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Construction Management @Multi-Storeyed Building by MS-Project - A Case Study

Manish S Darekar[1], Dr. Navnath V Khadake[2]
[1]*Imperial College of Engineering, Wagholi, Pune, Maharashtra*
[2]*Ph.D. (Civil), M.B.A.(Proj. Mgmt), FIE,FIV, FICA, MISH, C' Engr, Head civil Engg Deptt, Imperial college of Engineering and Research, Wagholi.*

Abstract: ***In every construction project, there are two most important factors to be considered in the planning of project i.e. time and cost. Time deals with speed, quality of work and availability of tools and materials whereas cost deals with optimization and availability of resource. The aim of this project is to complete the project within a given time and a budget, and also to achieve the other objectives. The constraints that are observed in every project is time overrun and cost overrun. As we can say it's a most difficult task for a project manager to practice it, which includes fixed measuring progress, executions as per plan and corrective actions should be taken whenever required. Due to proper planning and scheduling, it gives us a knowledge of proper time and the process of cost mostly remains the same. Basically, cost optimization and allocation of resource directly deals with availability of tools and materials. With a proper sequence of activities with assigned durations and resource, scheduled is prepared. In this project critical path and critical activities are studied with the use of MS-Project 2016, so that activities should be properly observed while execution, so that there will be no delay of time in the project, and also, stay focused on the wastage of materials thus lead to the proper optimization of materials and reduction of cost.***
Keywords: MS-Project, planning, Scheduling, Allocation of resource

I. INTORDUCTION

When introduced Critical path method was a great improvement in the field of project planning and management James E Kelley.Jr.and Morgan R. Walker officially introduced the CPM to the world by an article titled "Critical path planning and scheduling" published in March 1959. In Project Management, schedule is a listing of project's milestones and activities, usually deals with intended start date and finish dates. It involves keeping an eye and watching project work progress with respect to planned time, resources and scheduled performance during execution of the works and thus determining the activities which are require timely identification and correct action to fix it. Those items are oftenly estimated or calculated by other information included in the project schedule of resource allocation, budget, task duration, and linkages of activities depend on each other and scheduled events. With the help of "Project Monitoring" methods its easy for collecting, recording and reporting all the information regarding the project status and performance, which are needed by the concerned project managers and other personalities who wish to know about the status of project. A schedule is most commonly used in the project planning and project management. Elements on a schedule may be closely related to the work breakdown structure (WBS), the Statement of work, or a Contract Data Requirements List given by.

A. Planning and Scheduling of a Project

Project planning is a most common and general term in construction management which helps to carry on time expected task and activities. Planning is a key to bring expected projects into an existence. Generally, the project planning involves the breakdown of a project into a various identifiable, definable and quantifiable task or activities or work and then constitutes the logical interdependencies between them. Basically, planning process refers to three important and dominant questions:

1) Who does it?
2) What is to be done?
3) How to carry it?

Scheduling of a project deals with the final project duration and project delivery dates. Typically, it also shows and verifies the sequential order or phasing various project activities in a systematic way to complete the project. The schedule is simple a tool or technique of a project management team which is used to predict the most probable project completion time and also enable resource conception and outflow which are required on the particular work. And thus, allocation of a resource shows who are responsible for completing who are responsible for completing each activity.

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The reason for this is that a schedule itself is an estimate: each date present in the schedule is estimated, and if those dates do not have the buy-in of the people who are going to do the work, schedule will be inaccurate. In order to develop a project schedule, the following needs to be completed:

a) Scope of project
b) Sequence of activities
c) Work breakdown
d) Task dependencies map
e) Critical path analysis
f) Project milestones

B. Benefits of a well-planned Schedule

A properly executed construction schedule can help to manage materials, labours and equipments. It also allows for an adjustments to accommodate the unexpected events in the projects. This allows construction management team to complete projects on-time and on-budget.

II. OBJECTIVES

A. To propose and the importance and the need of planning, scheduling in construction project works. To showcase an ideal schedule for (G+18) Residential apartment building.
B. WBS of a project.
C. To calculate the proper duration required for the construction of a whole structure.
D. To advice and suggest the procedures to contractors for scheduling of project.
E. To showcase the feature project tracking, gnatt chart and the uses of MS-project in the construction industry.
F. To show the critical path in the case study observe in the MSP.

III. LITERATURE REVIEW

The scheduling of activities is the major requirement in project management activity. Activity scheduling is probably single most important tool for determining how project's resources should be separated. The schedule serves as a master plan from which both customer and management have an up-to-date picture of operation. Certain guidelines to be followed while preparing schedule are:

A. All major events and dates must be clearly defined and noted, if for an any reason the customer's milestone dates cannot be met, the customer should be notified immediately with proper delay statement.
B. The exact sequence of work should be defined clearly through a network in which an interrelationship between events can be identified.
C. Schedules should be directly relatable to the Work Breakdown Structure (WBS). If the WBS is developed according to a given or specific sequence of work, then it becomes an easy task to identify work in working sequences in schedules using the same numbering system as in the given WBS. The minimum requirement should be to show when all tasks start and finish.
D. All the schedules must identify the time and cost constraints, if possible, then should identify those resources required for each event to perform the execution.
E. As the lead and lag plays a vital role in the project management.
F. Follow up of the critical path is very important as it carries a major activity.
G. Proper allocation of resource leads to cost optimization in the project.

IV. METHODOLOGY

Methodology of the topic includes following 3 main factors on which utiliisation of time and optimization of cost and is dependent on it:

1) Planning
2) Schedulinng
3) Allocation of resource

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Critical path method is most widely used in planning and controlling of the construction project. At first essential data are collected for construction problem through a source. CPM is used to find out the critical path and critical activities. The critical activities are shortened to reduce the duration in order to get their lowest cost slopes. The important objective to use of critical path method is to determine how best reduce time required to perform repetitive and that are needed to support an organisation. The project is crashed up to minimum cost on the point of total cost.

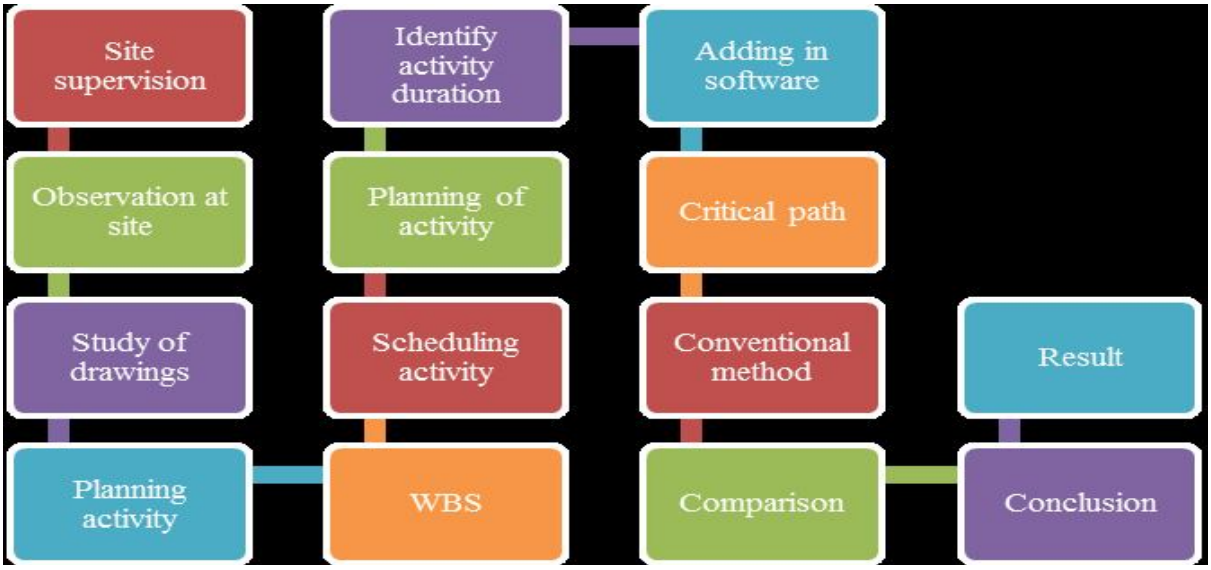


Fig -1 (flow chart for a planning)

The methodology of this paper is represented in Fig – 1.
Use of software MS-project 2016

A. Planning of a Multistoryed Building Includes

1) Project plan to key stakeholders and discuss its key components.
2) Define roles and responsibilities
3) Hold a kickoff meeting.
4) Develop a Scope Statement.
5) Develop scope baseline.
6) Develop the schedule and cost baselines.
7) Develop the staffing plan
8) Analyze project quality and risks**.**
9) Communicate

Construction planning involves identifying all the required steps to build a structure, splitting them into defined activities, ordering these steps logically, and determining the necessary materials, manpower, and equipment.

B. Scheduling of a Multistoryed Building Incudes

1) Splitting of the project into work activities.
2) Determining logic relationships/interrelationships between activities.
3) Construction of Network Diagrams.
4) Assigning durations to work activities.
5) CPM Calculations resulting in start times, finish times and float calculations of activities.
6) Marking of critical Path.
7) Construction of Bar Charts.

Scheduling in construction projects is the process of listing of tasks, activities, milestones with a planned start and finish date. The importance of scheduling in construction projects cannot be neglected since it plays a crucial role in a project's success.

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C. Resource Allocation

1) Resource scheduling
2) Resource smoothening
3) Resource levelling

Steps

a) Divide the Project into Tasks.
b) Assign the Resources.
c) Determine resource attributes.
d) Resource Leveling.
e) Re-allocate as necessary.

All to display properly in MSP 2016

V. THEORETICAL CONTENT

A. Collection of Data

A detailed analysis of the materials, man power, machinery, other resources used, and the sequence of activities (dependent or independent) executed from the beginning of the construction to its completion.

The methodology adopted to attain the project objective is as below:

1) Inception of ideas.
2) Literature study, for this the following sources are explore
a) Review of past study.
b) Study of published books, technical and research papers, reports, etc.
3) Site visit.
4) Collection of raw data from visiting various sites.
5) Studied the data. On the basis of it, prepared the plan and scheduled manually.
6) Learnt the project management software- MSP and Primavera.
7) Prepared the plan and scheduled by using various modules of software.
8) Finally, understood the ease, sufficiency & flexibility that the project management software offer us.

B. The Techniques Includes in Scheduling

1) CPM
2) BAR chart
3) Networking scheduling techniques.
4) WBS

C. Advantages

When comparing bar charts with networks, three advantages over bar charts(Mubarak, 2003):

1) Network show logic, the relationships among the activities. Bar charts do not
2) Networks can better represent large and complicated projects.
3) Networks can estimate, or predict, the completion date of the project, or other dates, on the basis of mathematical calculations of the CPM.

The essential technique for using CPM is to construct a model of the project that includes the following:

a) A list of all activities required to complete the project (typically categorized within a work breakdown structure),
b) The time (duration) that each activity will take to complete,
c) The dependencies between the activities and,
d) Logical end points such as milestones or deliverable items.

The bar chart was originally developed by Henry L. Gantt in 1917 and is called a Gantt chart. A bar chart is —a graphic representation of project activities which are shown in a time-scaled bar line with no links shown between activities (Popescu and Charoenngam, 1995). It quickly became popular in construction industry because of its ability to graphically represent a project‘s activities on a time scale. A bar chart has become a vehicle for representing many pieces of a project‘s information. A project must be broken into smaller, usually homogeneous components, each of which is called an activity or task. Bar charts basically use the x-axis to depict time, and the y-axis is used to represent individual activities

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D. Advantage Of Bar Chart Can Be Concluded As

1) Bar charts are time scaled, the length of the activity bar represents the time duration of the activity). Both the node, in the node networks, and the arrow, in the arrow networks, are not time-scaled.
2) Bar chart are simple to prepare
3) Bar chart are easy to understand
4) Bar chart are acceptable for presentation, especially for field people and people who are unfamiliar with the CPM
5) Bar charts can be loaded with more information, such as cash-flow diagrams and man-hours.

VI. CASE STUDY

A. Information about Project Site

1) *Name of Site:* FORESTA-OYESTER
2) *Location:* Opp.-Sailee Avenue, Kashimira, Mira-road (E),Thane -401107
3) *Type of Project:* High rise Residential Building.
4) *Project Manager:* Mr. Ramesh Sawant
5) *Site Engineer:* Mr. Ashish Yadav ,Mr. Manish Darekar
6) Name of Contractor/Builder- PMC
7) *Landscape consultant:* ATIT MISTRY
8) *Plumbing Consultant:* NEXUS project solutions Pvt.ltd
9) *Structural Consultant:* NEXUS project solutions Pvt.ltd
10) *Electrical Consultant:* MEP
11) *Project Architect:* AtitMistry
12) *Engineer stream:* Labour contract, Consultancy and Builder.
13) *RMC Supplier:* ACC-Shristikrupa, Ghodbunder.
14) *Project start Date:* 7-sept-2017
15) *Software:* MS-Project 22016

B. Area Statement

1) *Slab Area:* 2,457sq.ft.
2) Saleable area Unit: 5,808 sq.ft.

Resource sheet in MSP- All required resources inserted in resource sheet in Microsoft project software and its per unit cost also mentioned and it gives amount of each resources

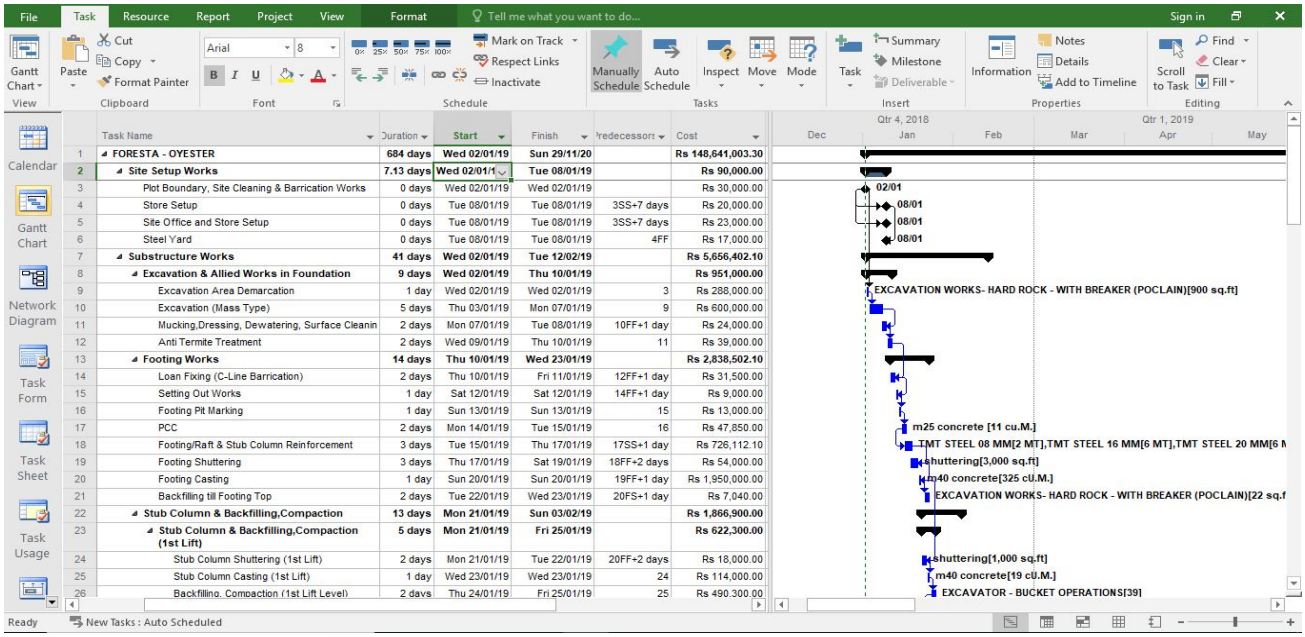


Fig No.2

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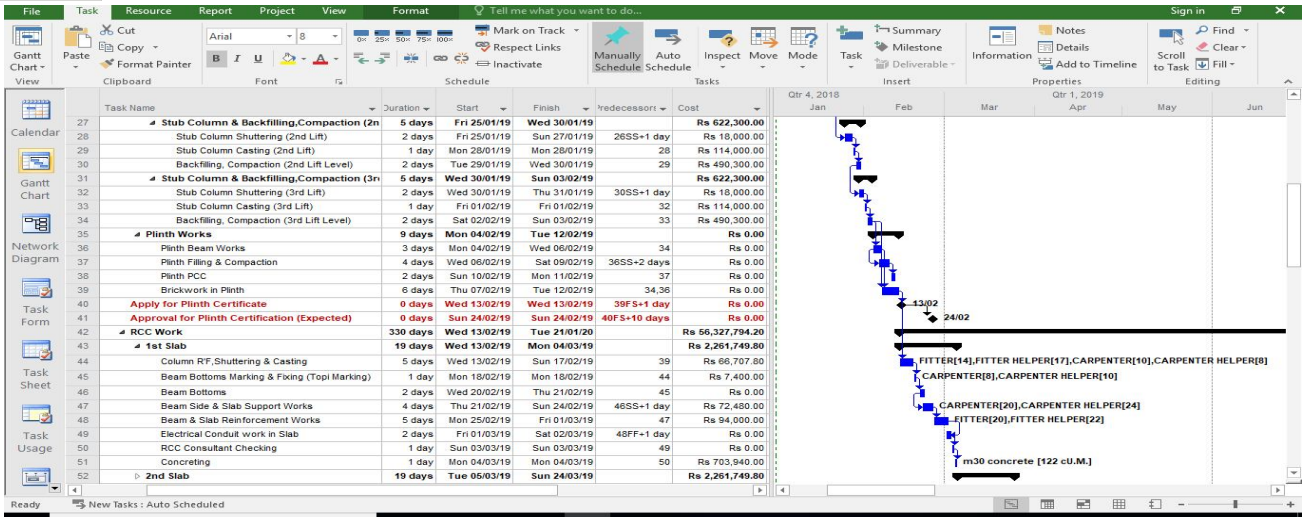


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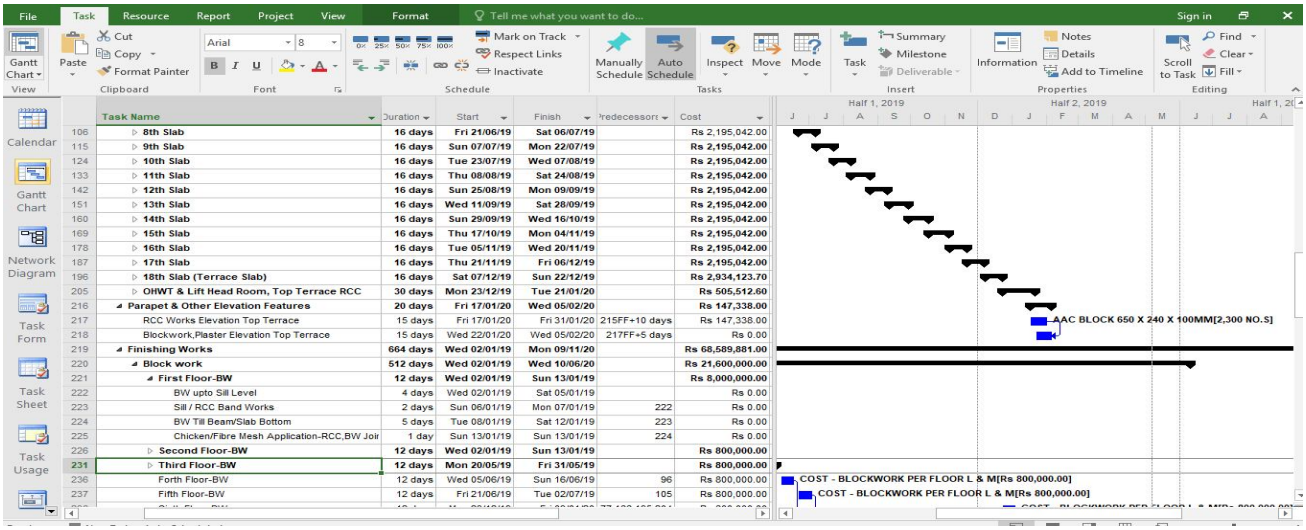


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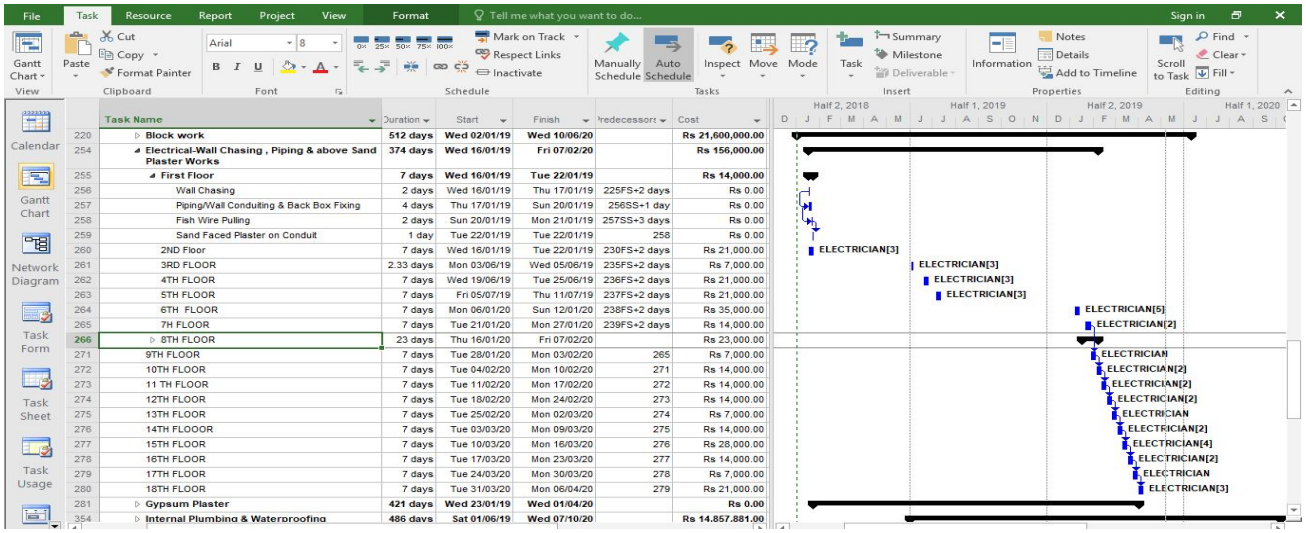


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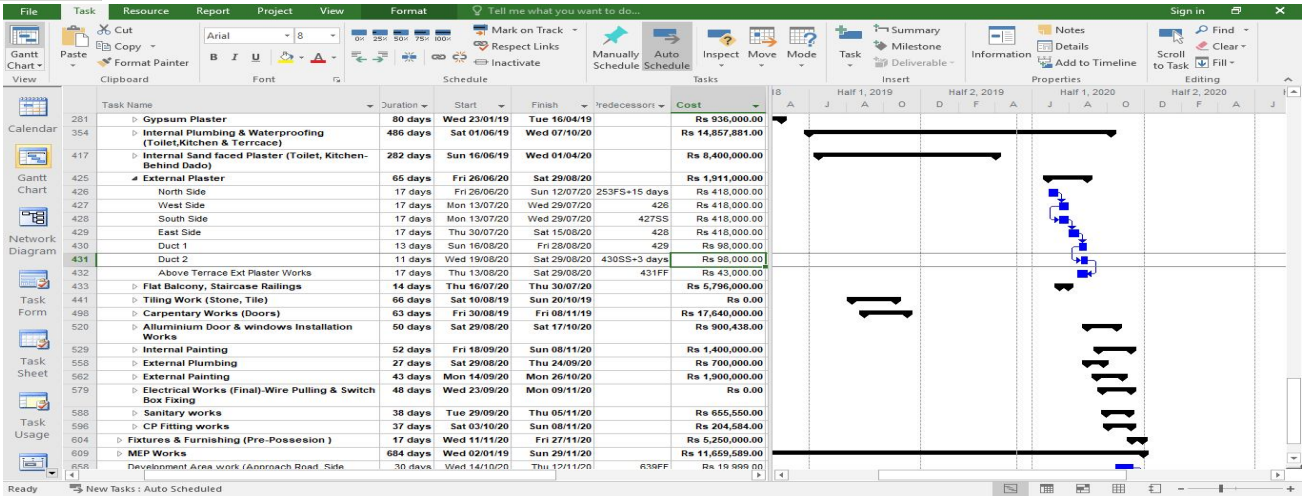


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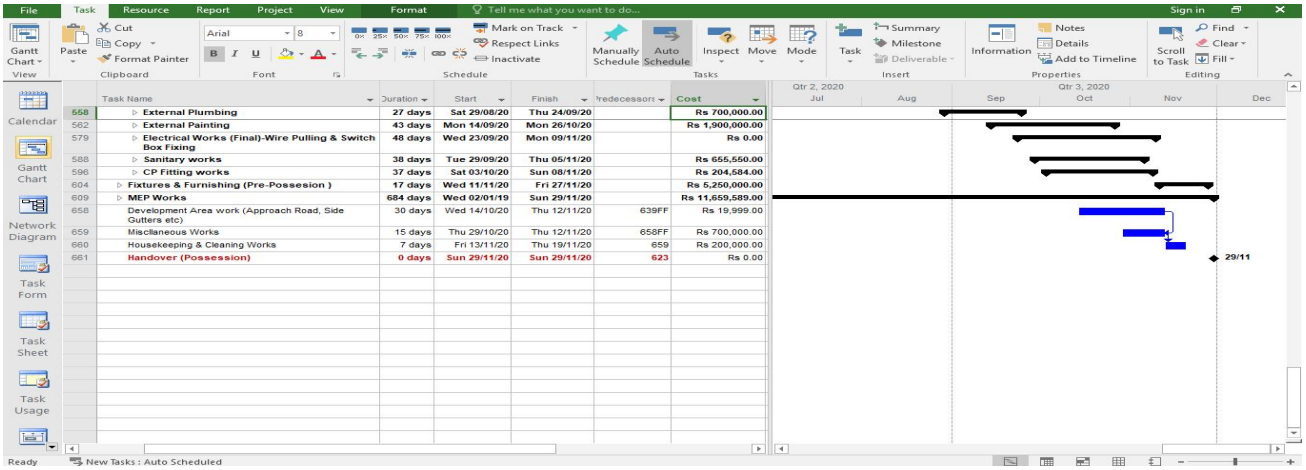


Fig No.7

All the above figures are from MS Project-2016 which gives an result for total duration and total cost of a project.
Rates have been updated from DSR 2015-16 of Thane.
Labour requisition from IS7272

C. Resourcesheet

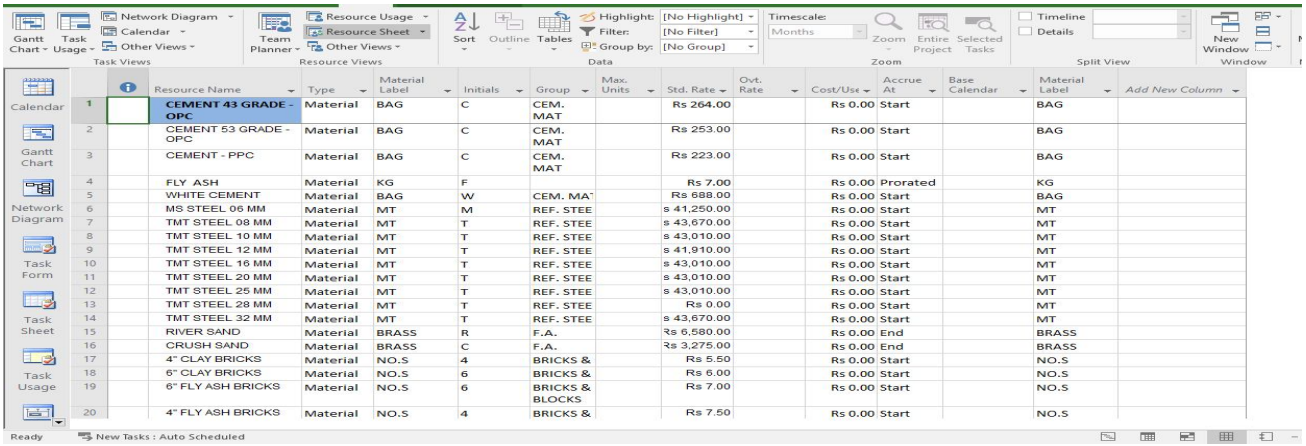
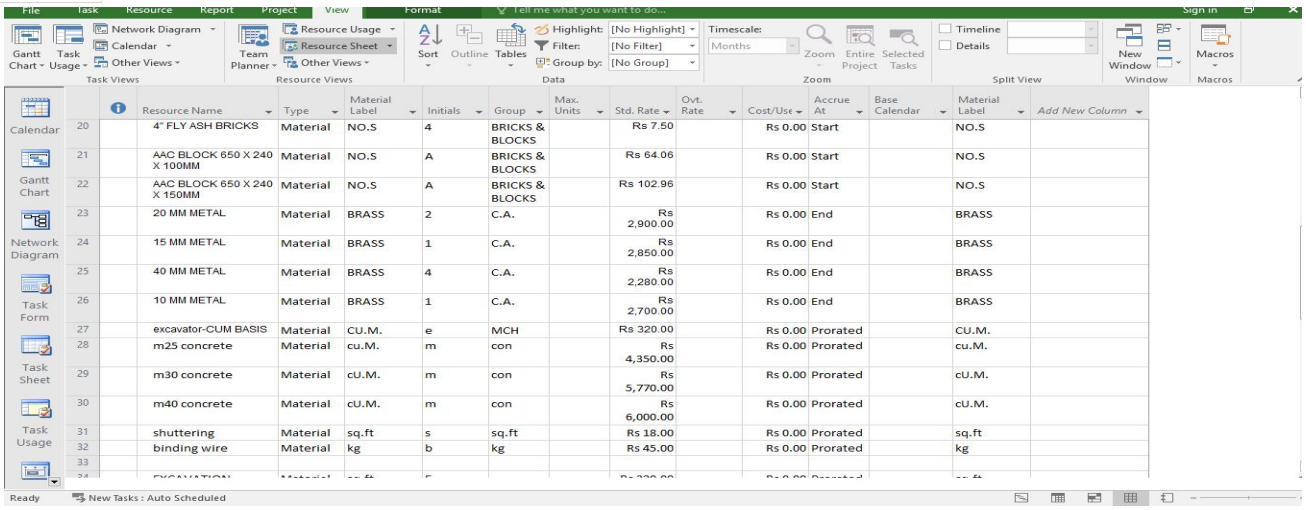


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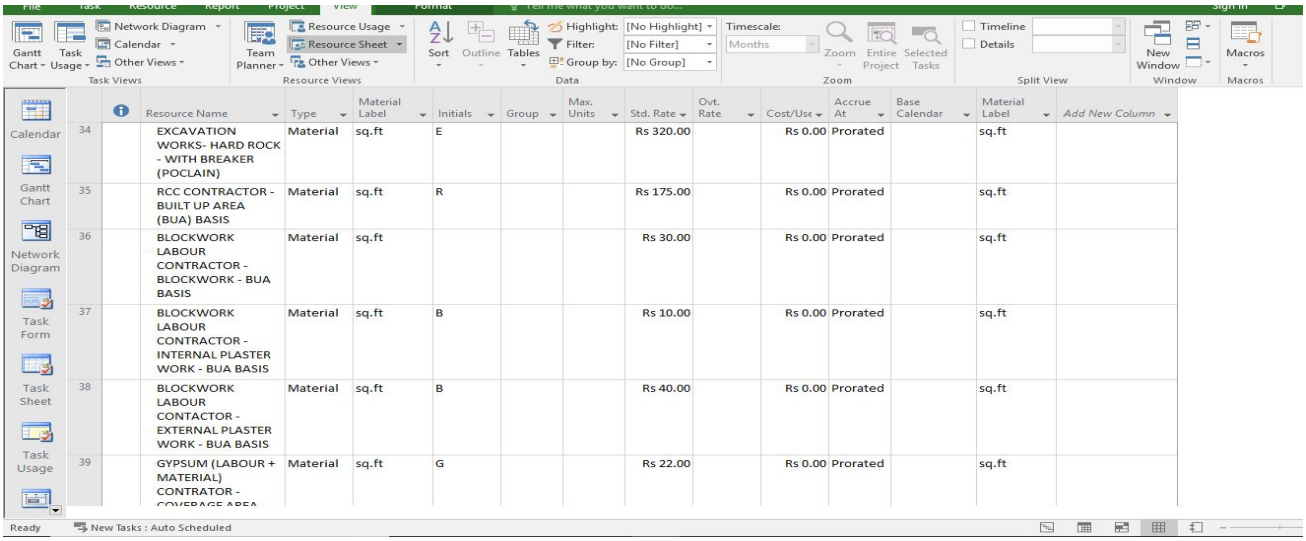
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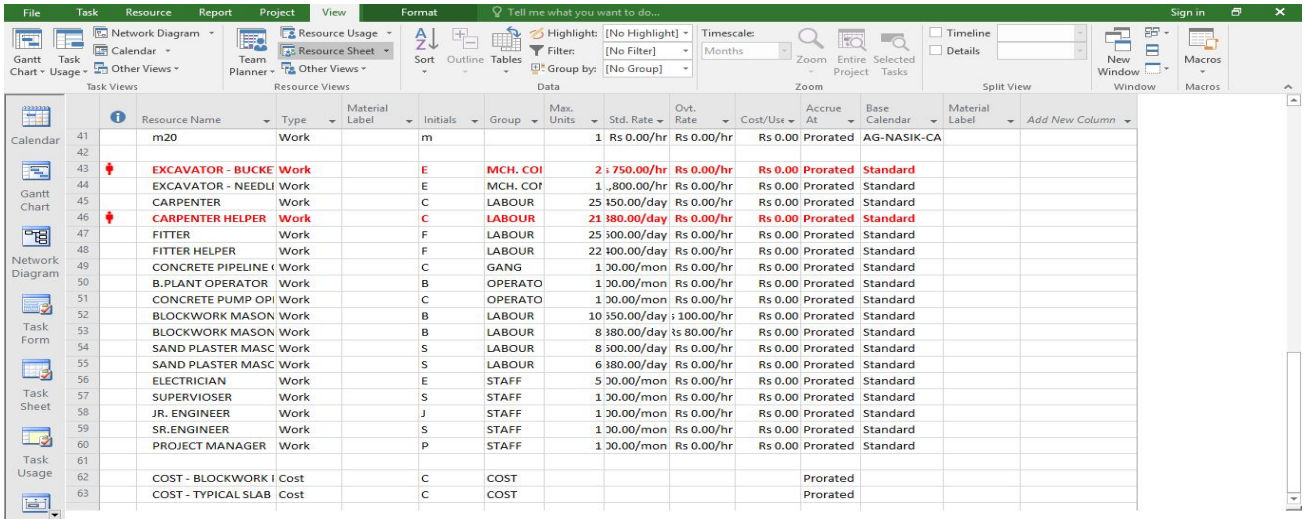
	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Material Label
20	4" FLY ASH BRICKS	Material	NO.S	4	BRICKS & BLOCKS		Rs 7.50		Rs 0.00	Start		NO.S
21	AAC BLOCK 650 X 240 X 100MM	Material	NO.S	A	BRICKS & BLOCKS		Rs 64.06		Rs 0.00	Start		NO.S
22	AAC BLOCK 650 X 240 X 150MM	Material	NO.S	A	BRICKS & BLOCKS		Rs 102.96		Rs 0.00	Start		NO.S
23	20 MM METAL	Material	BRASS	2	C.A.		Rs 2,900.00		Rs 0.00	End		BRASS
24	15 MM METAL	Material	BRASS	1	C.A.		Rs 2,850.00		Rs 0.00	End		BRASS
25	40 MM METAL	Material	BRASS	4	C.A.		Rs 2,280.00		Rs 0.00	End		BRASS
26	10 MM METAL	Material	BRASS	1	C.A.		Rs 2,700.00		Rs 0.00	End		BRASS
27	excavator-CUM BASIS	Material	CU.M.	e	MCH		Rs 320.00		Rs 0.00	Prorated		CU.M.
28	m25 concrete	Material	cu.M.	m	con		Rs 4,350.00		Rs 0.00	Prorated		cu.M.
29	m30 concrete	Material	cU.M.	m	con		Rs 5,770.00		Rs 0.00	Prorated		cU.M.
30	m40 concrete	Material	cU.M.	m	con		Rs 6,000.00		Rs 0.00	Prorated		cU.M.
31	shuttering	Material	sq.ft	s	sq.ft		Rs 18.00		Rs 0.00	Prorated		sq.ft
32	binding wire	Material	kg	b	kg		Rs 45.00		Rs 0.00	Prorated		kg

Fig No.8



	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Material Label
34	EXCAVATION WORKS- HARD ROCK - WITH BREAKER (POCLAIN)	Material	sq.ft	E			Rs 320.00		Rs 0.00	Prorated		sq.ft
35	RCC CONTRACTOR - BUILT UP AREA (BUA) BASIS	Material	sq.ft	R			Rs 175.00		Rs 0.00	Prorated		sq.ft
36	BLOCKWORK LABOUR CONTRACTOR - BLOCKWORK - BUA BASIS	Material	sq.ft				Rs 30.00		Rs 0.00	Prorated		sq.ft
37	BLOCKWORK LABOUR CONTRACTOR - INTERNAL PLASTER WORK - BUA BASIS	Material	sq.ft	B			Rs 10.00		Rs 0.00	Prorated		sq.ft
38	BLOCKWORK LABOUR CONTACTOR - EXTERNAL PLASTER WORK - BUA BASIS	Material	sq.ft	B			Rs 40.00		Rs 0.00	Prorated		sq.ft
39	GYPSUM (LABOUR + MATERIAL) CONTRATOR -	Material	sq.ft	G			Rs 22.00		Rs 0.00	Prorated		sq.ft

Fig No.9



	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Material Label
41	m20	Work		m		1	Rs 0.00/hr	Rs 0.00/hr	Rs 0.00	Prorated	AG-NASIK-CA	
42												
43	EXCAVATOR - BUCKE	Work		E	MCH. COI	2	; 750.00/hr	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
44	EXCAVATOR - NEEDLI	Work		E	MCH. COI	1	,800.00/hr	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
45	CARPENTER	Work		C	LABOUR	25	150.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
46	CARPENTER HELPER	Work		C	LABOUR	21	180.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
47	FITTER	Work		F	LABOUR	25	500.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
48	FITTER HELPER	Work		F	LABOUR	22	100.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
49	CONCRETE PIPELINE (	Work		C	GANG	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
50	B.PLANT OPERATOR	Work		B	OPERATO	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
51	CONCRETE PUMP OPI	Work		C	OPERATO	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
52	BLOCKWORK MASON	Work		B	LABOUR	10	550.00/day	; 100.00/hr	Rs 0.00	Prorated	Standard	
53	BLOCKWORK MASON	Work		B	LABOUR	8	380.00/day	ks 80.00/hr	Rs 0.00	Prorated	Standard	
54	SAND PLASTER MASC	Work		S	LABOUR	8	500.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
55	SAND PLASTER MASC	Work		S	LABOUR	6	380.00/day	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
56	ELECTRICIAN	Work		E	STAFF	5	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
57	SUPERVIOSER	Work		S	STAFF	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
58	JR. ENGINEER	Work		J	STAFF	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
59	SR.ENGINEER	Work		S	STAFF	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
60	PROJECT MANAGER	Work		P	STAFF	1	00.00/mon	Rs 0.00/hr	Rs 0.00	Prorated	Standard	
61												
62	COST - BLOCKWORK I	Cost		C	COST					Prorated		
63	COST - TYPICAL SLAB	Cost		C	COST					Prorated		

Fig No.10

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VII. CONCLUSION

After studying the results of case study, a CCPM approach was seen to be the most suitable approach than the existing CPM approach since it eliminates few drawbacks of CPM methods as stated above.
Planning of whole project have been divided properly by WBS. The overall activity included in MSP are **681** activities.
Planning has been done with the help of MS-Project 2016.

A. Time Optimization

The time calculated for the construction of Foresta-Oyester with the help of MS-Project 2016 is **684 days** i.e. approximately 22months and 18 days. The given period of time by Real Estate Regulatory Authority was 780 days i.e. 25 months 12days. Time period given by Client is 720 days

B. Result

The time period consume in percentage is 83% , that means project have been completed earlier 17% of the given time (140 days).
Start time of a project – 02-01-2019
Expected finish time of a project – 29-11-2020
Scheduling gives an proper approach for time consumption. That's the importance of scheduling in a construction industry Now-a-days.

1) A-B-C Analysis of a Material

S.No	Items	Annual Demand	Annual Percentage	Unite Price	Annual Cost	Annual Usage Percentage	Annual Usage Cumulative Percentage
1	Cement	67416	3.4932	535	36067560	19.2803	19.2803
2	Steel 25mm	471	0.0244	72150	33982650	18.1658	37.4462
3	Steel 16mm	350	0.0181	72150	25252500	13.4990	50.9452
4	Steel 10mm	220	0.0114	72150	15873000	8.4851	59.4303
5	Batching plant 2 size(0.5meter	45	0.0023	307000	13815000	7.3850	66.8153
6	Shingle	1089759	56.4663	11.25	12259788.8	6.5536	73.3689
7	Steel 20mm	156	0.0081	72150	11255400	6.0167	79.3856
8	Crush 10--20mm	243364	12.6100	45	10951380	5.8542	85.2398
9	Sand	221095	11.4561	21	4642995	2.4820	87.7218
10	Aggregate	100000	5.1815	34	3400000	1.8175	89.5393
11	Excavator 3	46800	2.4250	72	3369600	1.8013	91.3405
12	Wooden Batten	5000	0.2591	400	2000000	1.0691	92.4096
13	Heavy Loader	12	0.0006	150000	1800000	0.9622	93.3719
14	Concrete Pump 2	24960	1.2933	72	1797120	0.9607	94.3325
15	Mixture 4	24960	1.2933	72	1797120	0.9607	95.2932
16	Plié—Sheet	850	0.0440	1950	1657500	0.8860	96.1792
17	Crush 20--25mm	35909	1.8606	42	1508178	0.8062	96.9855
18	Roller 2—4	12	0.0006	80000	960000	0.5132	97.4986

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2) Cost of the Project

Total cost of project of Foresta-oyester: Rs 157,248,575.3

Per sq.ft cost: Rs 2600

Saleable per sq.ft cost is Rs 6800

Method uses for cost optimization is we deal everywork of the field with a contractor on sq.ft basis result we don't deal with a overtime cost of a labour thus practicing such works reduce the cost constraints and gives the flexibility to the mind for proper management.

	Resource Name	Type	Material Label	Initials	Group	Max. Units	Std. Rate	Ovt. Rate	Cost/Use	Accrue At	Base Calendar	Material Label
34	EXCAVATION WORKS- HARD ROCK - WITH BREAKER (POCLAIN)	Material	sq.ft	E			Rs 320.00		Rs 0.00	Prorated		sq.ft
35	RCC CONTRACTOR - BUILT UP AREA (BUA) BASIS	Material	sq.ft	R			Rs 175.00		Rs 0.00	Prorated		sq.ft
36	BLOCKWORK LABOUR CONTRACTOR - BLOCKWORK - BUA BASIS	Material	sq.ft				Rs 30.00		Rs 0.00	Prorated		sq.ft
37	BLOCKWORK LABOUR CONTRACTOR - INTERNAL PLASTER WORK - BUA BASIS	Material	sq.ft	B			Rs 10.00		Rs 0.00	Prorated		sq.ft
38	BLOCKWORK LABOUR CONTACTOR - EXTERNAL PLASTER WORK - BUA BASIS	Material	sq.ft	B			Rs 40.00		Rs 0.00	Prorated		sq.ft
39	GYPSUM (LABOUR + MATERIAL) CONTRATOR - COVERAGE AREA BASIS-WALL	Material	sq.ft	G			Rs 22.00		Rs 0.00	Prorated		sq.ft
40	GYPSUM (LABOUR + MATERIAL) CONTRATOR - COVERAGE AREA BASIS-CEILING	Material	sq.ft	G			Rs 10.00		Rs 0.00	Prorated		sq.ft

Fig no.7 labour contractor rates

C. WBS of the Project

Foresta-Oyester

1) SITE SET-UP WORK

2) SUBSTRUCTURE WORK

a) EXCAVATION & ALLIED WORK IN FOUNDATION

b) FOOTING WORKS

c) STUB COLUMN & BACKFILLING COMPACTION

d) PLINTH WORKS

3) APPLY FOR PLINTH CERTIFICATE

4) APPROVAL OF PLINTH CERTIFICATE

5) RCC WORK

a) 1^{ST} SLAB

- COLUMN AND RF SHUTTERING AND CASTING
- BEAM BOTTOM MARKING & FIXING (TOPI MARKING)
- BEAM BOTTOM
- BEAM & SLAB REINFORCEMENT
- ELECTRIC CONDUIT WORK IN SLAB
- ARCHITECT AND RCC CONSULTANT CHECKING
- CONCRETING

b) UPTO 18^{TH} SLAB

6) PARAPET & OTHER ELEVATION FEATURES

7) FINISHING WORK

a) BLOCK WORK

b) ELECTRIC WALL CHASING, PIPING & SAND PLASTER WORKS

c) GYPSUM PLASTER

d) INTERNAL PLUMBBING AND WATERPROOFING (TOILET, KITCHEN & BALCONY)

e) INTERNAL SAND FACE PLASTER (BEHIND DADO)

f) EXTERNAL PLASTER

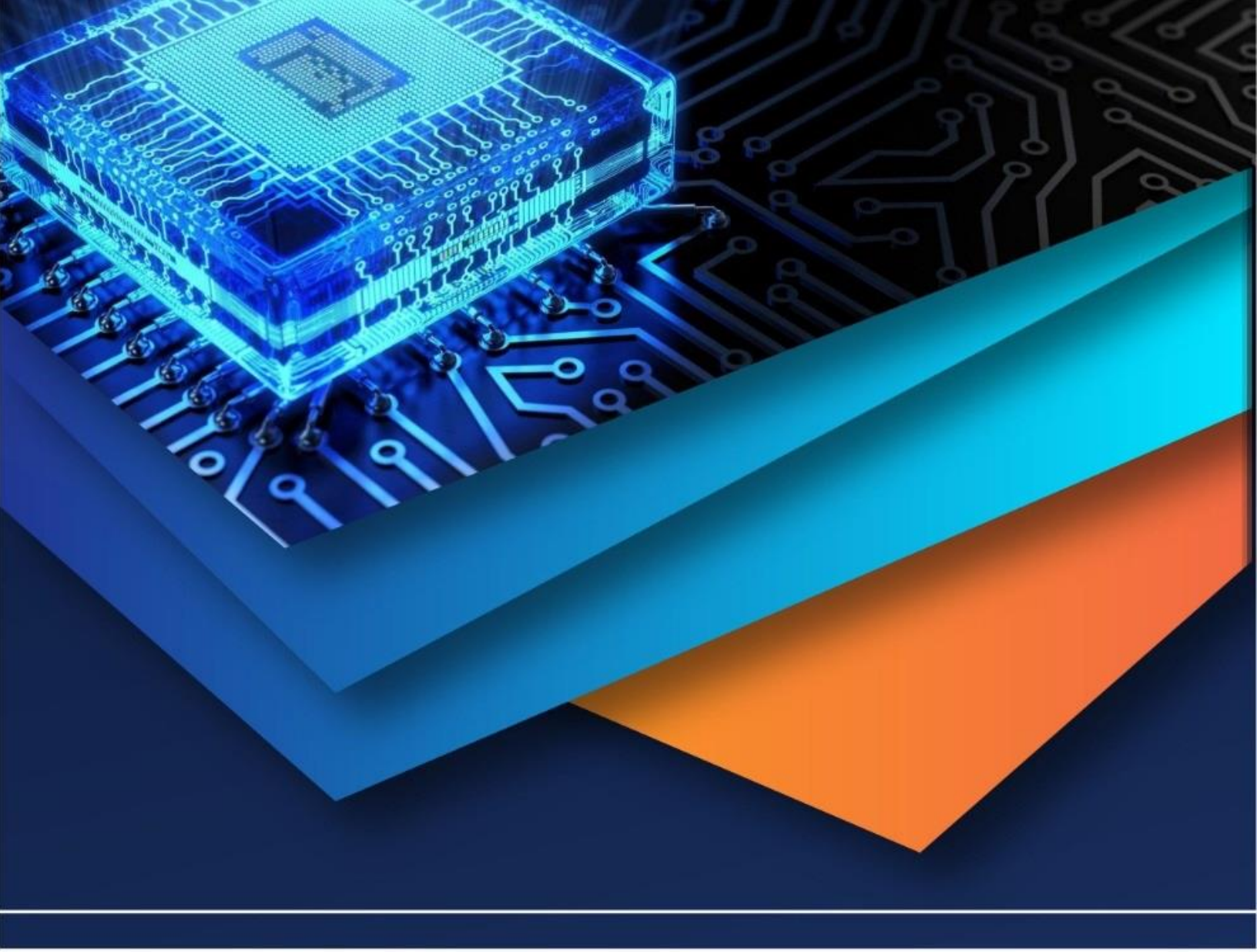
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g) FLAT BALCONY & STAIRCASE RAILINGS
h) TILING WORK
i) CARPENTARY WORKS
j) ALUMINIUM DOOR AND WINDOW WORK
k) INTERNAL PAINTING
l) EXTERNAL PLUMBING
m) EXTERNAL PAINTING
n) ELECTRIC WORKS (SWITCH BOXES)
o) SANITARY WORKS
p) CP FITTING WORKS
8) FIXTURES AND FURNISHING WORKS
9) MEP WORKS
a) DRAINAGE LINE WORKS
b) ELECTRIC MAIN LINE CONNECTION WORKS
c) PARKING FLOORING WORKS
d) TRANSFORMERS, HT-CABLES & PANELS
e) LIFT WORKS
f) PUMP WORK
g) FIRE FIGHTING WORKS
h) SOLAR SYSTEM WORKS
10) DEVELOPMENT AREA WORK (APPROACH ROAD, SIDE GUTTTERS ETC)
11) MISCELLANEOUS WORKS
12) HOUSE KEEPING & CLEANING WORTKS
13) HANDOVER-POSSESSION

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