of May and duration is calculated of total working days of 226 which includes the Sunday which is selected as the non working day.

4. Project is performed in MSP in auto scheduling mode which indicated that if project is delaying or preponing by any man hours it is directly reflected in duration changed of project.
5. Following below are the key summary reports generated by software

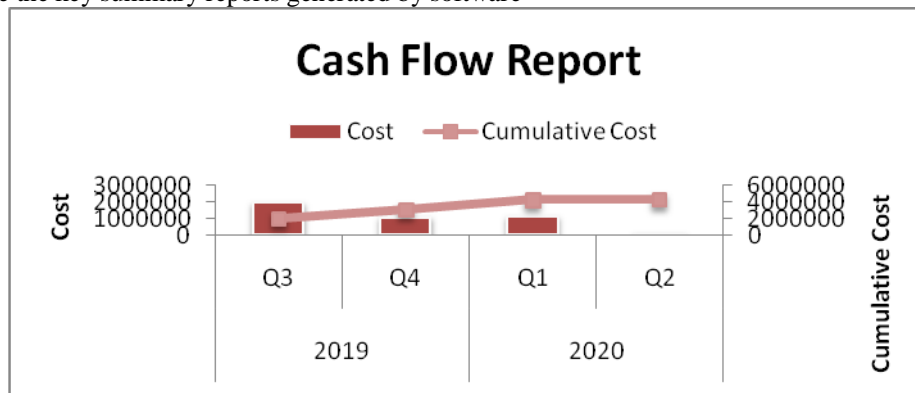


Chart 4.1 Cashflow Report chart indicates cash flow in four major parts of project X Axis representing duration while Y axis representing cost. In first part from July 2019 maximum funds will be required.

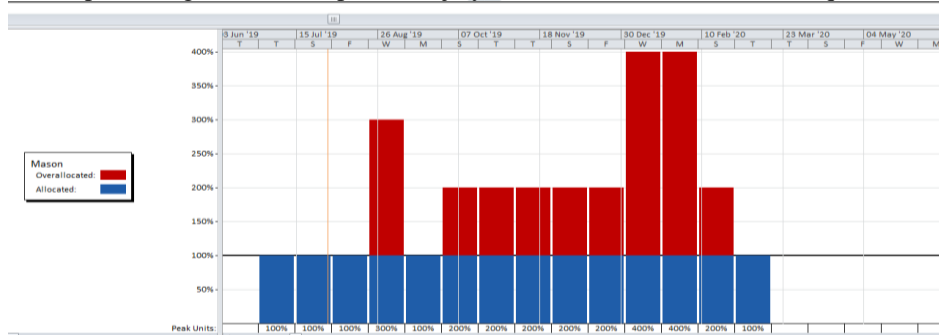


Chart 4.2 Showing Mason and its units red indicting in that particular week additional mason is required, as 400% means masons are required while similarly 500% means 5 masons are required in activities in that duration.

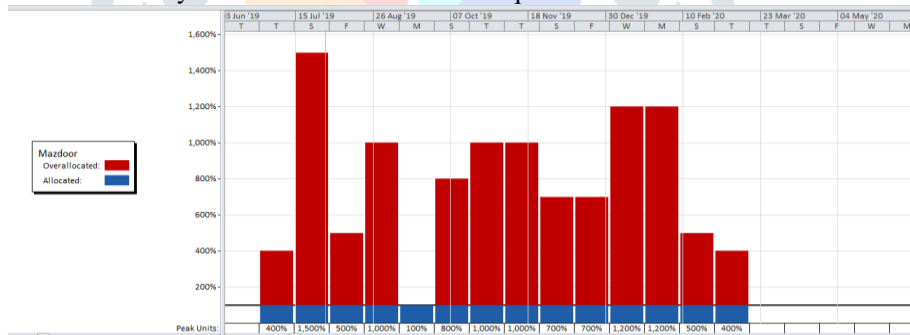


Chart 4.3 Showing Mazdoor and its units red indicting in that particular week additional Mazdoor is required, as 400% means 4 Mazdoor are required while similarly 500% means 5 Mazdoors are required in activities in that duration

IV. CONCLUSIONS

Brief Conclusions drawn regarding the project is as shown below:

1. Labour productivity must be given extreme importance in calculating the activity duration and reliable plan, and knowing the well-founded methods in the computation of various labour productivities and for its improvement.
2. The relationship between the tasks and their interdependencies should be known. Identification of various drawings required for the execution of works, and listing out various activities involved in a project and their sequential order should be prioritized.
3. Creating a Plan and the key elements of a plan like WBS, activity duration, and their dependencies etc. should be implemented from the basic idea of planning.
4. Critical path and critical activities of the project should be identified and Scheduled based on Project start date and Project end date.
5. WBS should be created based on the project deliverables and the advantages of creating a WBS using deliverable over WBS created on the basis of trade.
6. It is important to crosscheck the drafted plan with the drawings. As well as Activity durations, their allotment should be assessed correctly.

7. Developing and implementing the right HRMS for every company is important. While it is certainly possible to take care of these functions manually, an automated system ensures there is plenty of time available for the human resources staff to develop and maintain the data that goes into those systems.
8. Equipping the workforce with the skills required for the jobs of today and those of tomorrow is a strategic concern in the growth and development of country.
9. Today the skill labour shortage is one of the most decisive challenges faced by India's construction sector. Skill shortage affect the industry by less productivity , poor quality, material wastage, cost increase, inability to meet time deadlines and unhappy customers.

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