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Proper Planning and Scheduling of a Construction Project to Optimize Time and Cost

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Abstract: ***In the construction project time and money plays an important role. As in this project the aim is to complete the project on time. So as to we can save the time as well as money and proper planning within budget and to achieve the further project objectives.***
The delays caused results increases of expenses. Hence planning and scheduling has to be done and followed for the successful execution of the project. The presented work will provide them an Opportunity to clearly notice the difference between the Microsoft Project (MSP) and the Traditional Planning ways of doing thing which speeds up Construction and also make the Project Cost Effective with Proper Planning with the help of the case study on the construction project executed in Karad, Maharashtra, India.
Keywords: Planning, Time, Cost, Optimization, MSP (Microsoft office).

I. INTRODUCTION

Major development projects in the Indian construction industry are expected to be balanced with significant business obligations. They are closely attached to the national economy. The total number of construction projects and new infrastructure is based on the extraordinary scale that adds to the country's economic growth. Apart from the financial aspect, the pace of construction is also essential. Like various countries, India is also facing a significant time constraint and cost-cutting in construction projects. The sad part is that not much of the work is transferred as expected and at a cost.

Many of challenges has to face by construction industry which include design and constructability issues, land acquisition issues, shortage of quality workmanship, time and cost related issues, rising material and labour costs, structural changes. Time and cost are most important factors that are considered in every project without timely completion within scheduled duration the project may face loss therefore optimization is very important.

Optimization is a systematic effort made to improve profit margin and obtain the best result under given circumstances or situations. It also includes the comparison of actual progress of time and cost with the estimated hence time frame is paramount important.

II. OBJECTIVES OF THE PROJECT

1) To Study the problem related with material and equipment management.
2) To minimize the risk factor at construction site by preparing proper schedule.
3) Identify Suitable tools/ software for tracking and controlling of project.
4) Optimize the time and cost for well-organized the construction project.
5) Making awareness of using software for planning and scheduling of project, which ultimately optimization the time and cost of whole project.

III. NEED & SCOPE OF STUDY

1) The main scope is to finish project within minimum cost and time with effective manner.
2) Improving construction quality and efficiency.
3) It is necessary to decide which optimization is required.
4) This model is very useful in the area of time and cost overrun during the construction.

The traditional approach to material management system has been changing since past three decades. Now a days, construction industry is becoming implemented various technique to material management and inventory control to minimizing cost of project.

Therefore, this study on optimization is carried out to study the process of implementation, understand and find out the problems and provide suggestion to solve them.

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IV. LITERATURE REVIEW

1) Mr. Umesh Kamble, Prof. Shashank U. Vanakudari (2018) "Implementing Time and Cost Optimization in Commercial Building Using Project Management Techniques in Microsoft Project" This paper will mainly help out to investigate the behavioural improvements in time according to the relative cost. Microsoft project software is used to enhance the scheduling adding Crashing, Slack time and alternative building material to the work planning activity. This project is very much applicable where the time and cost is the major constraint which make a building more economical.
2) Mr. James Babu Raj, Dr.N.S. Elangovanb (2016) "Time and Cost Optimisation in Construction Using M.S Project" In this work, analysis part, for this building scheduling will be performed by using MS PROJECT. The study also includes visiting of some construction companies and conducts questionary surveys, then analyses the difficulties due to cost and time and suggests improvement for the phase of the construction project.
3) Akalya.K, Rex.L. K, Kamalnataraj.D "Minimizing the Cost of Construction Materials through Optimization Techniques" In construction industry the aim of project is to control the cost of the men, material and machineries and finish it on time, within the estimated budget. In this project we have performed the quantification of the structural elements with regard to dimensional and material properties in order to work out the cost per unit item for various design combinations.
4) Mali P.A*, Lokhande A.Y, Kadam S.K, Shirole S.B, More P.N, Velhal A.J (2017) "Time and Cost Optimization By MSP Software" Optimization is a systematic effort made to improve profit margins and obtain the best results under given circumstances. There is a Systematic planning and programming with effective management is necessary for timely completion of the project. There is availability of various tools and techniques for optimization. In this approach we have studied various factors which affect the cost of projects. Again in this approach we have studied various techniques and various materials used for cost optimization also the need of optimization is discussed.
5) Anuja Raj guru and Parag Mahatme "Effective Techniques in Cost Optimization of Construction Projects" In the construction project, time and cost are the most important factors to be in the planning of every project. The aim of project is to finish the considered projects on time, within budget and to achieve other project objectives. In this study various technique are used to optimize the cost and time of construction project with using of a case study.

V. METHODOLOGY

1) Identify the problem related material & equipment management.
2) Identify the risk factor in construction project.
3) Select a construction site.
4) Collection of material data.
5) Prepare schedule for optimization.
6) Identify & use tools/software for tracking & controlling of project.
7) Data Analysis of collected data.
8) Recommendation & Conclusion.

VI. CASE STUDY

Address	Karad.
Building Type	Residential

A. Msp Software Utilized For Proper Planning And Scheduling

On this site MSP software is being utilized for the planning and scheduling the activities of the project. On this site the data provide to the MSP are the work to be performed, their time, start and finish dates and the work are being linked which gives idea of doing work at the particular time.

The MSP schedule should be provide the details of work and also the assets as input data so that the software gives a identical output which can be utilized for perfect planning and scheduling which can be explained from the example given below which is a MSP residential project at Karad.

Below given is the typical Calendar prepared on the showing details of the major activities and exception.

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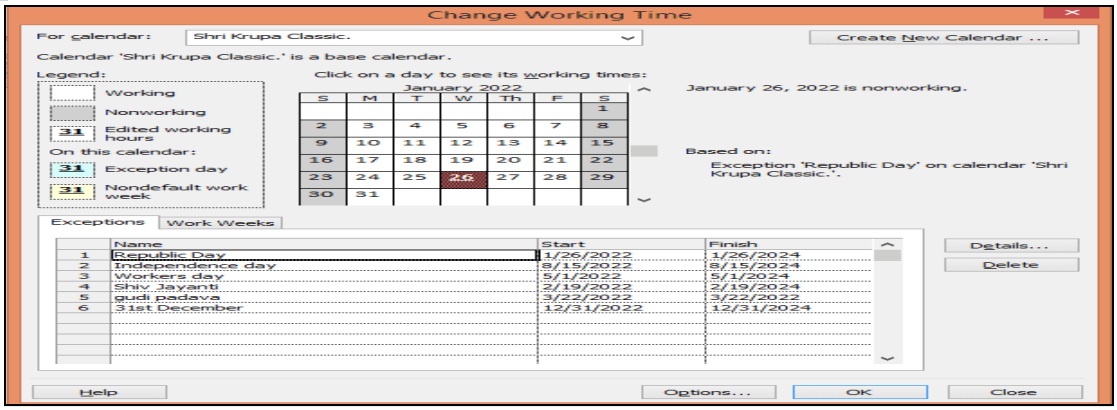


Image no. 1: MSP screen showing Calendar

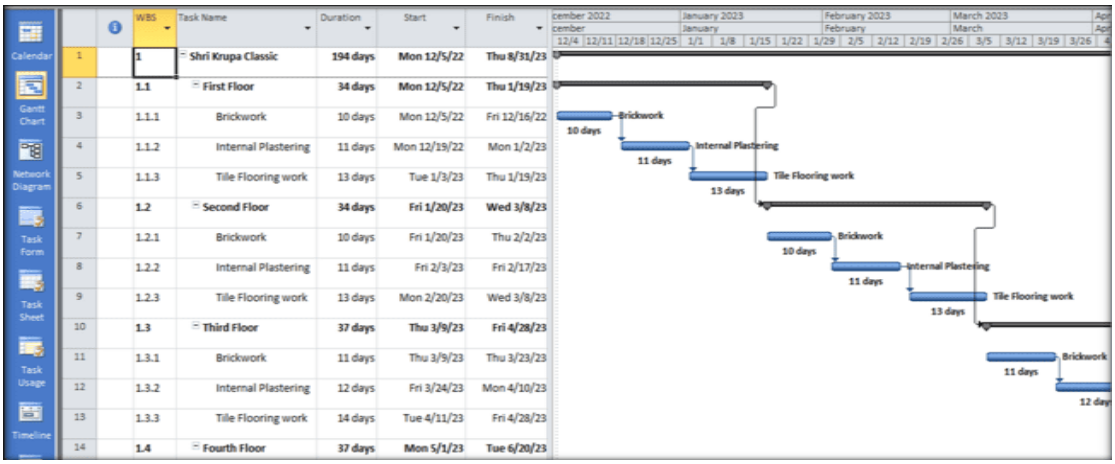
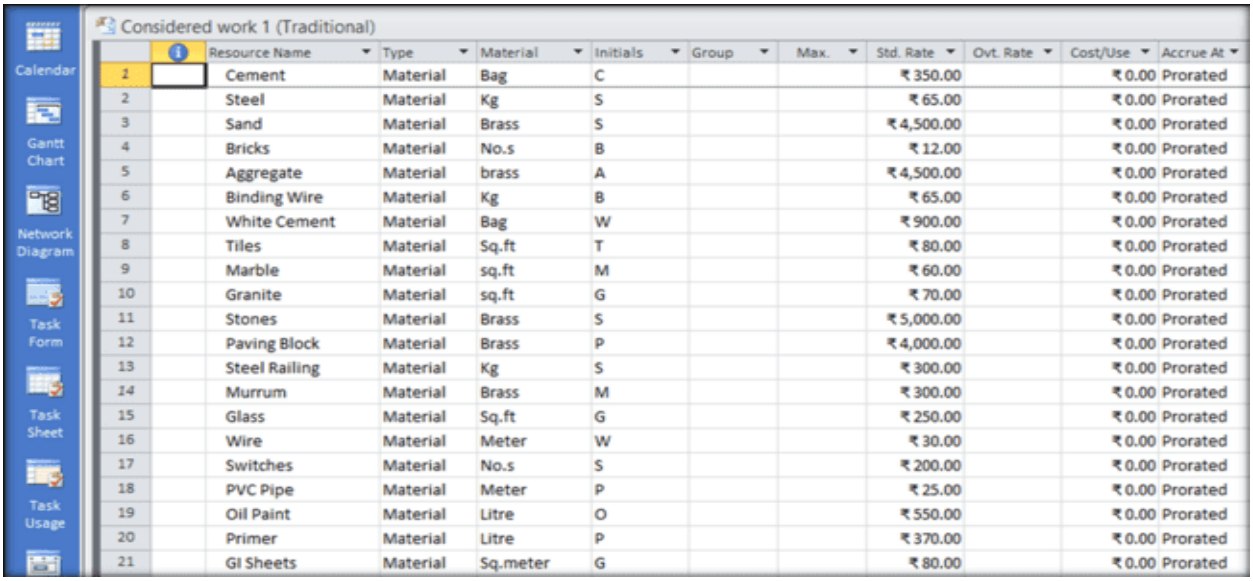


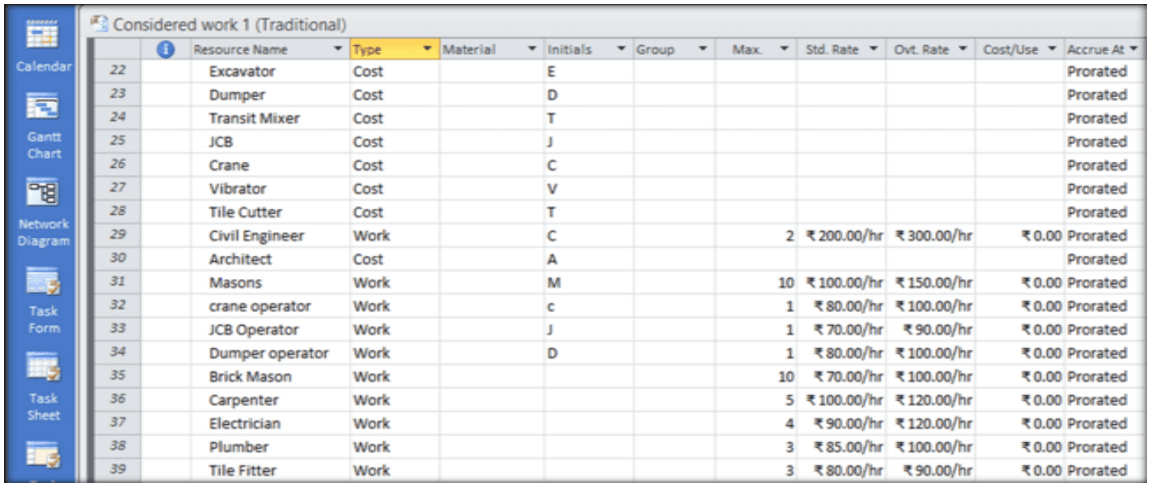
Image no. 2: MSP screen showing Activity List for considered work

In above image no.2 has shown the different activities to perform with their duration and bar chart (Gantt Chart) of traditional work. In this study the considered activities are Brickwork, Internal plaster, External plaster and Tile flooring.

After these details of activity the details of the resources are to be given to the software which is as shown below in image no. 3. The details of the resources are added in to the resources sheet of the MSP software. Typical MSP screen is shown below of the Residential Project in which the details of the resources for considered work are given to the software.



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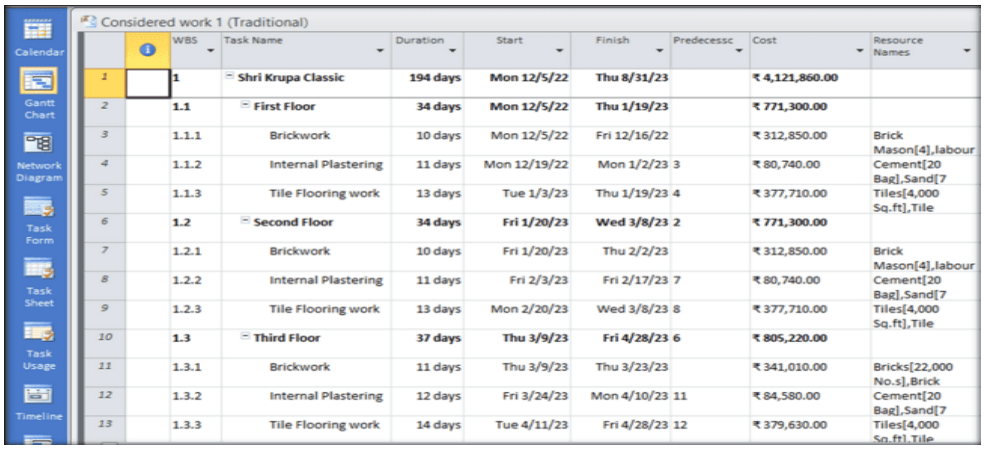
Considered work 1 (Traditional)

	Resource Name	Type	Material	Initials	Group	Max.	Std. Rate	Ovt. Rate	Cost/Use	Accrue At
22	Excavator	Cost		E						Prorated
23	Dumper	Cost		D						Prorated
24	Transit Mixer	Cost		T						Prorated
25	JCB	Cost		J						Prorated
26	Crane	Cost		C						Prorated
27	Vibrator	Cost		V						Prorated
28	Tile Cutter	Cost		T						Prorated
29	Civil Engineer	Work		C		2	₹ 200.00/hr	₹ 300.00/hr	₹ 0.00	Prorated
30	Architect	Cost		A						Prorated
31	Masons	Work		M		10	₹ 100.00/hr	₹ 150.00/hr	₹ 0.00	Prorated
32	crane operator	Work		c		1	₹ 80.00/hr	₹ 100.00/hr	₹ 0.00	Prorated
33	JCB Operator	Work		J		1	₹ 70.00/hr	₹ 90.00/hr	₹ 0.00	Prorated
34	Dumper operator	Work		D		1	₹ 80.00/hr	₹ 100.00/hr	₹ 0.00	Prorated
35	Brick Mason	Work				10	₹ 70.00/hr	₹ 100.00/hr	₹ 0.00	Prorated
36	Carpenter	Work				5	₹ 100.00/hr	₹ 120.00/hr	₹ 0.00	Prorated
37	Electrician	Work				4	₹ 90.00/hr	₹ 120.00/hr	₹ 0.00	Prorated
38	Plumber	Work				3	₹ 85.00/hr	₹ 100.00/hr	₹ 0.00	Prorated
39	Tile Fitter	Work				3	₹ 80.00/hr	₹ 90.00/hr	₹ 0.00	Prorated

Image no. 3: Typical MSP screen showing Resource Sheet

After providing the details to the software about the resources, they are assigned to the work in outcome of which software gives the perfect idea about which resource are required for the respective work and hence the cost of every work is being calculated separately.

Typical image is shown of project showing activities, resources assigned to the activities and the cost of the respective activities.



Considered work 1 (Traditional)

	WBS	Task Name	Duration	Start	Finish	Predecessc	Cost	Resource Names
1	**1**	**Shri Krupa Classic**	**194 days**	**Mon 12/5/22**	**Thu 8/31/23**		**₹ 4,121,860.00**	
2	**1.1**	**First Floor**	**34 days**	**Mon 12/5/22**	**Thu 1/19/23**		**₹ 771,300.00**	
3	1.1.1	Brickwork	10 days	Mon 12/5/22	Fri 12/16/22		₹ 312,850.00	Brick Mason[4],labour
4	1.1.2	Internal Plastering	11 days	Mon 12/19/22	Mon 1/2/23	3	₹ 80,740.00	Cement[20 Bag],Sand[7
5	1.1.3	Tile Flooring work	13 days	Tue 1/3/23	Thu 1/19/23	4	₹ 377,710.00	Tiles[4,000 Sq.ft],Tile
6	**1.2**	**Second Floor**	**34 days**	**Fri 1/20/23**	**Wed 3/8/23**	**2**	**₹ 771,300.00**	
7	1.2.1	Brickwork	10 days	Fri 1/20/23	Thu 2/2/23		₹ 312,850.00	Brick Mason[4],labour
8	1.2.2	Internal Plastering	11 days	Fri 2/3/23	Fri 2/17/23	7	₹ 80,740.00	Cement[20 Bag],Sand[7
9	1.2.3	Tile Flooring work	13 days	Mon 2/20/23	Wed 3/8/23	8	₹ 377,710.00	Tiles[4,000 Sq.ft],Tile
10	**1.3**	**Third Floor**	**37 days**	**Thu 3/9/23**	**Fri 4/28/23**	**6**	**₹ 805,220.00**	
11	1.3.1	Brickwork	11 days	Thu 3/9/23	Thu 3/23/23		₹ 341,010.00	Bricks[22,000 No.s],Brick
12	1.3.2	Internal Plastering	12 days	Fri 3/24/23	Mon 4/10/23	11	₹ 84,580.00	Cement[20 Bag],Sand[7
13	1.3.3	Tile Flooring work	14 days	Tue 4/11/23	Fri 4/28/23	12	₹ 379,630.00	Tiles[4,000 Sq.ft],Tile

Image no. 04: Typical MSP screen for resource assigned to the activities

Double tapping on the activity gives information of all the assets allotted to the work which help to get data of the Resources required for the work for next planning and scheduling.

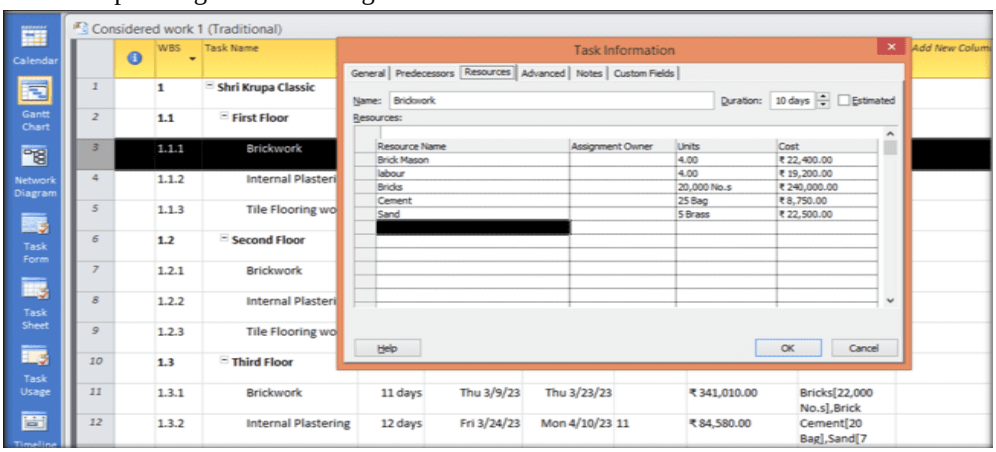


Image no.05: Task information dialogue box showing all resources assigned

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In large construction project, it is difficult to draw critical path or network diagram, but it's important for planning and scheduling activities. So, in MSP network diagram can see of any large project. In image no 9 screen showing the network diagram with critical and non-critical activities.

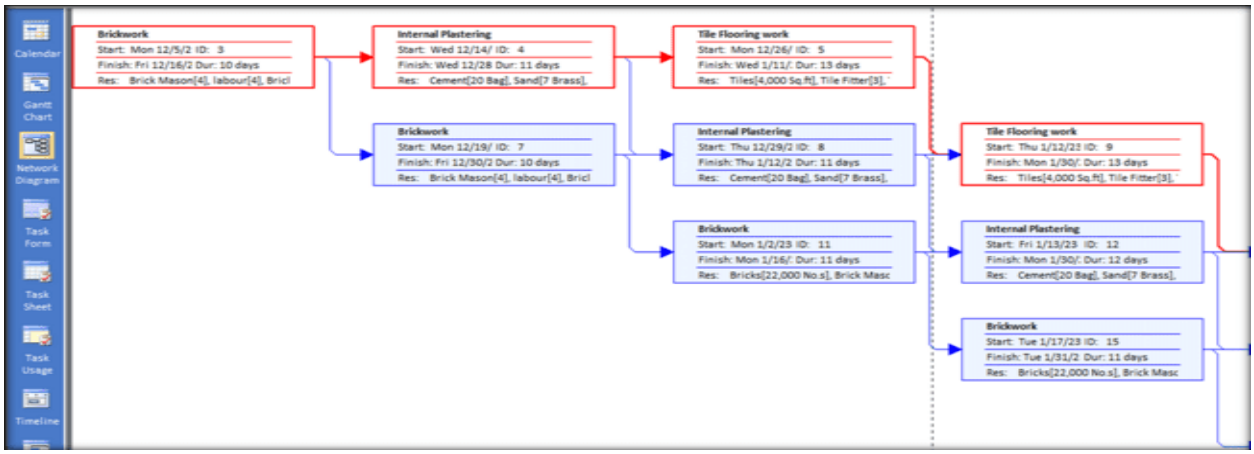


Image no.06: Network Diagram of Project with critical Path

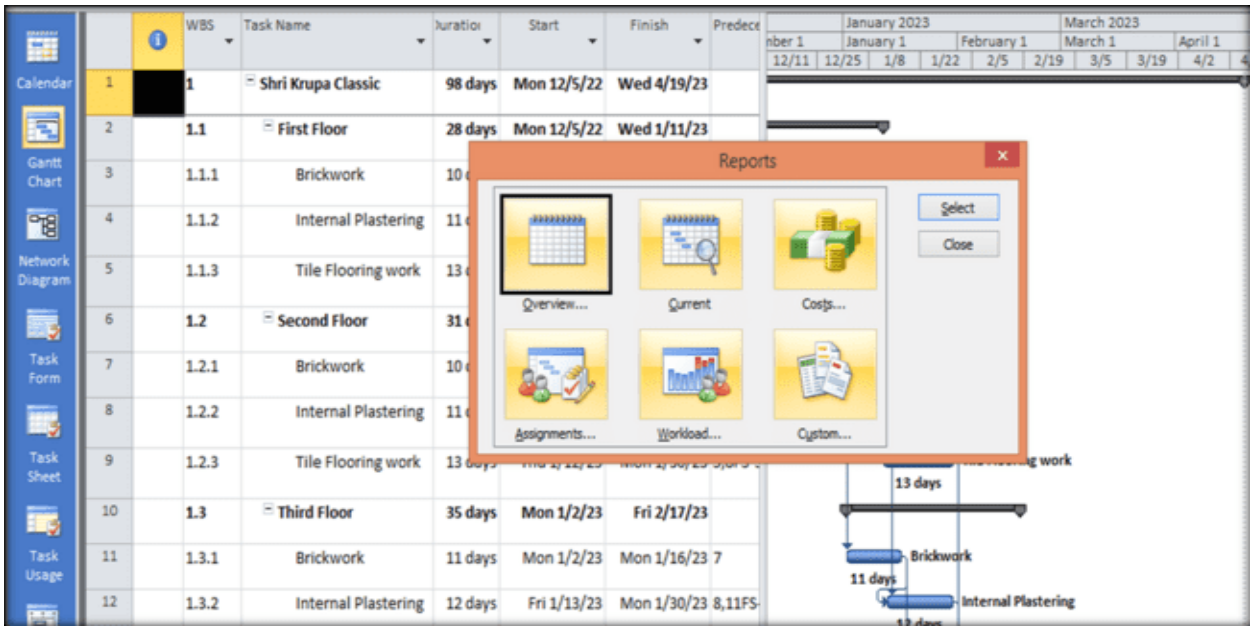


Image no.07: Various type of report by MSP

In above image no 7 showing the various report can acquire from MSP software which will help for analysis the work. There are visual (Graphical) and PDF format reports are available in MSP software.

Thusly MSP Provides a clear idea about the work to be executed and the resources required for the execution of the work. Output gives by the MSP can be utilized for proper planning, organizing and managing activities and resources to achieve target in given time and cost. Appropriate management can be done during project to avoid failure in achieving target in given specified time. MSP can deal huge and complex project and satisfy the demand of present project.

Without proper planning and scheduling activities resulted in:

1) Improper arrangement, scheduling and organizing of Resources.
2) Improper management of funds and resources.
3) Resulting in delay in supply.
4) Shortfall in quantities of resources.
5) Emergency supply condition in next month resulting in extra expenditure.

B. Data Collection

The case study focusing on optimization & material management. From this case study we collect data for some few activities with their material requirement. These activities are,

1) External Plaster
2) Internal Plaster
3) 9" Brick work
4) Tile Flooring work

Quantities of materials for 1 sq. m of Internal plasterwork

Calculations of material required for 1 sq. m of external plaster with thickness 25 mm is as follows:

Thickness=25mm C:M=1:4.

a) Cement

Consider (1x1) sq. m. of area to be plastered with thickness 25 mm. Therefore,

Volume of wet mortar=1x1x0.025=0.025 cum.

Adding 10% wastage

Therefore, Volume of wet mortar= 0.025+ (0.1x0.025) =0.0275 cum.

Now taking shrinkage =30%

Volume of dry mortar=0.0275+ (0.30x0.275) =0.035 cum.

Cement= (0.035/ (1+4))/0.0347=0.2 bags

Cement= 0.2x50=10 kg

Therefore, cement required for 1 m^2 of external plaster=10 kg

b) Sand

Volume of sand required for 1 m^2 of external plaster = (volume of dry mortar/ (1+4)) x 4= (0.035/ (1+4)) x4=0.028 cum.

Hence, requirements of cement and sand for 1 sq. m of external plaster are:

Cement required per sq. m= 10kg/sq. m. Sand required per sq. m= 0.028cum./ sq. m.

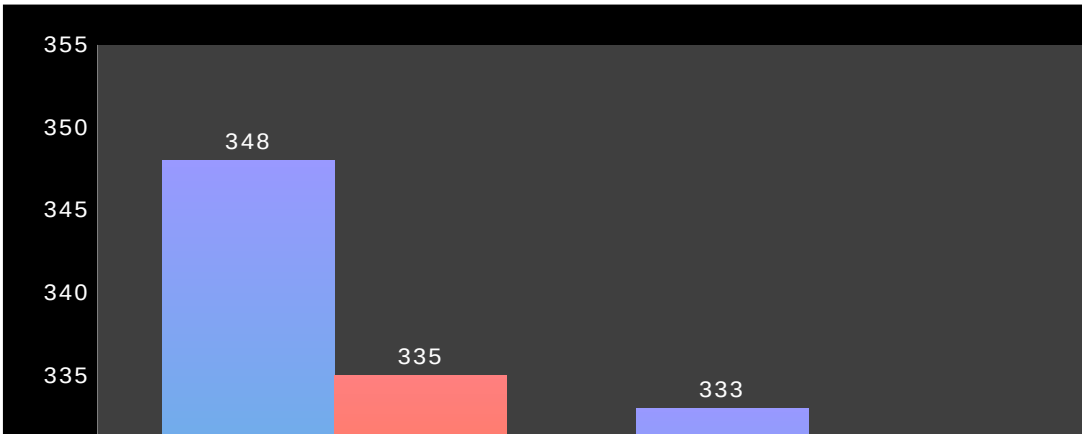


Figure no 01: Planned and Executed quantities of internal plastering work

Table no.1: Week wise Requirement of Cement for Executed Quantities of Internal Plastering Work:-

week	Executed Quantities (sq.m)	Cement Consumed (Bags)	Cement Calculated (Bags)	Difference (Bags)	Rate of Cement Rs.	Extra Cost Rs.
1	335	70.5	67	3.5	320	1120
2	326	68.5	65.1	3.4	320	1088
3	320	68.5	64	4.5	320	1440
Total				11.4		3648

Table no.2:- Week wise Requirement of Sand for Executed Quantities of Internal Plastering Work:

week	Executed Quantities (sq.m)	sand Consumed (Cu.m)	Sand Calculated (Cu.m)	Difference (Cu.m)	Rate of Sand Rs.	Extra Cost Rs.
1	335	9.89	9.38	0.51	3500	1750
2	326	9.69	9.13	0.56	3500	1960
3	320	9.36	8.96	0.40	3500	1400
Total				1.47		5110

(Likewise finding out the extra cost required for External plaster, Brickwork, flooring)

Summary of cost of extra material incurred for different works.

WORK	COST OF EXTRA MATERIAL INCURRED (Rs.)
External plaster	11950/-
Internal plaster	8758/-
brickwork	21620/-
Flooring	21803/-
TOTAL	64,131/-

Actual quantity executed in the period of 3weeks for considered item of works.
Delays in item of works

Sr. No	Item works	Unit	Planned quantity	Actual quantity	Difference	Reasons for delay
1	External plaster	Sq. m	700	685	15	1. Less procurement of materials 2. Poorly done planning and scheduling 3. Less man power available 4. Delay in getting drawings. 5. Improper coordination between different departments 6. Adverse weather conditions. 7. Disputes between client and contractor 8. Quarrel between labors.
2	Internal plaster	Sq. m	995	974	21	
3	9” burnt brickwork	Cu.m	207	197	10	
4	Flooring	Sq. m	434	401	33	

VII. CONCLUSION

In this study, the reasons of failure of actual material management are studied. It is seen that most of the construction projects fails due to improper planning of material management also extents due to improper knowledge of inventory management. Construction project delays and increase the cost of construction due to improper project planning and scheduling.

Due to lack of planning in material delivery program most of material remains waste from case study. Sometimes faulty ordering of material does not fit in terms of quality, type and dimensions for the actual works at site. These types of difficulties are coming at the last when material wastage occur. For that MSP software useful for proper planning and scheduling of different activities.

In this work we consider four different activity for 3 week data collection like Brickwork, Internal plastering, External Plastering and Tile flooring work. By using MSP software project can planned and scheduled such that time and cost will minimize for that particular activity/project. Proper scheduling of activities helps to working simultaneously and minimizes wastage. Supplier selection also plays important role, for an effective material management.

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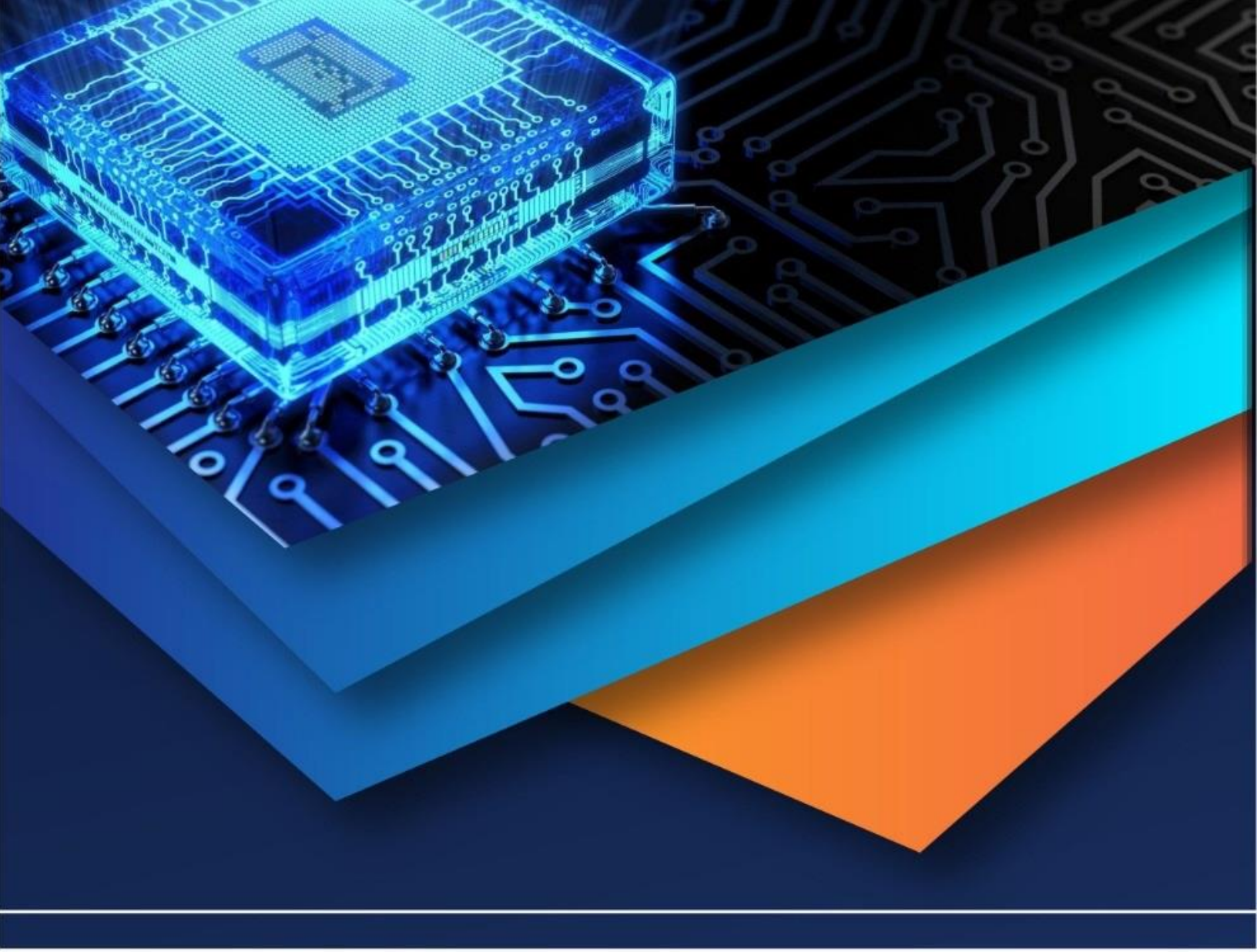
VIII. RECOMMONDATION

1) There should be a centralised material management team co-ordination between the site and the organization.
2) Proper control, tracking and monitoring of the system is required.
3) Awareness and accountability should be created within the organization.
4) On observing that the in-order time required for transfer of material from one place to another place is more so we can suggest to use inside material stock to reduce the time.
5) MSP software utilize for planning and scheduling the activities so the efficiency of project will increase. It will also give cost and resources required for particular activity well in advance, which help in execution of project.

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