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TIME AND COST MANAGEMENT IN REAL ESTATE CONSTRUCTION USING PROJECT MANAGEMENT TECHNIQUES

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Abstract— During the early phase of construction, cost & time management plays the most important role in the success of the project. At the planning stage, limited information is available hence the identification of many unknown factors that influence the project cost become crucial task to project manager. The objective of this study is to develop a cost and time management technique by using a Microsoft Project to manage the total time and cost of residential building construction projects. The work breakdown structure (WBS) is developed for G+4 residential apartment project. The management of time and cost for various activities were successfully carried out by using Microsoft Project (MSP) software for proper scheduling as well as allocating all kinds of required resources for each and every activity. The results and observations show that MSP works as a comprehensive tool for engendering Gantt Chart for effective scheduling and resource allocation residential building construction project. The present study provides an overview about the Microsoft Project software applications for planning and scheduling of building construction project.

Keywords: Microsoft Project (MSP), Planning, Scheduling, Resource allocation, Management, Activities.

I. Introduction

Project management is the application of knowledge, skills and techniques to project activities to meet project requirements. It can be also defined as the process and activity of planning, organizing, inspiring, and controlling resources, procedures and protocols to achieve specific goals in scientific or daily problems. Cost & Time is an important aspect to everyone, especially to those in the construction industry. It includes the selection of technology, the elaboration of work task, the estimation of required duration and resources of individual task, and identify the interactions between different work tasks. For instance, it provides the founder with an excellent image of the predicted cash & time flow throughout the project lifecycle. So, it is worthy to pay extensive effort to achieve a more reliable management of the final construction cost & time. Now-a-days software like Microsoft Project & Oracle Primavera is used in construction management.

It was common practice that most of small-scale construction organizations in India use Microsoft Excel for management of project activities. In a traditional approach, a project can be completed in a sequence of steps. They are distinguished as:

- Beginning Phase
- Planning and Designing Phase
- Execution and Construction Phase
- Monitoring and Controlling Phase
- Completion Phase

Microsoft Project is a project management software product, developed and sold by Microsoft. It is designed to assist a project manager in developing a plan, assigning resources to tasks, tracking progress, managing the budget and analyzing workloads. The application creates critical path schedules, and critical chain and event chain methodology. Schedules can be resource levelled and chains are visualized in a Gantt chart. There are several important terms such as Work Breakdown Structure, Milestone, Baseline, Critical Path Method, Stakeholders, Triple constraint, Change Control Board which are used by the Project Manager.

The research aim is to study the application of MSP in every single aspect of project from planning and scheduling of a residential building construction project. The important objectives of this research stated as below;

- To develop a Work Break-Down Structure (WBS).
- To provide planning and scheduling using MSP software.
- To work out the practical duration & cost required to carry out the project.

II. Literature Review

This are the various papers which were referred for the study of Planning and Scheduling of various buildings using Microsoft Project and Primavera P6 Software.

S. Laddha et at all (2017) developed this paper of Microsoft Project to easily understand and visualize the flow and network of the project. The Microsoft Project is the modern tool which helps the optimum and effective organization of the activities which helps to give the vision to complete the project in planned duration and within the economy.
M. Kumar et at all (2017) developed this paper to help understand Use of Traditional practices and improper planning reduce the efficiency of the construction industry which affects the project in the form of increased duration of the project, this leads to the increased overhead cost of the project and poor quality of work.
C. Chowdeswari et at all (2017) developed this paper to provide how to do planning and scheduling for a building which is multi-storied (G+8) with Microsoft Project software by observing the site available resources with proper utilization of time and resources.
R. S. Gayawal et at all developed this paper to discussed about the Time and Cost Management are the key processes of project & construction management. The above given example of software application is meant to provide insight to the software. The purpose is to make the software more approachable to all stakeholders of Real Estate Industry.
P. Tripathi et at all (2018) developed this paper to present work is to study the scheduling techniques and construction sequence of work for multi-store buildings and to perform the application of Microsoft Project software in planning and scheduling of a multi-store RCC building with Gantt chart concept. This gives easy understanding of the progress of work with schedule time.
A. Kelkar et at all (2017) developed this paper to understand the main aim of project management is to complete the project with in specified time, cost and scope along with assured quality. From the present study it is concluded that, with proper application of project management skills and techniques like: Resource optimization, identifying resource wastage and Fast tracking the scheduled activities to optimize duration, a reduction in time of 23.2% and cost of 3.14% can be achieved.
T. Subramani et at all (2014) developed this paper to understand the methodology adopted for this study by modelling the construction process for high rise building for both conventional and IBS which share more or less the same nature and size of the structure. This study compares time and performance of the conventional method of construction for high rise residential and Industrial Building System (IBS) method.
M. G. Chidambarakumar et at all (2017) developed this paper to minimize the complexity in manual calculation Project Management Software can be preferred. Oracle Primavera P6 is one of the best software in construction management. Primavera is efficient foe the project because linking the project activities easily and also by using the four relationship can optimize the time of project.

III. METHODOLOGY

A complete methodology adopted for this study is shown by the fig. 1

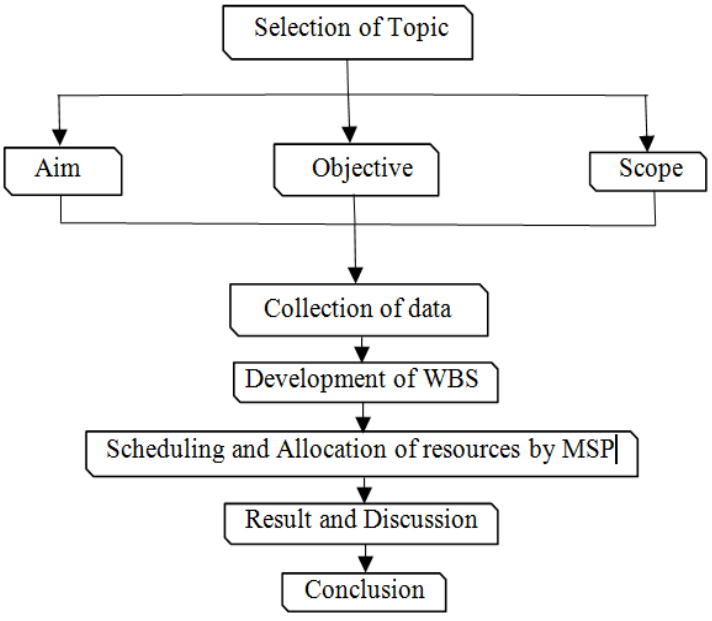


Fig. 1 Research Methodology

A. Selection of Topic:

Countries around the world provide major preference to the construction industries. The major construction activities of a country involves, Building constructions which includes residential and commercial buildings, Heavy infrastructure projects such as roads, bridges, dams and industrial construction etc, these construction activities are carried out using old and traditional construction practices which cause several problems in in the construction such as increased cost of construction, delay in delivery of project, poor quality in construction, increased risk of crises, all

these flaws in construction practices calls for an effective project management and quality control system. Project management tools such as Microsoft Project, Primavera, Microsoft Excel and techniques such as CPM, PERT which can reduce the efforts and also helps to maintain the accuracy and quality of the project.

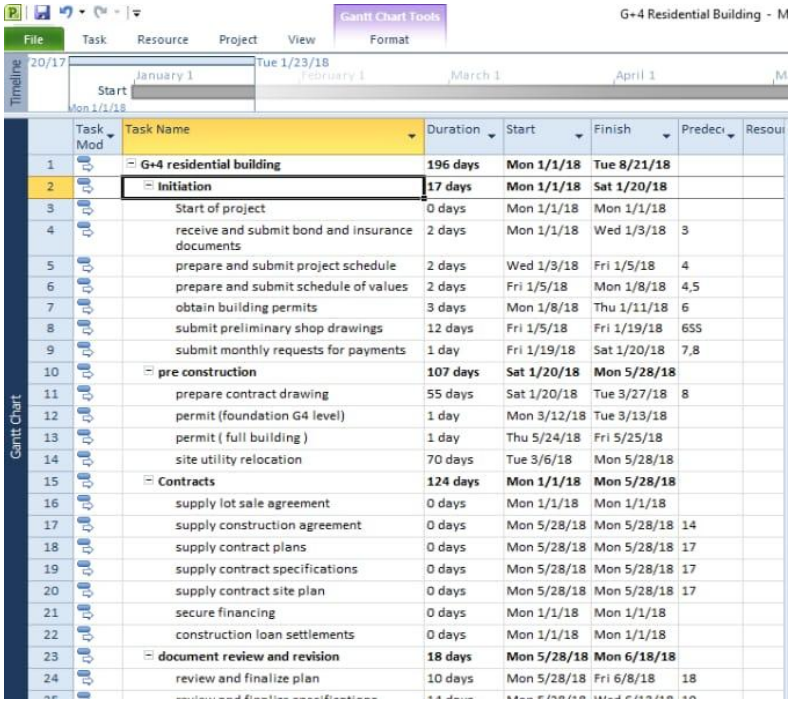
B. Collection of Data:

In this section we collected various data related to the Application of MSP from different sources like Journal Magazines, Reference Books, Internet to study the Modern Techniques used for Planning and Scheduling. As well as identified the various activities, Material resource, Labour resource, Wok resource in the process of construction of multi-storey building by visiting the number of under construction sites

I. Work Resource: Work resource indicates the people or equipment that consumes time when working on a task. When you set up work resource, you define the amount of time that resource have to spend on a task for a project. Collection and scheduling of various activities required for G+4 residential building is shown in Fig. 2

II. Material Resource: While working on a project some material items are needed. They are called as material resources. Material resources such as gasoline or wood or cement bags or steel etc. A material resource is assigned to a task and appropriate units should be specified for material resource.

III. Cost Resource: It represents a financial cost associated with a task that you need to account for. The value of the cost resource doesn't depend on the amount of work done on a task or on the duration of a task.



	Task Mod	Task Name	Duration	Start	Finish	Predec	Resou
1		**G+4 residential building**	**196 days**	**Mon 1/1/18**	**Tue 8/21/18**		
2		**Initiation**	**17 days**	**Mon 1/1/18**	**Sat 1/20/18**		
3		Start of project	0 days	Mon 1/1/18	Mon 1/1/18		
4		receive and submit bond and insurance documents	2 days	Mon 1/1/18	Wed 1/3/18	3	
5		prepare and submit project schedule	2 days	Wed 1/3/18	Fri 1/5/18	4	
6		prepare and submit schedule of values	2 days	Fri 1/5/18	Mon 1/8/18	4,5	
7		obtain building permits	3 days	Mon 1/8/18	Thu 1/11/18	6	
8		submit preliminary shop drawings	12 days	Fri 1/5/18	Fri 1/19/18	6SS	
9		submit monthly requests for payments	1 day	Fri 1/19/18	Sat 1/20/18	7,8	
10		**pre construction**	**107 days**	**Sat 1/20/18**	**Mon 5/28/18**		
11		prepare contract drawing	55 days	Sat 1/20/18	Tue 3/27/18	8	
12		permit (foundation G4 level)	1 day	Mon 3/12/18	Tue 3/13/18		
13		permit (full building)	1 day	Thu 5/24/18	Fri 5/25/18		
14		site utility relocation	70 days	Tue 3/6/18	Mon 5/28/18		
15		**Contracts**	**124 days**	**Mon 1/1/18**	**Mon 5/28/18**		
16		supply lot sale agreement	0 days	Mon 1/1/18	Mon 1/1/18		
17		supply construction agreement	0 days	Mon 5/28/18	Mon 5/28/18	14	
18		supply contract plans	0 days	Mon 5/28/18	Mon 5/28/18	17	
19		supply contract specifications	0 days	Mon 5/28/18	Mon 5/28/18	17	
20		supply contract site plan	0 days	Mon 5/28/18	Mon 5/28/18	17	
21		secure financing	0 days	Mon 1/1/18	Mon 1/1/18		
22		construction loan settlements	0 days	Mon 1/1/18	Mon 1/1/18		
23		**document review and revision**	**18 days**	**Mon 5/28/18**	**Mon 6/18/18**		
24		review and finalize plan	10 days	Mon 5/28/18	Fri 6/8/18	18	

Fig. 2 – Scheduling of various activities

C. Study of Plan:

Study of plan plays a significant role in the planning of activities. In this course various drawings are identified like Superstructure architectural drawings, Structural drawings, floor plan, Door and window schedule etc.

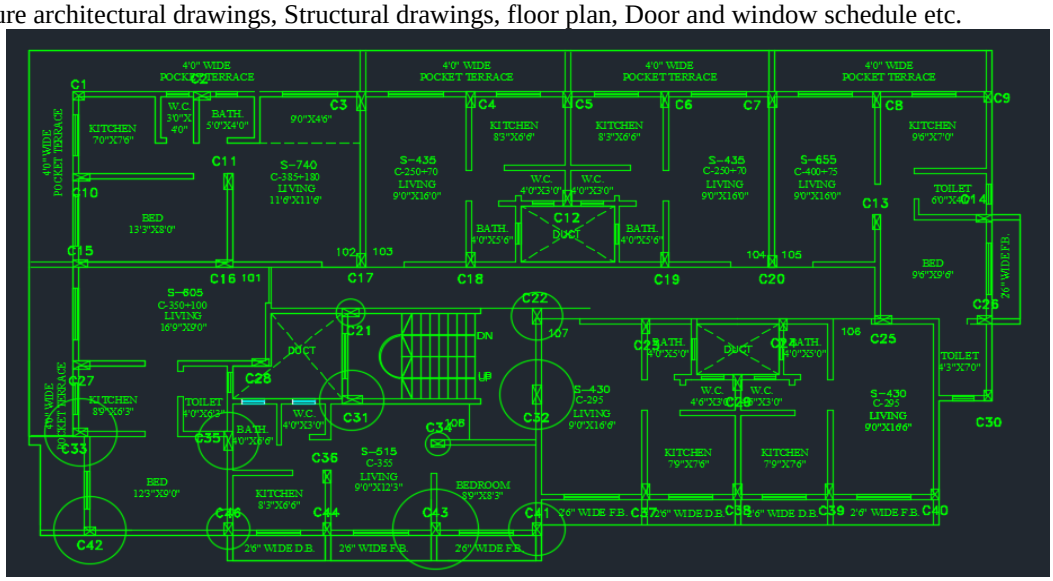


Fig. 3 – First floor plan

This study helps to recognize the various activities involved in delivering a project. In this course of study of plan, first all the activities are recognized and then the activities are deduced. We found a structural plan of a residential building (G+4) to know the detailed specification of various diameters of bar, number of bars and other quantities of materials (cement, aggregate, sand and reinforcement) to estimate the approximate cost of the required building.

SCHEDULE OF R.C.C. COLUMNS AND FOOTINGS								
COLUMN NOS.	SECOND FLOOR		FIRST FLOOR		GROUND FLOOR		BELOW GROUND FLOOR	
	SIZE	STEEL	SIZE	STEEL	SIZE	STEEL	SIZE	STEEL
C1,30,45	230 X 300	4 DIA 12	230 X 300	4 DIA 12	230 X 300	4 DIA 12	280 X 350	4 DIA 12
C9,40,42	230 X 300	4 DIA 12	230 X 300	6 DIA 12	230 X 300	6 DIA 12	280 X 350	6 DIA 12
C20,24,34,36, 41,43,44,46	230 X 350	6 DIA 12	230 X 350	6 DIA 12	230 X 350	6 DIA 12	280 X 450	6 DIA 12
C15,17,26,33	230 X 350	6 DIA 12	230 X 380	6 DIA 12	230 X 400	6 DIA 12	280 X 450	6 DIA 12
C5,8,10,14, 16,22,28,38	230 X 450	8 DIA 12	230 X 450	8 DIA 12	230 X 450	8 DIA 12	280 X 500	8 DIA 12
C2,7,11,12, 13,23,29	230 X 450	8 DIA 12	230 X 450	8 DIA 12	230 X 450	8 DIA 12	280 X 500	8 DIA 12
C4,6,18,19,21, 25,27,37,39	230 X 450	8 DIA 12	230 X 450	8 DIA 12	230 X 450	10 DIA 12	280 X 500	10 DIA 12
C3,31,32,35	230 X 450	10 DIA 12	230 X 500	10 DIA 12	230 X 550	10 DIA 12	280 X 600	10 DIA 12

TABLE 1 SCHEDULE OF RCC COLUMNS AND FOOTING

D. Application of MSP:

Microsoft Project is the world's most popular project management software developed and sold by Microsoft. The application is designed to assist project managers in developing plans, assigning resources to task, tracking progress, managing budgets and analysing workloads. Microsoft project creates budgets based on assignment work and resource rate. 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.

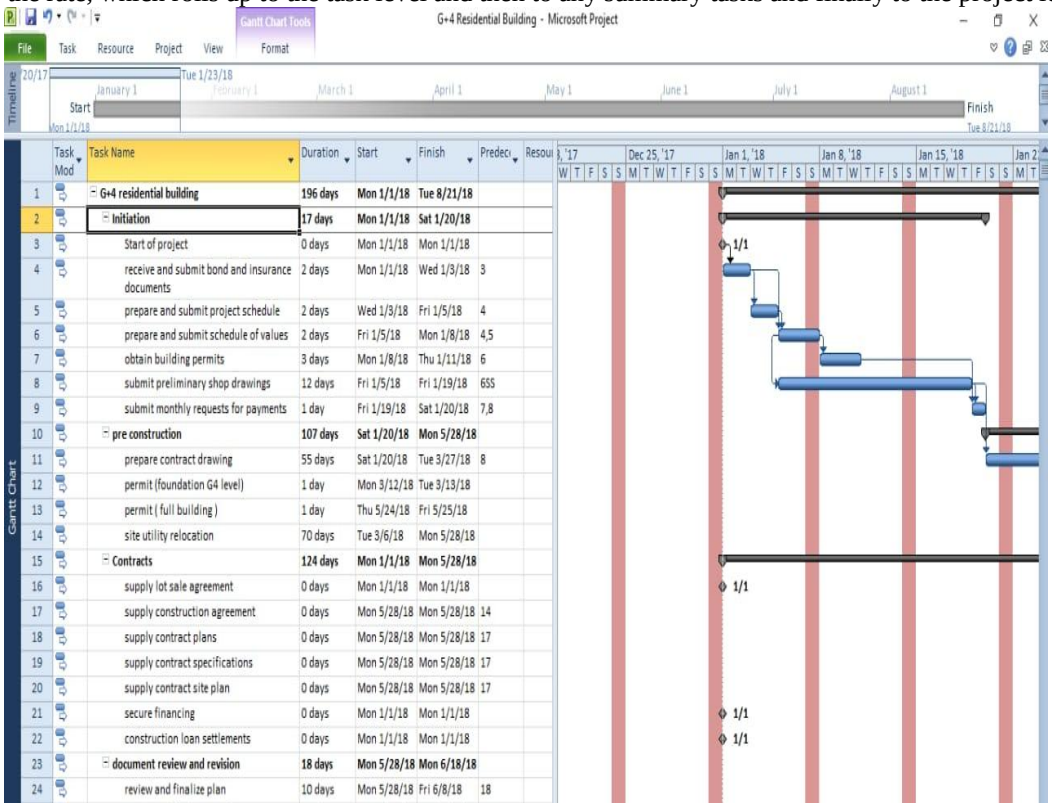


Fig. 4– Gantt chart along with activity interdependencies.

Fig. 5 shows the critical path for the project where time and cost are the important factors should be considered.

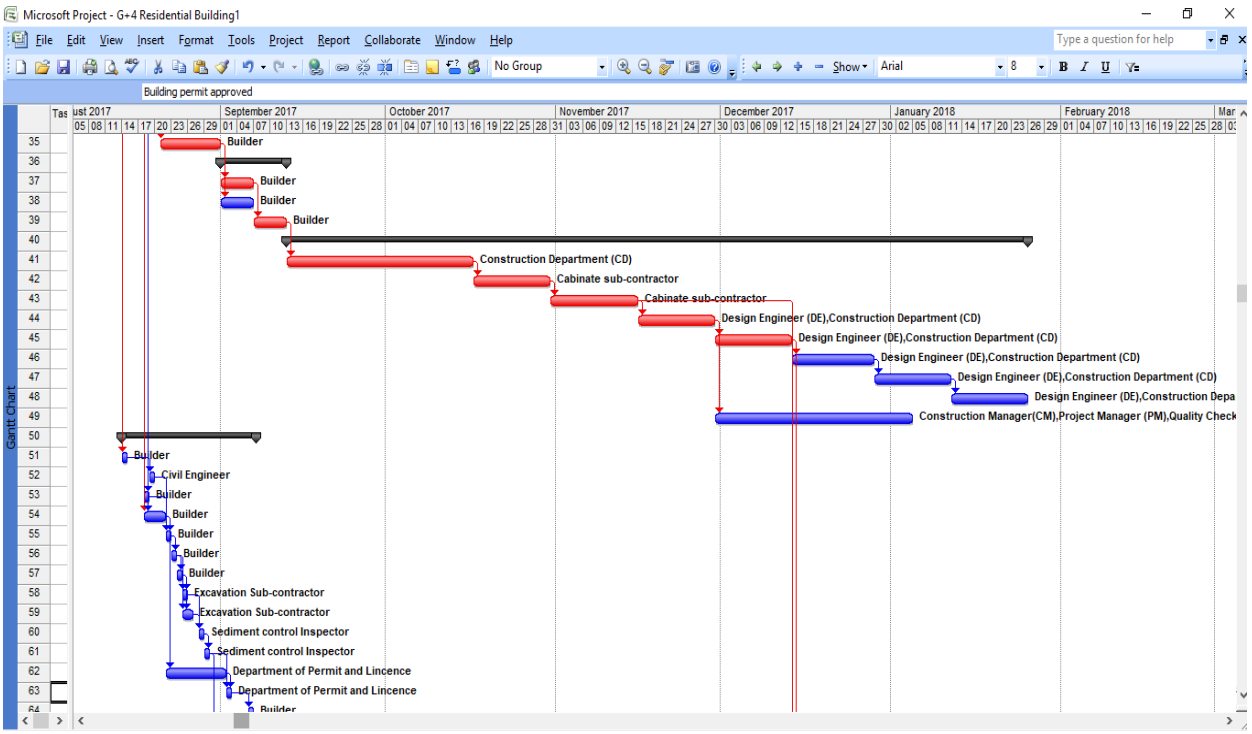


Fig. 5 – Gantt chart showing Critical Path

I. About WBS: A work breakdown structure (WBS), in project management is a deliverable-oriented decomposition of a project into smaller components. A work breakdown structure element may be a product, date, services, or any combination thereof. WBS is a hierarchical and incremental decomposition of the project into phases, deliverables and work packages. WBS is also called as an organized method of dividing a product into sub product at lower level of details.

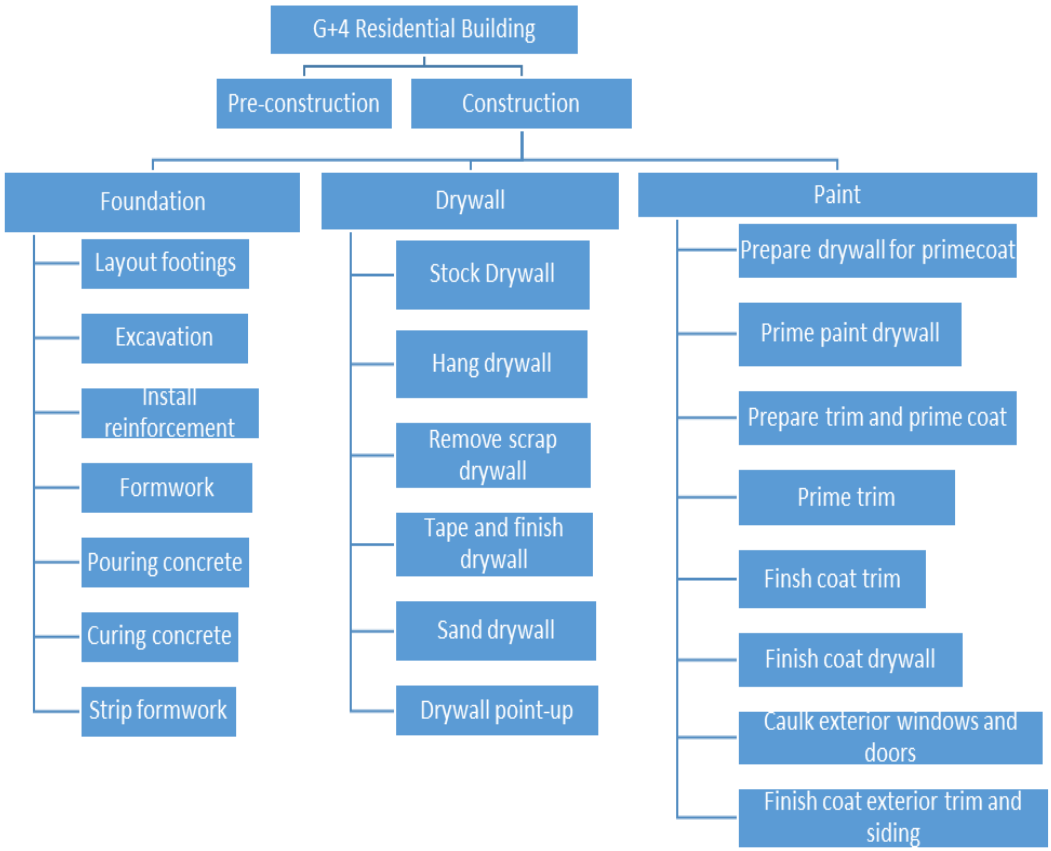


Fig. 6 WBS for G+4 Building structure

Logical task dependencies are identified to establish the sequence of work within the project. Gantt Chart show these links as running between taskbars, an arrow at one end point to successor task.
There are four main types of task dependency:

- Finish-to-Start (FS) – A logical relationship in which a successor activity cannot start until a predecessor activity has finished.

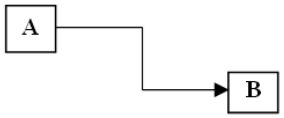


Fig. 7

- Start-to-Start (SS) – A logical relationship in which a successor activity cannot start until a predecessor activity has started.

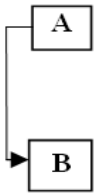


Fig. 8

- Finish-to-Finish (FF) – A logical relationship in which a successor activity cannot finish until a predecessor activity has finished.

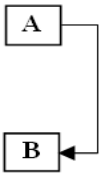


Fig. 9

- Start-to-Finish (SF) – A logical relationship in which a successor activity cannot finish until a predecessor activity has started.

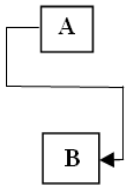


Fig. 10

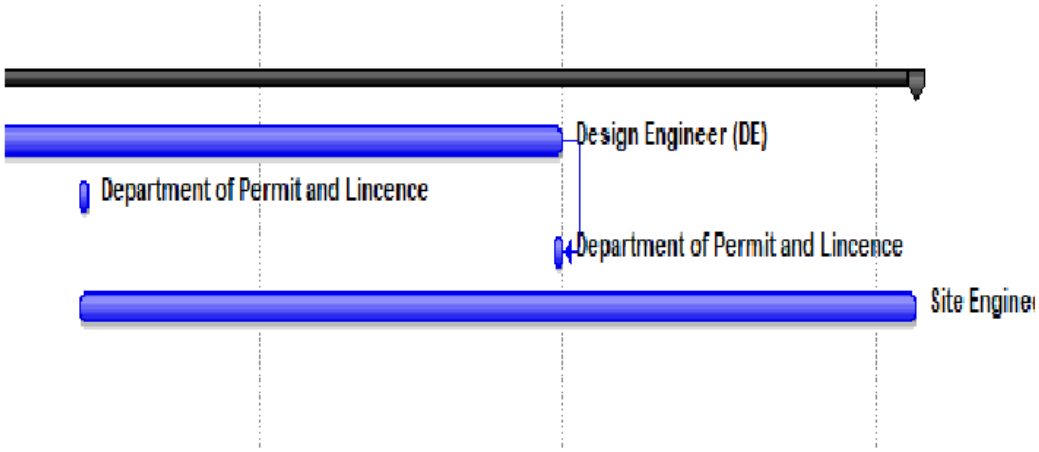


Fig. 11 – Finish to Finish Interdependency

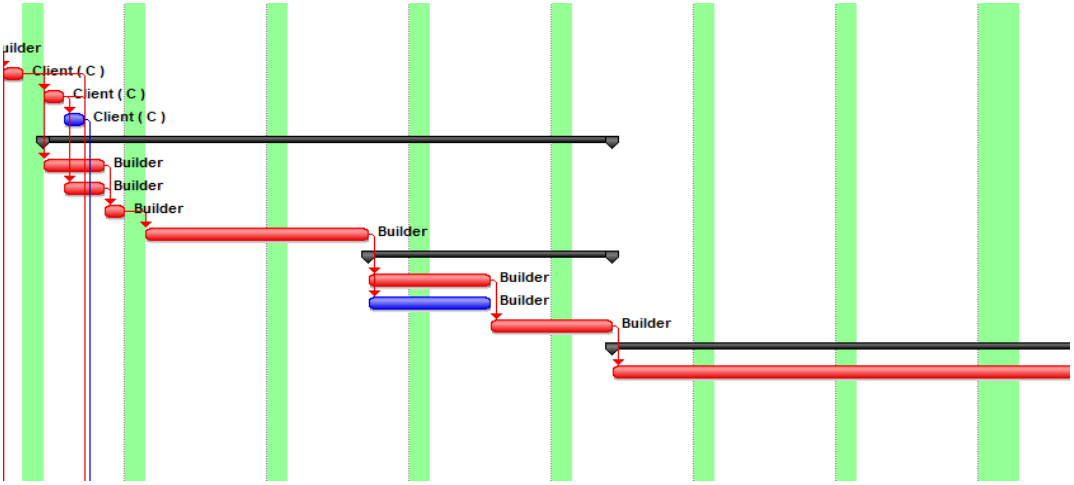


Fig. 12 – Finish to Start Interdependency

IV. CONCLUSION

Time and Cost management is one of the important aspects which play a vital role during the execution of project. The cost management at the early phase of construction provides general idea about the budget to the investor hence arrangement of funds and its proper utilisation can be successfully carried out during the each phases of project. Application of proper management helps project manager to achieve efficient project performance by resource optimization along with proper planning, scheduling and controlling activities during construction processes. The use of project management techniques in a proper way reduces the cost and time of construction, without affecting the quality and performance. The scheduling of the project gives information about the actual time required for the completion of each and every activity. The case study of G+4 residential project is selected for this research and the work breakdown structure (WBS) is developed. All the mentioned activities in WBS was successfully interlinked in Microsoft Project. The duration of all the activities are identified with the help of expert advice from the Indian construction industry. The Microsoft Project software is selected for the development of scheduling of WBS activities as well as for the allocation of resources.

The present study it is concluded that, with proper application of project management skills and techniques like: Resource optimization, identifying resource wastage and fast tracking the scheduled activities to optimize duration, a reduction in time of around 10-20% and cost of around 1-5% can be achieved. Also, Microsoft Project is an effective tool for project planning, monitoring and control, can be applied for the cost and time management with higher degree of accuracy.

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