A Thesis on

IMPACT OF WORK BREAKDOWN STRUCTURE ON PROJECT LIFE CYCLE

Submitted for partial fulfillment of award of

MASTER OF TECHNOLOGY
Degree in

CONSTRUCTION TECHNOLOGY & MANAGEMENT

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2019-2020

DECLARATION

I declare that the research thesis entitled "**IMPACT OF WORK BREAKDOWN STRUCTURE ON PROJECT LIFE CYCLE "** is bonafide research work carried out by me, under the guidance of **Mr. Anwar Ahmad, Associate Professor, Department of Civil Engineering, Integral University, Lucknow.** Further I declare that this has not previously formed the basis of award of any degree, diploma, associate-ship or other similar degrees or diplomas, and has not be submitted anywhere else.

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Place: Lucknow

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*Certified that the thesis entitled "**IMPACT OF WORK BREAKDOWN STRUCTURE ON PROJECT LIFE CYCLE "** is being submitted by **Mr. Ashish Kumar (Roll no 1701104001)** in partial fulfilment of the requirement for the award of degree of Master of Technology (Structures) of Integral University, Lucknow is a record of candidate's own work carried out by him/her under my supervision and guidance.*

The result presented in this thesis has not been submitted to any other university or institute for the award of any other degree or diploma.

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ABSTRACT

In this study, same project comprising of six repetitive units is planned with three different sequences as explained previously. It is seen that with detailed planning and development of the mentioned sequences yielded completely variant path, duration cost and resources requirements. For the purpose of comparison between these sequences, it is done on the following parameters namely cost, duration, critical path and critical resources.

It is seen that the cost of the sequence 1, which takes single unit sequentially, is highest. The total cost for sequence 2 is moderate while with sequence 3 project is costing the lowest. While for the duration of different sequences the total duration of first sequence is longest while sequence2 and sequence 3 takes lesser time. Since in the 1 X 6 approach no unit run parallel thus highest duration. While in 2 X 3 and 3 X 2 approach multiple units run simultaneously thus takes short time for completion.

The critical path for the three sequences shows variation in terms of count of activities as well as the duration of critical path. The critical path for the first sequence have smallest number of activities in critical path at a time and also the duration is the longest. The critical resource in this sequence are also less as the activities are also less. For the second sequence, the no of activities is in between the other two sequences and the duration of critical path is moderate. The critical resources for this sequence are greater than the previous sequence. The third sequence with largest quantum of work in it has largest no of activities in its critical path with the smallest duration. Also the pool of critical resources is largest for this sequence. It is to be pointed out that the lag time between the non-critical activities is smallest for the third sequences underlining the fact that the schedule of work is very compact. The execution team need to be on their toes for such execution.

CHAPTER-1

INTRODUCTION

1.1 General:

The term work breakdown structure may be define as it is a key project which can organises the team work into the manageable sections .The work breakdown structure also can provide the necessary framework for detailed cost estimating and control along with providing guidance for schedule development and control.The work break down structure lays out the individual building blocks that will construct the project.This process is critical because for most of us planning a project can be an intimidating experience. The WBS helps us create a necessary structure to the project by outlining the individual steps needed to succeed.Schematic Expression of work break down structure are primarily , give a detailed list of work which are primary. Then breakdown all the primary work into secondary ,then breakdown all the secondary work into tertiary.The component of work break down structure plan includes the process for preparing a detailed project scope statement. It also includes the process that enables a creation of the work breakdown struction from the detailed project scope management. It also includes the process that establishes how the work breakdown structure will be maintained and approved . It may also includes the process that specifies how formal acceptance of the completed project deliverable will be obtained .

It also contains the process to control how requests for changes to the detailed project scope statement will be processed.

The work break down structure (WBS) is described as a hierarchical structure which designed to locally sub divide all the works elements of the project into a graphical presentation.the work break down structure is taken as a fundamental task by professional WBS can the be established to align the appropriate work flow, material flow, and cash flow, for detailed planning in the construction schedule project planning and control will bring the project to success in terms of time,cost and quality.In order for the project to be effectively implemented the work needs to broken down into Smaller parts.The planning and execution of these parts of works refers to a structure called work Break down structure is a frame work for project implementation as well as a means for planning Monitoring and controlling a project.The WBS helps as create a necessary structure to the project by the outlining the individual steps needed to succeed.Schematic expression of work break down structure are primarily give a detailed list of of work which are primary . The component of work break down structure plan includes the process that enable a creation of the work break down structure from the detailed project management.

A well-defined and comprehensive WBS that fits the organizational structure and the project System profile is important to increase the probability of project success by ensuring that the best resources are applied to the correct selection of projects suiting the particular company.

works most effectively when it is compartmentalized, i.e. when the project is broken down into an organized Work Breakdown Structure, or WBS. The WBS is used as the basic building block for the planning of the project. It is a product-oriented division of project tasks that ensures the entire Scope of Work is captured and allows for the integration of technical, schedule, and cost information. It breaks down all the work scope into appropriate elements for planning, budgeting, scheduling, cost accounting, work authorization, progress measuring, and management control. The two most common WBS systems are the Construction Specifications Institute (CSI) format, and the Uniformat. Often at the preliminary stages of design the Uniformat lends a better understanding of the cost centres, and at final bid level of documents often the CSI format is used. The indirect costs of design, oversight, and management must be included in the WBS to reflect the full budget.

1.2 TOOLS AND TECHNIQUES

Decomposition is the subdivision of project deliverables into smaller, more manageable components until the work and deliverables are defined to the work package level. The work package level is the lowest level in the WBS, and is the point at which the cost and schedule for the work can be reliably estimated. The level of detail for work packages will vary with the size and complexity of the project.

Decomposition of the total project work into work packages generally involves the following activities:

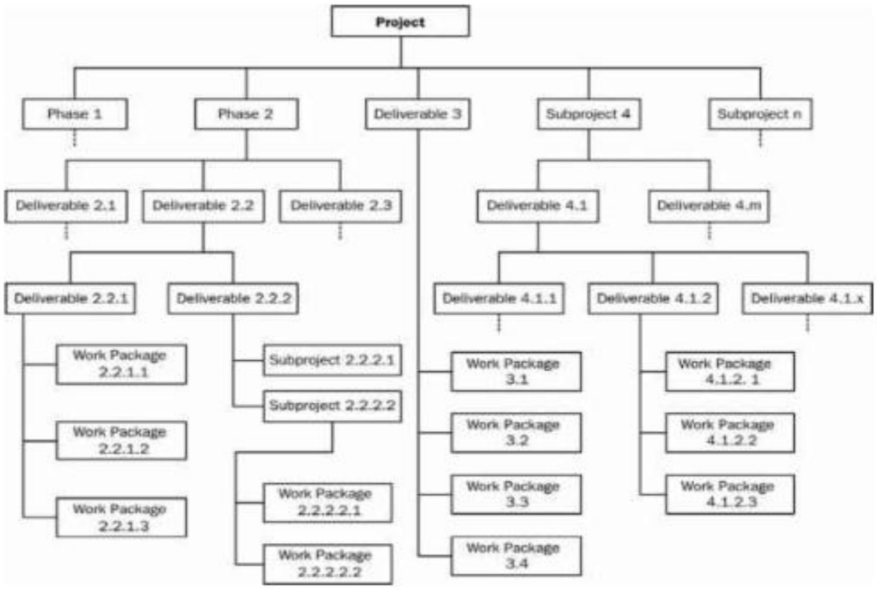
• Identifying and analyzing the deliverables and related work.

• Structuring and organizing the WBS.

• Decomposing the upper WBS levels into lower level detailed components.

• Developing and assigning identification codes to the WBS components, and

• Verifying that the degree of decomposition of the work is necessary and sufficient. Structuring and organizing the deliverables and associated project work into a WBS that can meet the control and management requirements of the project


Project
Phase 1
Phase 2
Deliverable 3
Subproject 4
Subproject n
Deliverable 2.1
Deliverable 2.2
Deliverable 2.3
Deliverable 4.1
Deliverable 4.m
Deliverable 2.2.1
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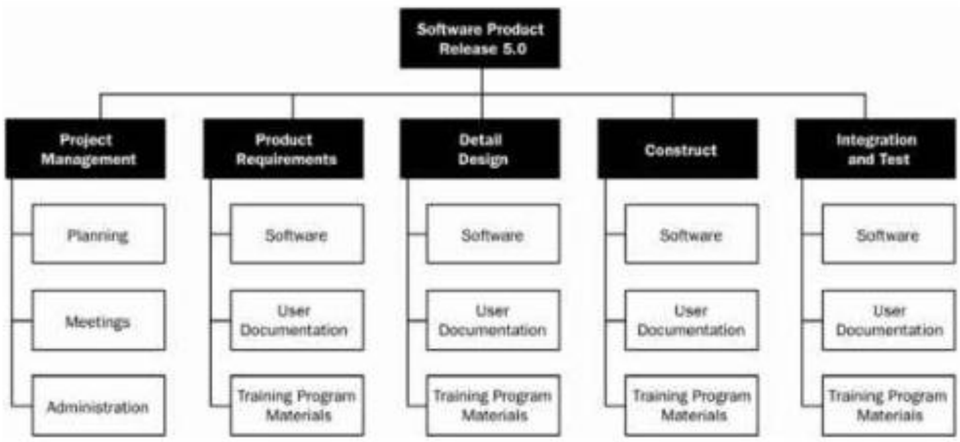
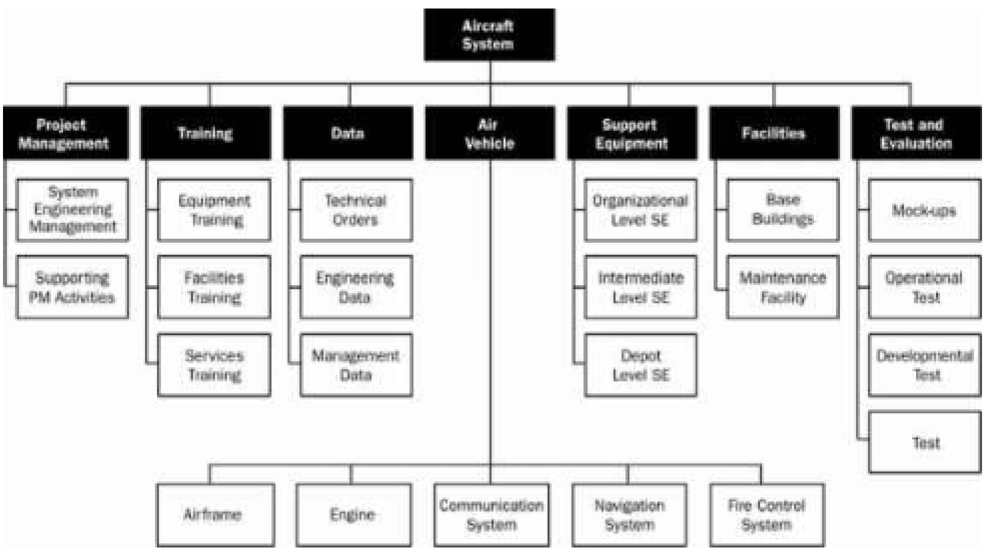

Software Product Release 5.0
Project Management
Product Requirements
Detail Design
Construct
Integration and Test
Planning
Meetings
Administration
Software
User Documentation
Training Program Materials


Aircraft System
Project Management
Training
Data
Air Vehicle
Support Equipment
Facilities
Test and Evaluation
System Engineering Management
Supporting PM Activities
Equipment Training
Facilities Training
Services Training
Technical Orders
Engineering Data
Management Data
Organizational Level SE
Intermediate Level SE
Depot Level SE
Base Buildings
Maintenance Facility
Mock-ups
Operational Test
Developmental Test
Test
Airframe
Engine
Communication System
Navigation System
Fire Control System

1.3 The Importance of the Work Breakdown Structure

Experienced project managers know that many things can go wrong in projects, regardless of how successfully the work is planned and executed. Component or full-project failures, when they do occur, can often be traced to a poorly developed or nonexistent WBS. A poorly constructed WBS can result in adverse project outcomes including ongoing, repeated project re-plans and extensions, unclear work assignments, scope creep or unmanageable, frequently changing scope, budget overrun, missed deadlines, and unusable new products or delivered features.

The WBS is a functional building block to initiating, planning, executing, and monitoring and controlling processes that are used to manage projects as they are described in the PMBOK® Guide—Third Edition (PMI, 2004). Typical examples of the contribution that the WBS makes to other processes are described and elaborated in the Practice Standard for Work Breakdown Structures–Second Edition (PMI, 2006).

There are many project management tools and techniques that use the WBS or its components as input (PMI, 2004, pp. 112-118). For example, the WBS utilizes the project charter as its starting point. The high-level elements in the WBS should match, word-for-word, the nouns used to describe the outcomes of the project in the scope statement. In addition, the resource breakdown structure (RBS) describes the project's resource organization and can be used in conjunction with the WBS to define work package assignments. The WBS Dictionary defines, details, and clarifies the various elements of the WBS. The network diagram is a sequential arrangement of the work defined by the WBS and the elements of the WBS are starting points for defining the activities included in the project schedule.

The WBS is used as a starting point for scope management and is integral to other PMI processes, and, as a result, the standards that define these processes explicitly or implicitly rely on the WBS.

- **Activity Definition** :

Describes the inputs, tools, techniques, and outputs necessary to create the listing of activities that will be performed to produce desired project outcomes. The Project Time Management Overview the detail found in this section clearly show the **scope statement, WBS, and WBS dictionary** as inputs to the activity definition process. Tools for development of the activity list, milestone list and remaining outputs of the process include decomposition, rolling wave planning, and others. Illustrated simply, this can be described as:

Input	Process	Output
WBS & WBS Dictionary →	Decomposition →	Activity/Milestone List

- **Activity Sequencing**

Explains how the project's activities, milestones, and approved changes are used as inputs to the activity sequencing process, while the tools for developing the outputs are described, including the **project schedule network diagram,** updated activity and milestone lists include various network diagramming techniques, such as precedence diagramming method (PDM), and arrow diagramming method (ADM). As above, a simplified view would be:

Input	Process	Output
Activity / Milestone List →	Network Diagramming →	Project Schedule Network Diagram

- **Schedule Development**

Describes how these two processes are used to produce the end objectives of the process: the **project schedule, schedule model, schedule baseline,** and other related schedule components. Here, the chapter explains how the outputs of the two processes above are incorporated as inputs to the scheduling tools and scheduling methodologies to produce the project schedule. Simplified, this can be illustrated as:

Input	Process	Output
Activity List / Network Diagram →	Scheduling Method/Tools →	Project Schedule

Summarizing the information found in these sections:

- The core elements that enable the elaboration and development of the project schedule begin with the **Scope Statement, WBS, and WBS Dictionary.**
- These inputs are taken through a decomposition process to produce the project's activity and milestone lists.
- These in turn, are input elements to **network diagramming** that produces the project schedule network diagram and updated activity/milestone lists.
- Finally, the project schedule network diagram, updated activity, and milestone lists are then used as input to the project scheduling tools and methodology to generate the **project schedule.** Illustrated in simplified process-flow form as before, the entire process can be summarized as follows:

Input	Process	Output
WBS / WBS Dictionary →	Network Diagram →	Project Schedule

1.4 OBJECTIVE

- Assessment of duration and cost of a repetitive multiple units project with three different sequence through Work Breakdown Structure method
- Comparison of cost and duration of the project with different sequence using WBS derivatives to monitor and control project objective

1.5 SCOPE

The scope of work breakdown structure is the clear identification of work that is required to complete the project successfully. The scope of project will explain the boundaries of the project established.

The responsibilities of each member of the team and set up procedure how work that is complete will be verified of approval. The scope of work break down structure is to achieve the project management cycle in an easy manner.

The other scope is to help the entire process of project management cycle to achieve their specific criteria. It can identify the practical problem to achieve the project management cycle and try to improve by work done structure. It is to determine the importance of work breakdown structure in facilitating the project management cycle.

1.6 INFERENCE

In summary applying the WBS to the project management life cycle is simply an outcome of effective scope analysis. WBS development and careful project management execution, monitoring and control by the project manager. Applying a carefully articulated WBS and WBS dictionary to subsequent project process further utilize tools such as the network diagramming technique or scope relationship diagram development and results in the creation of a base lined project schedule, drawn from the decomposition of work packages -Which reveals key project tasks, Activities, and milestones. Key attributes associated with effective WBS development are include below.

An effective works breakdown structure has the following characters: -

- It is a deliverable-oriented grouping of project elements.
- It is created by those doing the work.
- It contains 100% of the work defined by the scope or contact and captures all deliverable s (internal. External, Interim) in terms of work to be completed, including project management.

- It defines the context of the project clarifies the work, and communication project scope to all stakeholders.
- It is expressed as an illustration, chart or outline providing a graphical or textual breakdown.
- It should contain at least two levels
- It uses nouns and objectives-not verbs
- It arranges all major and minor deliverable s in a hierarchical structure -and is constructed so that each level of decomposition contains 100% of the work in the parent level.
- It evolves along with the progressive elaboration of project scope up to the point of scope baseline , and thereafter in accordance with project change control,allowing for continual improvement
- It employs a coding scheme for each WBS element that clearly identifies the hierarchical nature of the WBS When viewed in any format.

1.7 Essential Project Management Functions

- Project Planning – Be able to easily plan projects while taking previous track record into account.
- Tracking project evolution when it comes to completion, time and costs – Warn the right people when things are veering off track.
- Scheduling and Time Management – Be able to easily register time on work items and take people's work schedule into account.
- Resource allocation – Making sure that people are working on the right things at the right time.
- Project budgets, incl. costs of people – Keeping real-time check of not only time but also allotted budget.
- Communication and Collaboration – Easily post comments and concerns, communicate with external stakeholders, all while keeping a full historic record of all actions.
- Documentation & Files – Easily document requirements, specs, directly or via files.
- Easy to use – The software should be an enabler and not get in the way of actual work.
- No need for a specific method – Support the company's preferred method of breaking down any project, making schedules, allocating people and managing budgets.

1.8 Project Management Software

The primary purpose of project management software is to assist project managers as they zip through different project stages. In this respect, full-suite platforms have numerous advantages. Uniting project planning, resource management, team collaboration, finance and billing, time tracking and reporting, you can manage projects from quote to invoice. Here are the benefits:

1. Effortless project planning

If enterprises have learned anything from years of managing projects, it's that most of the time spent project planning goes to waste. But it doesn't have to be this way. Project management software has moved forward to get you accurate AI predictions of when projects can be completed, capturing constraints like cost, scope, and schedule.

The key benefit of advanced project management solutions is automation when it comes to project planning and scheduling. Such platforms not only help project experts establish a solid foundation for their projects, providing tools to scope out the milestones, key deliverables, and roles before executing. They'll keep plans up to date and help to track progress against your baseline.

2. Balanced resource management

Seasoned project managers know that to deliver projects successfully, they'll need an effective resource management strategy to keep their teams in a tip-top shape without overbooking them with work or vice versa. The importance of resource planning should not be underestimated, as it encourages healthier standards of work. Project and resource management tools have the best features to spot resource bottlenecks and insights when to bring more people onto the team, like the following heat map that provides visibility into the workloads of the entire portfolio of resources.

3. Pipeline forecasting

More often than not, the role of a project manager implies managing multiple projects. It's a given that by taking in more initiatives and leading them in parallel, companies become more competitive and profitable. However, what often comes together with multi-project management is the lack of visibility into how multiple project progress and resources are allocated. Project management software provides everyone with an overview of finished, running, and planned projects, so all kinds of bottlenecks can be prevented before they lead to a disaster.

4. Improved team collaboration

In addition to various resource management benefits, project management solutions are designed with a purpose to improve team collaboration. People frequently designate individual tasks which are part of a bigger project the whole team is trying to complete. Project management software gives employees a method to collaborate on projects by discussing tasks, time lines, dependencies, outstanding work, etc. Using project management software with Kanban boards or Sprints, you keep everyone in the loop and make sure the project team knows what to work on and has task lists with priorities front and center. This way, you not only stay aligned with the team, but also reduce re-work and create focus on continuous and fast-paced delivery of services

5. Real-time project budget management

Budgets are among one of the most important items in controlling your projects. The way forward for any business depends on how well you can deliver within the budget provided. Project management software helps control the budget from the initial statement of work to the final delivery. With Forecast, for instance, you get the financial picture of each project across key financial metrics, being able to track planned vs. actual spend and spot where you’re earning or burning money. Learn more about this side of the platform

6. Solid up-to-the-minute reporting

To attain long-term success for just about any business, monitoring the progress of work is essential. Dedicated software plays an important role in monitoring the stages of projects and can provide insights into whether things will complete on time or not. This is achieved through daily time registrations that feed directly into the reporting mechanism. Project management software solutions can then assist you in making the right decisions as you have all the details in one designated place. Hence the decision process is enhanced and much more accurate. If you ask me, it's better to choose a platform that covers reporting on a portfolio level, but also allows you to chronicle, customize, and share more digestible pieces of insights.

7. Effective internal & external communication

Project Management software develops a funnel for communication concerning tasks and projects both internally for the team and externally for your clients and other stakeholders. Document sharing, whether inside the tool or in an integrated 3rd party system, for instance, enables people to find comprehensive information that enables transparency and communication.

In addition to internal communication, companies should also be able to talk to and collaborate with clients and suppliers from the same place. Using project management software, they can offer their clients the ability to log in and view only project data relevant specifically to them. This way clients can provide direct feedback, make edits, and review project progress in the same place.

8. Enhanced customer satisfaction

Another frequently cited benefit of project management software is enhanced customer satisfaction. When you get a project done promptly and under budget, the client walks away with a smile on their face - and a satisfied customer is one you will see again. Smart project management software offers the tools which allow this customer/supplier relationship to carry on. By applying fundamental project management software strategies, you'll narrow your focus, achieve your goals, and improve your deliverability and rate of success.

Put together, all these benefits can overhaul business operations massively. Without the benefits of project management software, project-centric companies will always struggle to meet three constraints - budget, scope, and quality - simultaneously.

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CHAPTER-2

LITERATURE REVIEW

Robert C. Tausworthe et al (1980) in his study he tells that the work breakdown structure (WBS) is a vehicle for breaking an engineering project down into subproject, tasks, subtasks, work packages, and so on. It is an important planning tool which links objectives with resources and activities in a logical framework. It becomes an important status monitor during the actual implementation as the completions of subtasks are measured against the project plan. Whereas the WBS has been widely used in many other engineering applications, it has seemingly only rarely been formally applied to software projects, for various reasons.

Shelly A. Brotherton et al (1993) refers that experienced project managers know there are many things that can go wrong in projects regardless of how successfully they plan and execute their work. Component or full-project failures, when they do occur, can often be traced to a poorly developed or nonexistent WBS. A poorly constructed WBS can result in adverse project outcomes including ongoing, repeated project re-plans and extensions, unclear work assignments, scope creep or unmanageable, frequently changing scope, budget overrun, missed deadlines and unusable new products or delivered features.

Shlomo Globerson et al (1994) tells us that Organizational needs relating to the WBS may be changed in time. An organization will, in the design stage, vote for the use of a WBS with a system or function orientation. However, at the implementation stage, it may prefer to use a 'geographic' WBS orientation. Although proper coding of the WBS enables the work content to be grouped according to any desired feature, the orientation of the original chart is of great importance to its users.

J. W. Layland et al (1997) gives the principal efforts of the DSN Advanced Systems Program and its impact upon the operational Deep Space Network from about 1960 to 1995. The article is structured along two main themes. First is a tour of the fundamental services provided by the Network and the physical elements and technologies that support these services. The second theme is presented as a series of focused case histories of changes inspired by specific missions, such as Galileo, Voyager, or Mariner Venus Mercury, or by specific technologies, such as the application of fiber optics.

M. J. Clayton et al (1999) he tells that he reviewed intranet technologies as a strategy for improving the availability and quality of building information to support operations. Discussions with facility managers and design consultants have revealed problems with the as-built documents that are typically provided by the AEC team. Experiments with intranet technologies have led us to a concept of just-in-time operations documents that can be implemented using Web technology. The paper examines formats, structure and content for these operations documents. It describes an early prototype implementation that tested the feasibility of our concepts.

Parviz F. Rad et al (2000) gives the paper which introduces the concept of a Resource Breakdown Structure. Analogous to the traditional Work Breakdown Structure, the RBS lists, in a methodical fashion, the resources, with their specific cost rates, that are available for the projects contemplated within an organization. Because proper utilization of the RBS requires precision and standardization in terms of units and dimensions, we review the basic nomenclature and present an example. When combined with a deliverable-oriented WBS, an up-to-date RBS greatly facilitates both initial project planning and the inevitable iterations on the original plans.

Kim Colenso et al (2000) tells that the Work Breakdown Structure (WBS) is the foundation for project planning and control. It is the connecting point for work and cost estimates, schedule information, actual work effort/cost expenditures, and accountability. It must exist before the project manager can plan these related and vital aspects of the project, and they all must be planned before the project manager will be able to measure progress and variance from plan**.**

Jamal A1-Qawasmi et al (2000) his research focuses upon studio-based architectural design education, and specifically the use of desk crits in which the student and instructor discuss an interim state of a solution to a building design problem. The strengths and weaknesses of Internet collaboration software in comparison to face-to-face meetings can be determined objectively through observations of the two ways of conducting a desk crit in controlled experiments. Our study suggests that the collaborative tools still get in the way of smooth communication, but in some ways they provide intensified channels that are superior to face-to-face meetings**.**

J.C. van Tonder et al (2001) tells us that The work breakdown structure (WBS) forms the base for most project management processes. A well-defined and comprehensive WBS that fits the organizational structure and the project system profile is important to increase the probability of project success by ensuring that the best resources are applied to the correct selection of projects suiting the particular company. Many different bases for the WBS are found in the literature, but most WBSs only repeat the functional breakdown of the project organizational structure. A method of building the WBS up from identified interdependent key project deliverables has a distinct advantage in increasing the probability of a successful project.

Prof. Andrew Baldwin et al (2001) states that A variety of modelling methods has been used to model construction processes and projects, either during normal project planning or for process re-engineering efforts or research. One common method, which is widely used by construction industry practitioners, is scheduling. In addition to schedules, some companies have used a simple box-and-arrow method, which graphically resembles schedules, for analyzing their working processes.

K. Sehdev et al (2003) his paper presents an integrated WBS approach for managing the work scope in aircraft modification projects. The modelis the result of an in-depth study and analysis of the working methods in an aircraft modification industrial company This WBS is designed to incorporate the information needs and the views of the different functions involved in aircraft modification. It provides the structure for the reuse of information, such as cost and schedules, in the diverse range of aircraft modification projects**.**

Rev E. et al (2003) gives description that the WBS is a particularly important project tool. Considerable thought and planning should be given to its development and implementation so that subsequent changes are minimized. Major revisions to a WBS require both substantial effort and resources, due to its application to a wide array of project activities. Project WBSs, which are driven by the scope of a project, should not be confused with other uses of WBS-like systems**.**

BoazGolany et al (2003) tells that Division of labor is a management approach based on the breaking up of a process into a series of small tasks so that each task can be assigned to a different worker. Division of labor narrows the scope of work each worker has to learn enabling workers to learn new jobs quickly and providing an environment where each worker can be equipped with special tools and techniques required to do his job.

Denis F. Cioffi et al (2004) tells that it is generally recognized by project management professionals that the work breakdown structure (WBS) is the foundation of planning, estimating, scheduling, and monitoring activities. Although the lower-level elements of a WBS need to be schedule-oriented, the upper levels can (and should) be deliverable.

Josep Lluis Cano Giner et al (2009)tells that the acquisition and use of information are key factors in successful executive performance. Although there are various and different media that executives use to obtain information, in the last decade the academic research has emphasised computer-based systems. Inside this group of systems, we can find the Executive Information Systems (EIS), which are tools that can help executives to obtain relevant information more efficiently. Recently, EIS have been analyzed through the technology Acceptance Model (TAM) with significant results**.**

Michael D. Taylor et al (2009) tells that a well-designed WBS describes planned outcomes instead of planned actions. Outcomes are the desired ends of the project, such as a product, result, or service, and can be predicted accurately. Actions, on the other hand, may be difficult to predict accurately. A well-designed WBS makes it easy to assign any project activity to one and only one terminal element of the WBS.

Jonathan Lee et al (2010) states that in software development, project plans document scope, cost, effort, and schedule, guide project managers, and control project execution. Developing a project plan without incorporating how an organization doing things – i.e., organizational culture – may lead to project failure. To ensure stable process performance and to benefit from organizational culture, it is crucial that organizational processes be taken into account in project planning.

Gui Ponce de Leon et al (2011) states that practitioners who develop schedules at different levels do not agree on the criteria that apply to summary- and detailedlevel schedules, including scheduling technique. This paper reviews recent developments on the concept of schedule levels, including the hierarchy in Guide to the Forensic Scheduling Body of Knowledge.

T.Rajani Devi et al (2012) tells that the WBS or the Work Breakdown Structure is essential as part of project's lifecycle and timeline. An important part of Project planning, the WBS begins with a hierarchy of tasks and levels that help to identify how the project will flow within a designed timeline set by the project manager .

Robert T. Hans et al (2013) states that *Software project scope* verification is a very important process in project scope management and it need to be performed properly and thoroughly so as to avoid project rework and scope creep

Yusree Abubaka et al (2016) tells that the usage of Information Technology in GLC is vital in bringing it as one of potential competitive advantage. Information Technology projects can be a long term or a short term based on the requirement and the scale of the project itself. Project obstacles that lead to failure were caused by different factors and one of the obstacles is the change management. The purpose of this paper is to address the practices of project change management in the context og Government-Linked Company (GLCs) in Malaysia focusing on the Project Management Factors, Change Management Factors, Top Management Factors, Organizational Factors and Process Factors.

Nur Izzati Ahmad Nasir et al (2016) gives the purpose of this paper is to address the practices of project change management in the context og Government-Linked Company (GLCs) in Malaysia focusing on the Project Management Factors, Change Management Factors, Top Management Factors, Organizational Factors and Process Factors. Furthermore, this paper will evaluate the validity of number of critical failure factors introduced by Walid Al Ahmad. A questionnaire will be distributed to staff in GLCs that is or has involved in IT project management.

Luca Alvares Guedes Vaz et al (2016) states that all the Information Systems Projects involve risk of some sort and these projects are becoming increasingly complex, intensifying therefore the probability of various risks. Risks cannot be avoided but they can be managed in way that they are recognized and their impacts accepted, avoided, mitigated or transferred. Frameworks like, PMBOK and PRINCE2 provide guidance and principles that contribute in achieving success in Risk Management processes in Project Management**.**

. **Leni Sagita Riantini Supriadi et al (2017)** in his study The Work Breakdown Structure (WBS) forms the base for most project management processes. Despite each project being unique, most building retain cognate, elemental options that provide the basis for any structure, and these can be standardized and used as a basis for a universal programme of construction works. The standardization of task would enable the automation of project planning processes and hence would result in reduced management cost. This paper proposes the development of WBS Standard and analyzing the possible risks that arise in project implementation then consider those risks for the estimation process.

Ali Hadi Jebrin et al (2018) states that the importance is emphasis from the role of organizations in making strategic decision in field operational project management arises from failures at the planning stage leading to a series of subsequent alterations and clarifications..

S. Abujudeh (2018) tells that the improvement of the project management forced the industrial organizations to focus on using the project management techniques in their industry, to plan and control the workflow to achieve their targets, further to increase the satisfaction of their customers. One of the most common project management tools are used is the work breakdown structure (WBS), which provide a framework for the implementation of the project scope including project planning, scheduling, monitoring, control, and estimation.

Neellohit Burghate et al (2018) tells that the Work Breakdown Structure (WBS) is a powerful tool for project management. It is the cornerstone of effective project planning, execution, controlling, statusing, and reporting. All the work contained within the WBS is to be identified, estimated, scheduled, and budgeted**.**

CHAPTER-3

RESEARCH METHODOLOGY

3.1 Introduction

The study establishes the relation of work breakdown structure technique in context of project life cycle. To find out the actual interpretation on site work. Factor which resist the work breakdown structure application project life cycle. Establish the specific standards where work breakdown structure technique is used in project life cycle management.

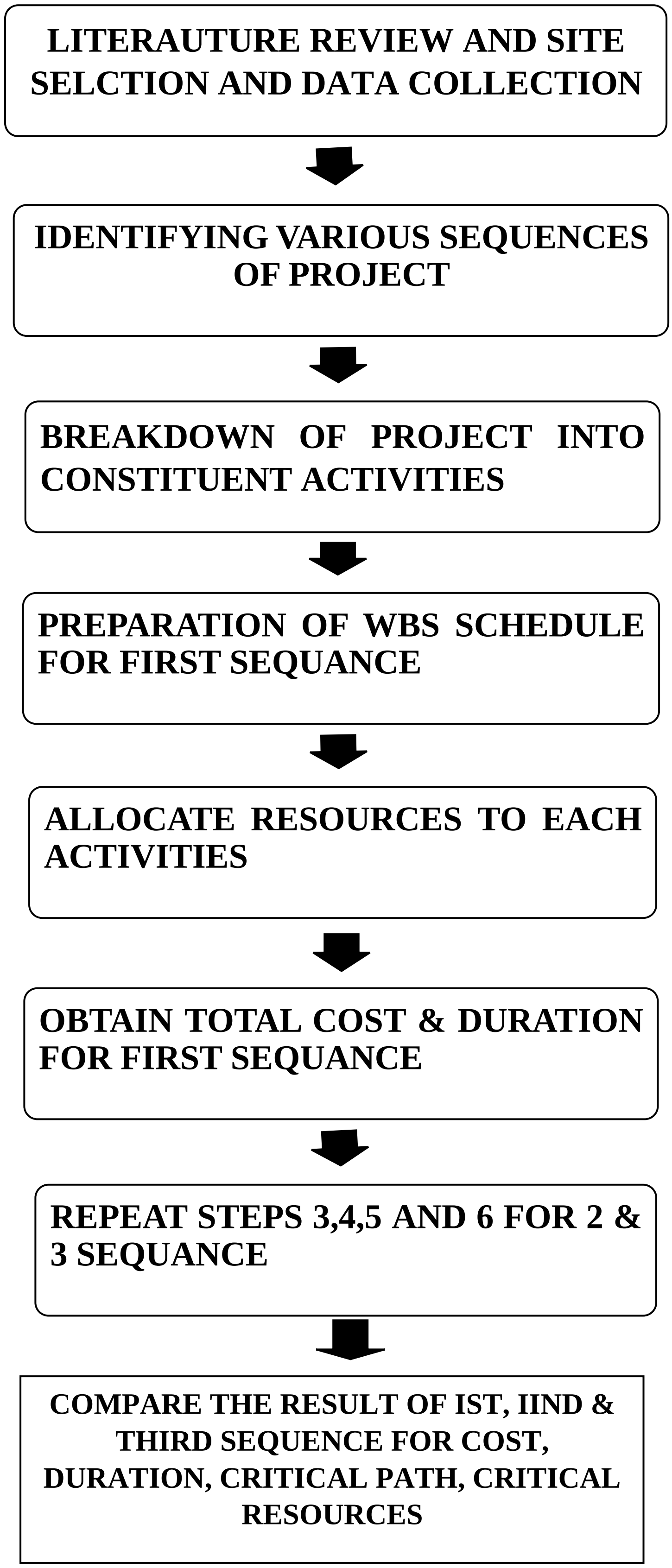
3.2 Methodology

To achieve the stated objective a project consisting of 6 repetitive unit is undertaken. WBS is prepared for each unit. Methodology followed in this paper work is that, first the work breakdown structure of the whole work is prepared and scheduled. Change in completion time and budget is then observed by changing the order of activities. For enabling comparison three different sequence were employed for realization and completion of repetitive unit project.

This paper work makes use of a software method for computing the result faster with lesser chance of error. MSP 2016 is scheduling software which helps to keep an eye on the progress of the construction work from beginning till the end. Web application of this software makes it reachable to all level of employees. Other functions such as resource allocation, role assigning, estimating budget and resource leveling are also available in this software.

A work-breakdown structure (WBS) in project management and systems engineering, is a deliverable-oriented breakdown of a project into smaller components. A work breakdown structure is a key project deliverable that organizes the team's work into manageable sections.

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm theoretical model, phases and quantitative or qualitative techniques.The various steps involved in this study are chronologically explained in the following flow chart.


LITERAUTURE REVIEW AND SITE SELCTION AND DATA COLLECTION
IDENTIFYING VARIOUS SEQUENCES OF PROJECT
BREAKDOWN OF PROJECT INTO CONSTITUENT ACTIVITIES
PREPARATION OF WBS SCHEDULE FOR FIRST SEQUANCE
ALLOCATE RESOURCES TO EACH ACTIVITIES
OBTAIN TOTAL COST & DURATION FOR FIRST SEQUANCE
REPEAT STEPS 3,4,5 AND 6 FOR 2 & 3 SEQUANCE
COMPARE THE RESULT OF IST, IIND & THIRD SEQUENCE FOR COST, DURATION, CRITICAL PATH, CRITICAL RESOURCES

CHAPTER-4

DATA COLLECTION

Sushant Golf City, Lucknow, a Hi-tech Township sprawling across 6465 acres. Located on Amar Shaheed Path & Lucknow-Sultanpur Highway. This ultra modern township has a world class – 18 hole international standard championship Golf Course surrounded by Residential and Commercial Developments. It consist of Apartments, Condos, Single Family Home, Villas, Studio etc.We have chosen a line of 6 unit of single family home as project for our study.

Fig 4.1: Areal View of site

INTRODUTION TO THE SITE

SITE NAME- ANSAL API

PROJECT TYPE - SINGLE FAMILY HOME (6 UNITS)

SITE ENGINEER-Er.SHAYAQ RAZA

LOCATION-AMAR SHAHEED PATH,LUCKNOW

TOTAL AREA OF PROJECT- 16,600sqft

BUILT-UP AREA OF SINGLE UNIT-2106sqft

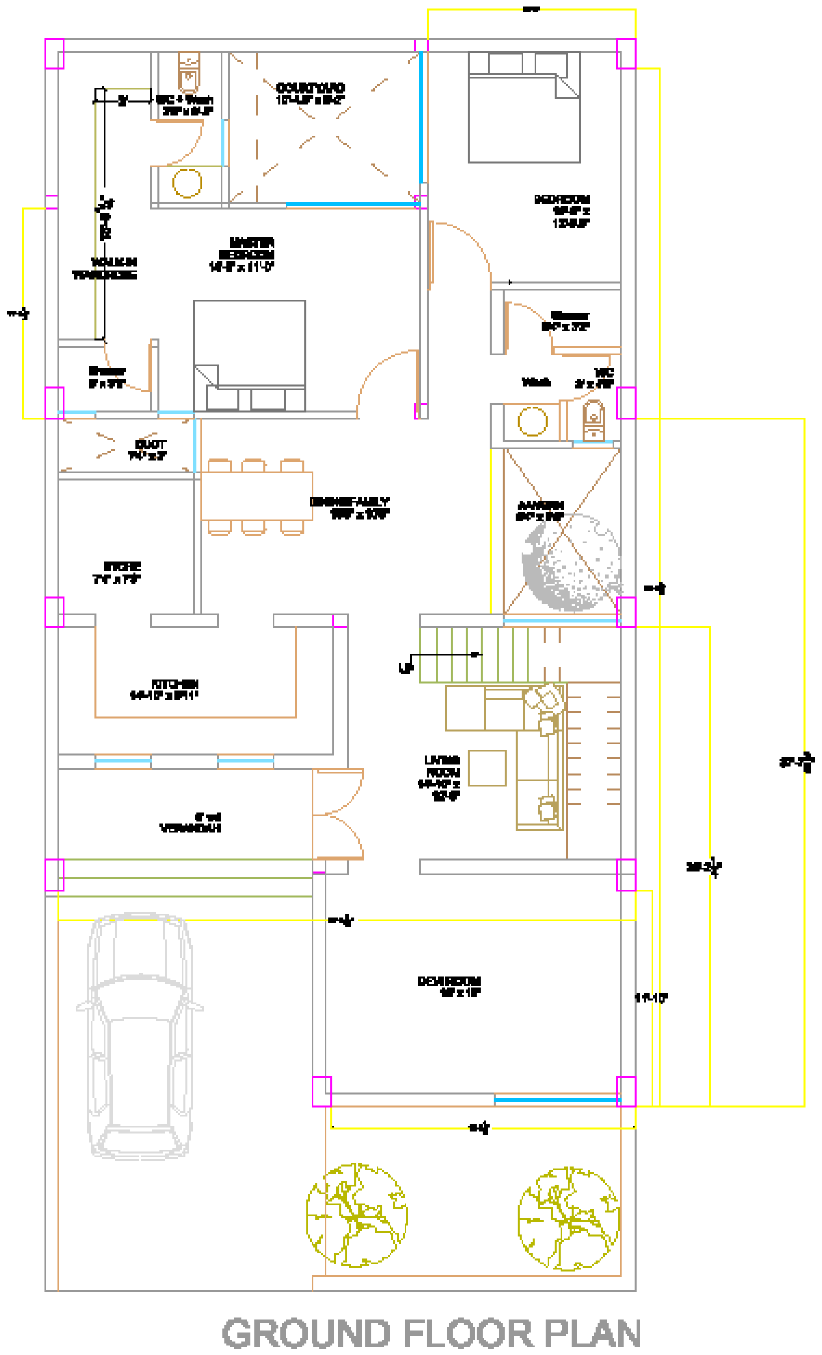
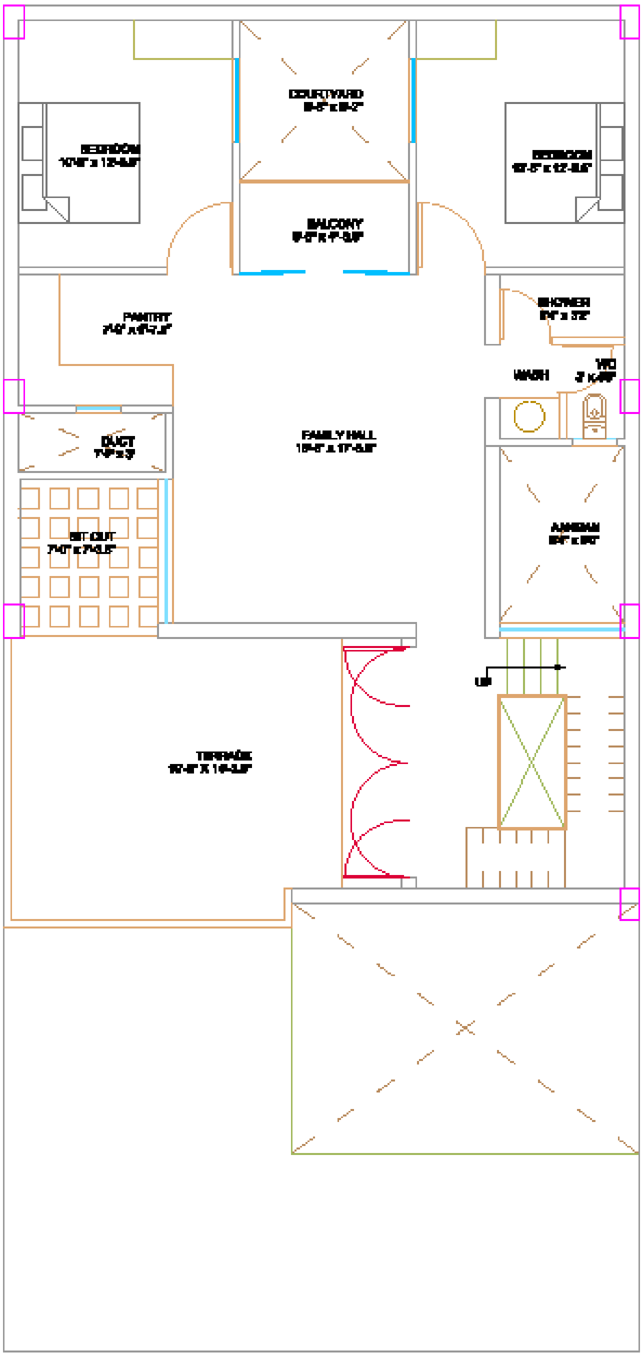


Fig 4.2: Plan of basic unit Ground Floor



FIRST FLOOR PLAN

Fig 4.3: Plan of basic unit First Floor

Fig 4.4: Form work and casting of slab

Fig 4.5: Brickwork and plastering

CHAPTER-5

DATA ANALYSIS

5.1 INTRODUCTION

In Order to draw conclusion from the empirical data statistical evidence is necessary, the existence of strength of the relationship between the variables represented by the data. The project management software Microsoft Project is used to analyze the data collected from the project and findings of work breakdown structure Analysis of construction project are presented in this chapter.

5.2 Data Analysis Procedure

For the completion of this study, a group of 6 repetitive unit of single family home is undertaken as sample on going project. Data for the projected is collected and represented in chapter 4. Three different sequence are employed to complete the same work. Work Breakdown Structure Analysis for all three sequence is performed. Results of the three sequences are compared and conclusion is drawn from the results.

Sequence 1 is one by six. In this sequence work of only one unit is commenced and after the completion of first unit, second unit starts and so on. Sequence 2 is two by three. In this sequence work of two unit commences simultaneously and after the completion of first two unit, next two unit starts and so on. Sequence 3 is three by two. In this sequence work of three unit commences simultaneously and after the completion of first three unit, next three unit are constructed .

Detailed estimated of the basic single unit is provided in table1. After Work Breakdown Structure Analysis for all three sequence is performed, Gantt chart, resources allocation sheet and activity chart are obtained. These are chronologically represented later in this chapter.

Table 5.1: detailed estimate of basic unit

Sl.no.	Description of work	Unit	Rate	Quantity	Amount
1	**Foundation works**				
a	Excavation	Cft	8.00	7103.25	56,826.00
b	Anti termite treatment	Cft	12.00	6986.5	83,838.00
c	PCC (1:4:8)	Cft	135.00	315.70	42,619.50
d	substructure brickwork	Cft	135.00	3157.00	426,195.00
e	RCC (1:1.5:3)	Cft	165.00	169.13	27905.63
f	refilling	Cft	5.00	3157.00	15,785.00
2	**MASONARY WORKS**				
	GROUND FLOOR	Cft	150.00	2,860.60	429,090.00
	FIRST FLOOR	Cft	150.00	1,454.50	218,175.00
	parapat wall	Cft	165.00	1,000.00	165,000.00
	mumty	Cft	165.00	300.00	49,500.00
3	**CONCRETE WORKS**				
	GROUND FLOOR	Cft	170.00	928.48	157,841.60
	FIRST FLOOR	Cft	170.00	659.99	112,198.30
	mumty	Cft	185.00	50	9,250.00
4.0	**Steel works**	kgs	70	13680	957600
5.0	**Doors and windows**				
	Door	sft	900	308	277,200.00
	windows	sft	900	175	157,500.00
6	**Plastering works and Pointing work.**				
	GROUND FLOOR	Sft	35.00	1,480.00	51,800.00
	FIRST FLOOR	Sft	35.00	780.00	27,300.00
	parapat wall	Sft	35.00	1,250.00	43,750.00
	mumty	Sft	40.25	600.00	24,150.00
7	**Waterproofing**				

	external plaster	Sft	80.00	3,010.00	240,800.00
	roof	Sft	60.00	2,128.80	127,728.00
8	**Flooring and Dadoing works**				
	GROUND FLOOR	Sft	120.00	2,850.00	342,000.00
	first floor	Sft	120.00	1,443.00	173,160.00
	staircase	sft	130.00	504.00	65,520.00
9	**painting works**				
	All floors	Sft	20.00	8,950.00	179,000.00
	ms railing and others component	kg	10.00	1,500.00	15,000.00
10	**ELECTRICAL WORK (10% of total cost)**	**L.S**			**388,000.00**
11	**Plumbing work(10% of total cost)**	**L.S**			**388,000.00**
12	**Steel fabrication works**				
	main gate	**L.S**			160,000.00
	ms railing	**L.S**	300.00	220.00	66,000.00
13	**SHUTTERING**	sft	26.00	5,147.45	133,833.70
	TOTAL AMOUNT				**5,612,565.73**

The work breakdown structure gives the following data given below which determines health of the project. Analysis using work breakdown structure concepts gives lots of facts about our project.This helps project manager to monitor the changes happening from the baseline. Work breakdown structure is carried out by tracking the project & collecting data from site and then monitoring all the activities of the project carefully after all the data carried out from project the analysis is carried out with the help of The Microsoft Project is a project management software.

5.3 SEQUENCE-1 ONE BY SIX

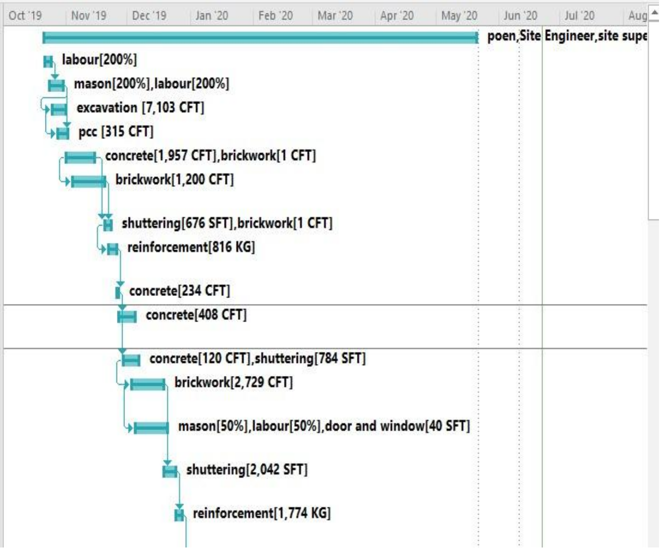
In this sequence work of only one unit is commenced and after the completion of first unit, second unit starts and so on. The details of single unit is provided in the previous chapter. Work Breakdown Structure for one unit is shown in fig 5.1 . The listing of all related activities and their relationship along with duration is represented in the Gantt Chart shown in same figure.

Figure 5.2 shown the activity chart for unit1. Activity chart consist of different paths.It allows the project manger to gauge the importance of various paths in terms of resources, labour and time. The longest path in the activity chart is the critical path. Any delay in activities of this path due to shortage of labour or material would eventually lead to increase in the duration of whole project. While activities in other path have lag period i.e completion of such can be delayed but by lag period only.

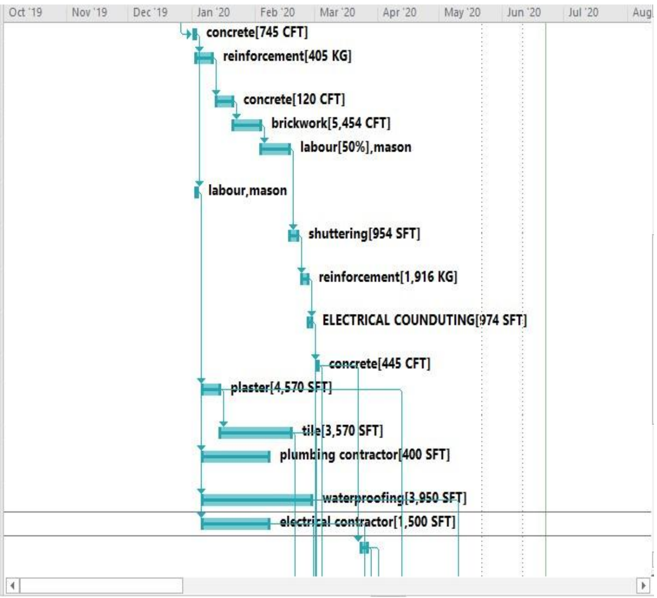
Figure 5.3 shows the Resource Allocation Chart of unit1. In this chart listing of all the resources required in the project is done. Along with the listing of resources, a time line is also developed representing the resources required at a point of time. It allows project manager to gather fund for resources required at a point of time.

- Only one unit is commenced after the completion of unit, second unit starts.
- Demand of fund is linear.
- Work progresses in slow pace.
- Suitable for project with Fund are to be arranged.

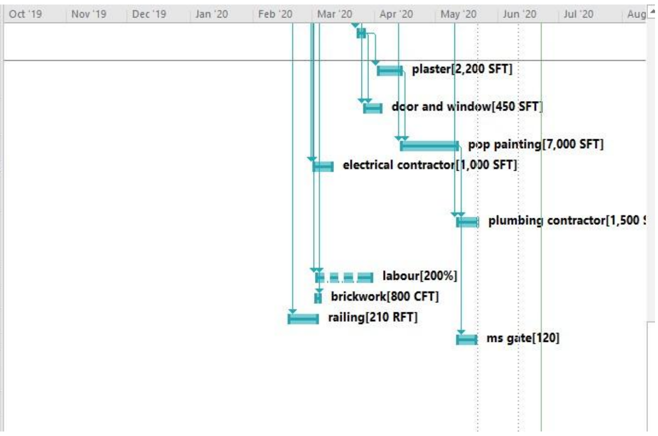
	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1	✓	UNIT 1	153 days	Mon 21-10-1	Wed 20-05-2	
2	✓	Clearing of site	2 days	Mon 21-10-1	Thu 24-10-19	
3	✓	Layout	3.5 days	Wed 23-10-1	Wed 30-10-1	2
4	✓	excavation OF SOIL	5 days	Fri 25-10-19	Thu 31-10-19	3
5	✓	PCC	5 days	Mon 28-10-1	Fri 01-11-19	3,4SS+1 day
6	✓	Foundation casting	10 days	Fri 01-11-19	Thu 14-11-19	
7	✓	Brickwork in substructure	12 days	Mon 04-11-19	Tue 19-11-19	6SS
8	✓	form work tie beam	3 days	Wed 20-11-1	Fri 22-11-19	6,7
9	✓	tie beam reinforcement	2 days	Fri 22-11-19	Mon 25-11-19	8SS+2 days
10	✓	casting of tie beam	1 day	Tue 26-11-19	Tue 26-11-19	9
11	✓	Column reinforcement GF	6 days	Wed 27-11-19	Wed 04-12-19	10
12	✓	column casting	6 days	Fri 29-11-19	Fri 06-12-19	10FS+2 days
13	✓	brickwork groumd floor	12 days	Tue 03-12-19	Wed 18-12-19	12SS+2 days
14	✓	door and window frame fixing	12 days	Thu 05-12-19	Fri 20-12-19	13SS+2 days
15	✓	formwork for GF Slab	4 days	Thu 19-12-19	Tue 24-12-19	13
16	✓	reinforcemnt for gf Slab	3 days	Wed 25-12-19	Fri 27-12-19	15



	Task Mode	Task Name	Duration	Start	Finish	Predecessors
18	✓	casting of slab	1 day	Thu 02-01-20	Thu 02-01-20	17SS+3 days
19	✓	Column reinforcement FF	6 days	Fri 03-01-20	Fri 10-01-20	18
20	✓	column casting	6 days	Mon 13-01-2	Mon 20-01-2	19
21	✓	brickwork first floor	10 days	Tue 21-01-20	Mon 03-02-2	20
22	✓	door and window frame fixing FF	10 days	Tue 04-02-20	Mon 17-02-20	21
23	✓	removal of GF foam work	1 day	Fri 03-01-20	Fri 03-01-20	18
24	✓	formwork for FF Slab	4 days	Tue 18-02-20	Fri 21-02-20	22
25	✓	reinforcemnt for FF Slab	3 days	Mon 24-02-20	Wed 26-02-20	24
26	✓	electrical conduiting FF	2 days	Thu 27-02-20	Fri 28-02-20	25
27	✓	casting of slab FF	1 day	Mon 02-03-2	Mon 02-03-2	26
28	✓	Plaster Ground floor	7 days	Mon 06-01-20	Tue 14-01-20	23
29	✓	Flooring	25 days	Wed 15-01-2	Tue 18-02-20	28
30	✓	Laying of PLUmbing line	25 days	Mon 06-01-20	Fri 07-02-20	23
31	✓	water proofing	40 days	Mon 06-01-2	Fri 28-02-20	23
32	✓	electrical wiring	25 days	Mon 06-01-2	Fri 07-02-20	23
33	✓	REMOVAL OF FORMWORK FF	3 days	Tue 24-03-20	Thu 26-03-20	27FS+15 days



	Task Mode	Task Name	Duration	Start	Finish	Predecessors
33	✓	REMOVAL OF FORMWORK FF	3 days	Tue 24-03-20	Thu 26-03-20	27FS+15 days
34	✓	PLASTERING FIRST FLOOR	7 days	Fri 03-04-20	Mon 13-04-20	33FS+5 days
35	✓	doors and window fixing	6 days	Fri 27-03-20	Fri 03-04-20	32,33
36	✓	pop/putty/painting	20 days	Tue 14-04-20	Mon 11-05-2	28,34
37	✓	electrical accessories installation	7 days	Mon 02-03-20	Tue 10-03-20	26,32FS+15 days
38	✓	Plumbing accessories Installation	8 days	Tue 12-05-20	Thu 21-05-20	31,36
39	✓	landscaping	10 days	Tue 03-03-20	Mon 30-03-2	27,29
40	✓	parapet wall	2 days	Tue 03-03-20	Wed 04-03-2	27
41	✓	railing	10 days	Wed 19-02-2	Tue 03-03-20	29
42	✓	main gate	7 days	Tue 12-05-20	Wed 20-05-2	36



GANTT CHART

Fig. 5.1WBS and GANTT chart unit 1

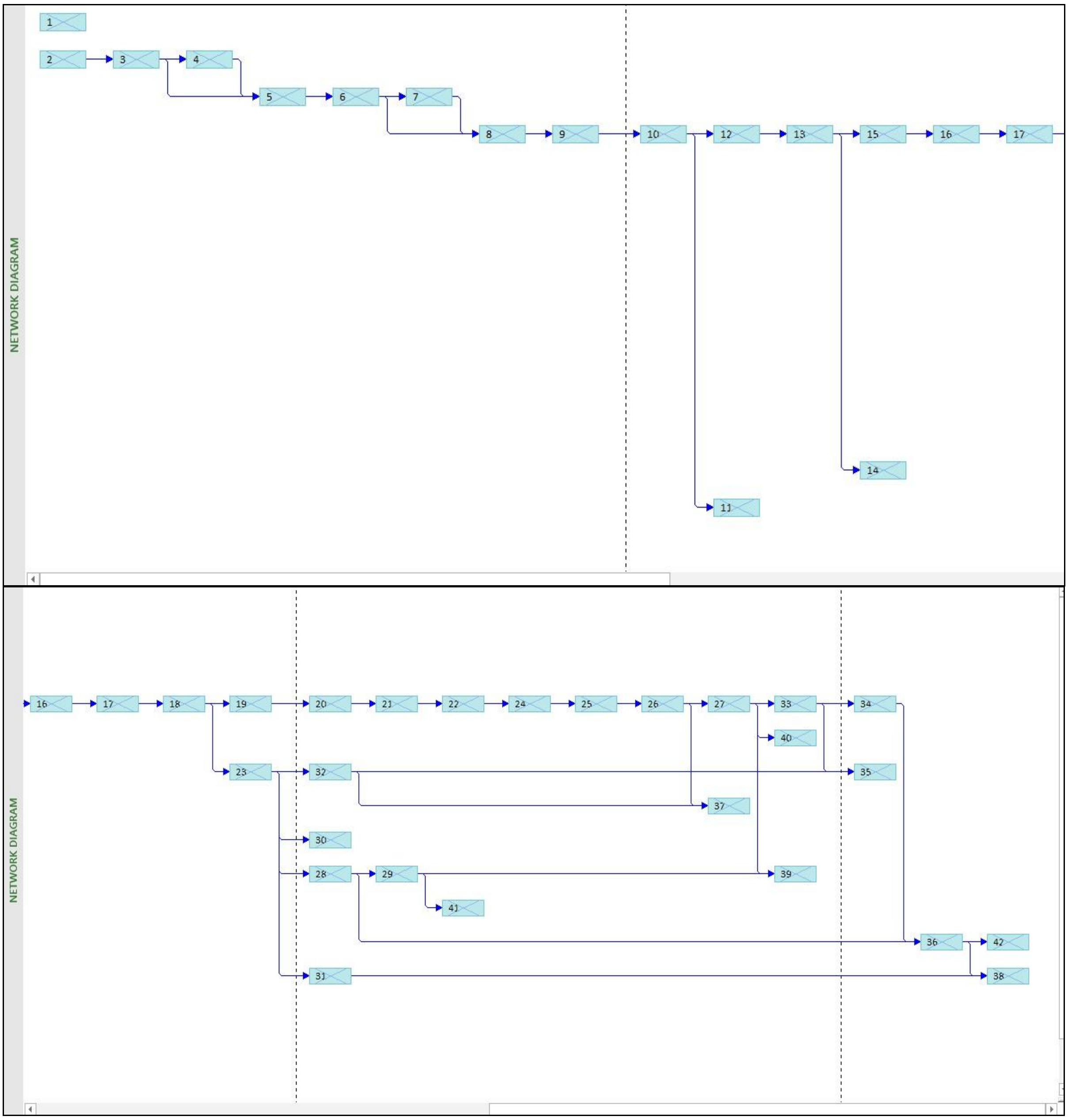


Fig. 5.2 Activity chart unit-1

RESOURCE USAGE

	Resource Name	Work	Details	21 Oct	04 Nov	18 Nov	02 Dec	16 Dec	30 Dec	13 Jan	27 Jan	10 Feb	24 Feb	09 Mar	23 Mar	06 Apr	20 Apr
				November 2019			December 2019		January 2020		February 2020		March 2020		April 2020		
	◢ Unassigned	0 hrs	Work														
	REMOVAL OF FORMWORK FF	0 hrs	Work														
1	◢ concrete	4,029 CFT	Work (CFT)	195.7	1,761.3	458	304		745	120			445				
	Foundation casting	1,957 CFT	Work (CFT)	195.7	1,761.3												
	casting of tie beam	234 CFT	Work (CFT)			234											
	Column reinforcement GF	408 CFT	Work (CFT)			204	204										
	column casting	120 CFT	Work (CFT)			20	100										
	casting of slab	745 CFT	Work (CFT)						745								
	column casting	120 CFT	Work (CFT)							120							
	casting of slab FF	445 CFT	Work (CFT)										445				
2	◢ brickwork	10,183 CFT	Work (CFT)		1,000	200	2,046.75	682.25		2,181.6	3,272.4		800				
	Brickwork in substructure	1,200 CFT	Work (CFT)		1,000	200											
	brickwork groumd floor	2,729 CFT	Work (CFT)				2,046.75	682.25									
	brickwork first floor	5,454 CFT	Work (CFT)							2,181.6	3,272.4						
	parapet wall	800 CFT	Work (CFT)										800				

RESOURCE USAGE

	Resource Name	Work	Details	21 Oct	04 Nov	18 Nov	02 Dec	16 Dec	30 Dec	13 Jan	27 Jan	10 Feb	24 Feb	09 Mar	23 Mar	06 Apr	20 Apr
				November 2019			December 2019		January 2020		February 2020		March 2020		April 2020		
3	◢ pcc	315 CFT	Work (CFT)	315													
	PCC	315 CFT	Work (CFT)	315													
4	◢ plaster	6,770 SFT	Work (SFT)						3,264.29	1,305.71					314.29	1,885.71	
	Plaster Ground floor	4,570 SFT	Work (SFT)						3,264.29	1,305.71							
	PLASTERING FIRST FLOOR	2,200 SFT	Work (SFT)												314.29	1,885.71	
5	◢ reinforcement	4,911 KG	Work (KG)			816		1,774	405				1,916				
	tie beam reinforcement	816 KG	Work (KG)			816											
	reinforcemnt for gf Slab	1,774 KG	Work (KG)					1,774									
	Column reinforcement FF	405 KG	Work (KG)						405								
	reinforcemnt for FF Slab	1,916 KG	Work (KG)										1,916				
6	◢ door and window	490 SFT	Work (SFT)				23.33	16.67							450		
	door and window frame fixing	40 SFT	Work (SFT)				23.33	16.67									
	doors and window fixing	450 SFT	Work (SFT)												450		

RESOURCE USAGE

	Resource Name	Work	Details	21 Oct	04 Nov	18 Nov	02 Dec	16 Dec	30 Dec	13 Jan	27 Jan	10 Feb	24 Feb	09 Mar	23 Mar	06 Apr	20 Apr
				November 2019		December 2019			January 2020		February 2020		March 2020		April 2020		
7	tile	3,570 SFT	Work (SFT)							1,142.4	1,428	999.6					
	Flooring	3,570 SFT	Work (SFT)							1,142.4	1,428	999.6					
8	plumbing contractor	1,900 SFT	Work (SFT)						80	160	160						
	Laying of PLUmbing line	400 SFT	Work (SFT)						80	160	160						
	Plumbing accessories Installation	1,500 SFT	Work (SFT)														
9	electrical contractor	2,500 SFT	Work (SFT)						300	600	600		714.29	285.71			
	electrical wiring	1,500 SFT	Work (SFT)						300	600	600						
	electrical accessories installation	1,000 SFT	Work (SFT)										714.29	285.71			
10	ELECTRICAL COUNDUTING	2,748 SFT	Work (SFT)						1,267.14	506.86			974				
	electrical conduiting	1,774 SFT	Work (SFT)						1,267.14	506.86							
	electrical conduiting FF	974 SFT	Work (SFT)										974				
11	shuttering	4,456 SFT	Work (SFT)			806.67	653.33	2,042				954					
	form work tie beam	676 SFT	Work (SFT)			676											

RESOURCE USAGE

	Resource Name	Work	Details	S	N	J	M	M	J	S	N
					Half 1, 2020				Half 2, 2020		
	column casting	784 SFT	Work (SFT)		784						
	formwork for GF Slab	2,042 SFT	Work (SFT)		2,042						
	formwork for FF Slab	954 SFT	Work (SFT)			954					
12	railing	210 RFT	Work (RFT)			168	42				
	railing	210 RFT	Work (RFT)			168	42				
13	ms gate	120	Work					120			
	main gate	120	Work					120			
14	pop painting	7,000 SFT	Work (SFT)				4,550	2,450			
	pop/putty/pain	7,000 SFT	Work (SFT)				4,550	2,450			
15	waterproofing	3,950 SFT	Work (SFT)			3,950					
	water proofing	3,950 SFT	Work (SFT)			3,950					
16	excavation	7,103 CFT	Work (CFT)	7,103							
	excavation OF SOIL	7,103 CFT	Work (CFT)	7,103							
17	soil refilling	0 CFT	Work (CFT)								
18	labour	320 hrs	Work	64h	48h	48h	160h				
	Clearing of site	32 hrs	Work	32h							
	Layout	32 hrs	Work	32h							
	door and window frame fixing	48 hrs	Work		48h						
	door and	40 hrs	Work			40h					

RESOURCE USAGE

					Half 1, 2020				Half 2, 2020		
	Resource Name	Work	Details	S	N	J	M	M	J	S	N
	door and window frame fixing FF	40 hrs	Work			40h					
	removal of GF foam work	8 hrs	Work			8h					
	landscaping	160 hrs	Work				160h				
19	mason	168 hrs	Work	32h	48h	88h					
	Layout	32 hrs	Work	32h							
	door and window frame fixing	48 hrs	Work		48h						
	door and window frame fixing FF	80 hrs	Work			80h					
	removal of GF foam work	8 hrs	Work			8h					
20	Site Engineer	1,224 hrs	Work	72h	344h	344h	352h	112h			
	UNIT 1	1,224 hrs	Work	72h	344h	344h	352h	112h			
21	site supervisor	1,224 hrs	Work	72h	344h	344h	352h	112h			
	UNIT 1	1,224 hrs	Work	72h	344h	344h	352h	112h			
22	poen	1,224 hrs	Work	72h	344h	344h	352h	112h			
	UNIT 1	1,224 hrs	Work	72h	344h	344h	352h	112h			
			Work								
			Work								

Fig 5.3:A Resource allocation chart Unit 1

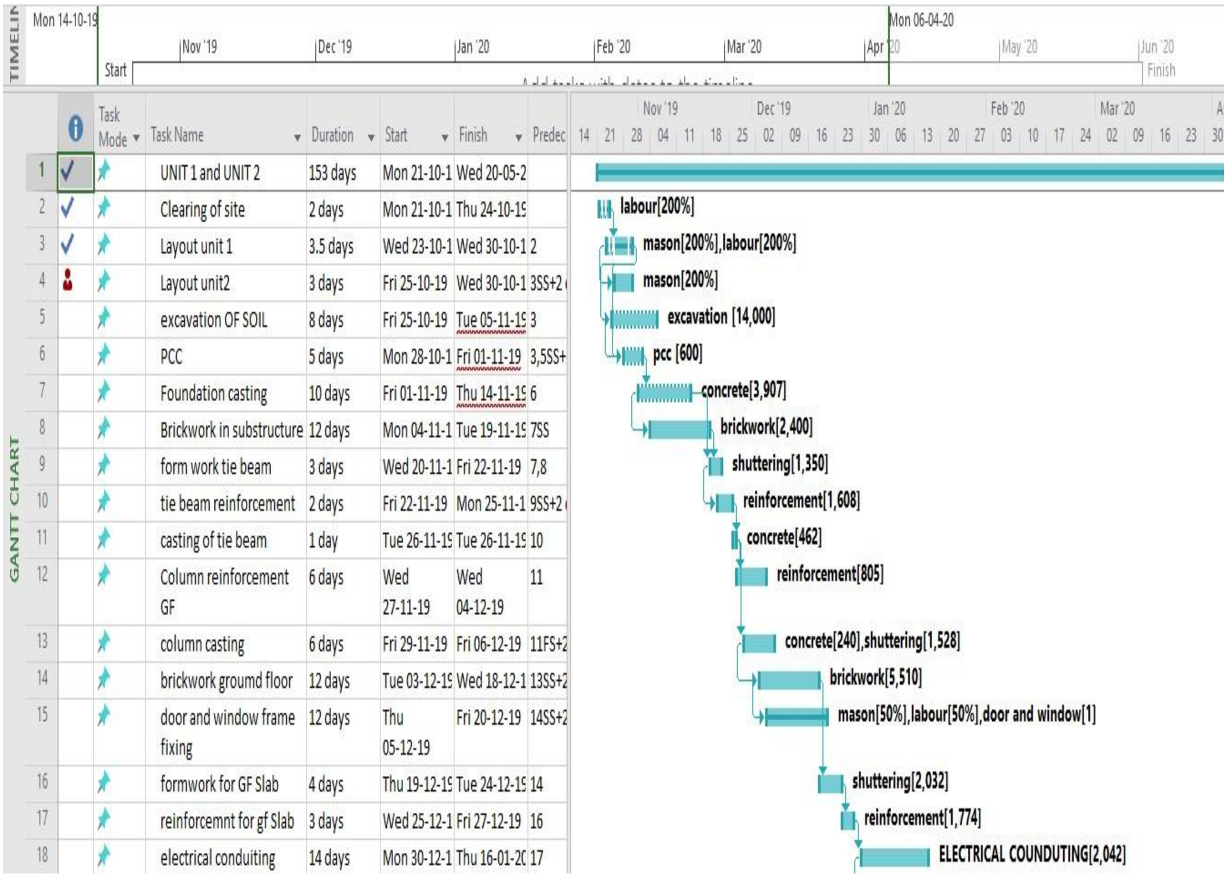
5.4 SEQUENCE-2 TWO BY THREE

In this sequence work of only one unit is commenced and after the completion of first unit, second unit starts and so on. The details of single unit is provided in the previous chapter. Work Breakdown Structure for one unit is shown in fig 5.4 . The listing of all related activities and their relationship along with duration is represented in the Gantt Chart shown in same figure.

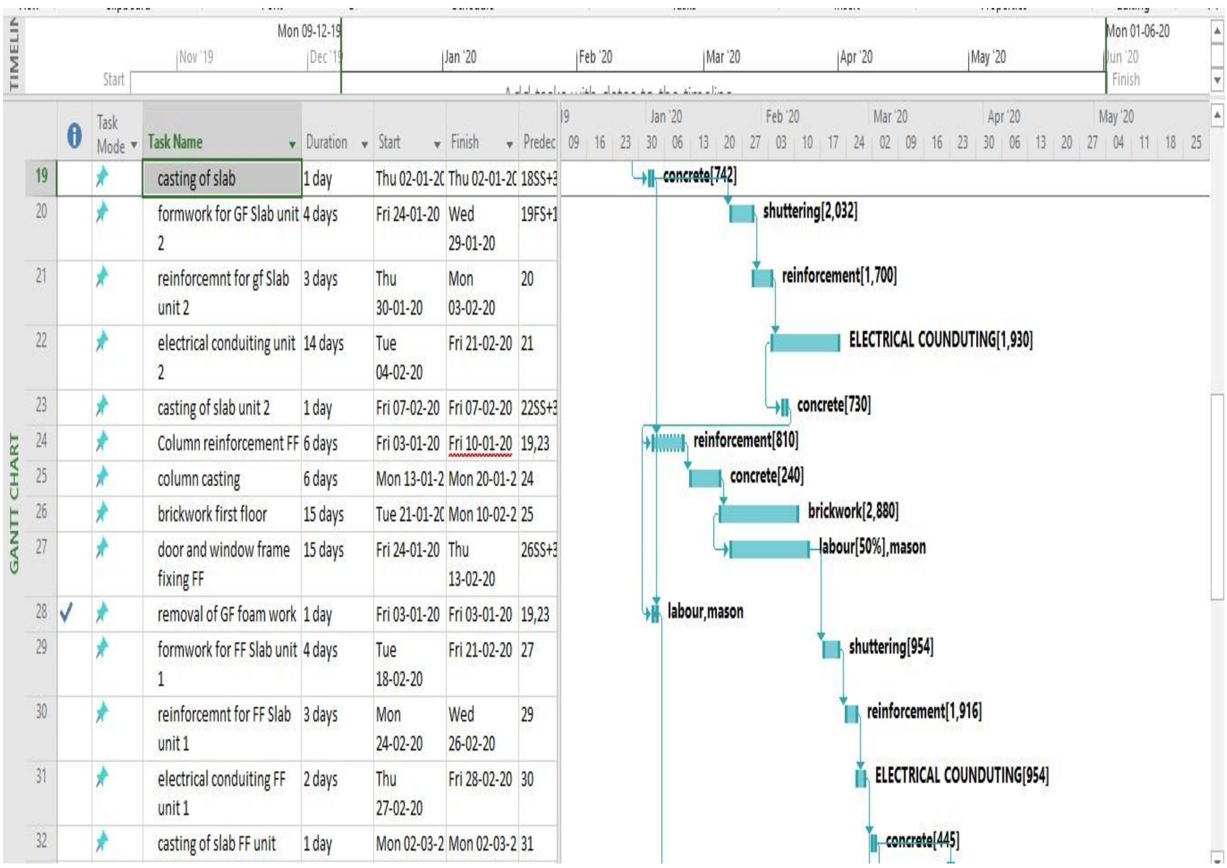
Figure 5.5 shown the activity chart for unit 2. Activity chart consist of different paths.It allows the project manger to gauge the importance of various paths in terms of resources, labour and time. The longest path in the activity chart is the critical path. Any delay in activities of this path due to shortage of labour or material would eventually lead to increase in the duration of whole project. While activities in other path have lag period i.e completion of such can be delayed but by lag period only.

Figure 5.6 shows the Resource Allocation Chart of unit2. In this chart listing of all the resources required in the project is done. Along with the listing of resources, a time line is also developed representing the resources required at a point of time. It allows project manager to gather fund for resources required at a point of time.

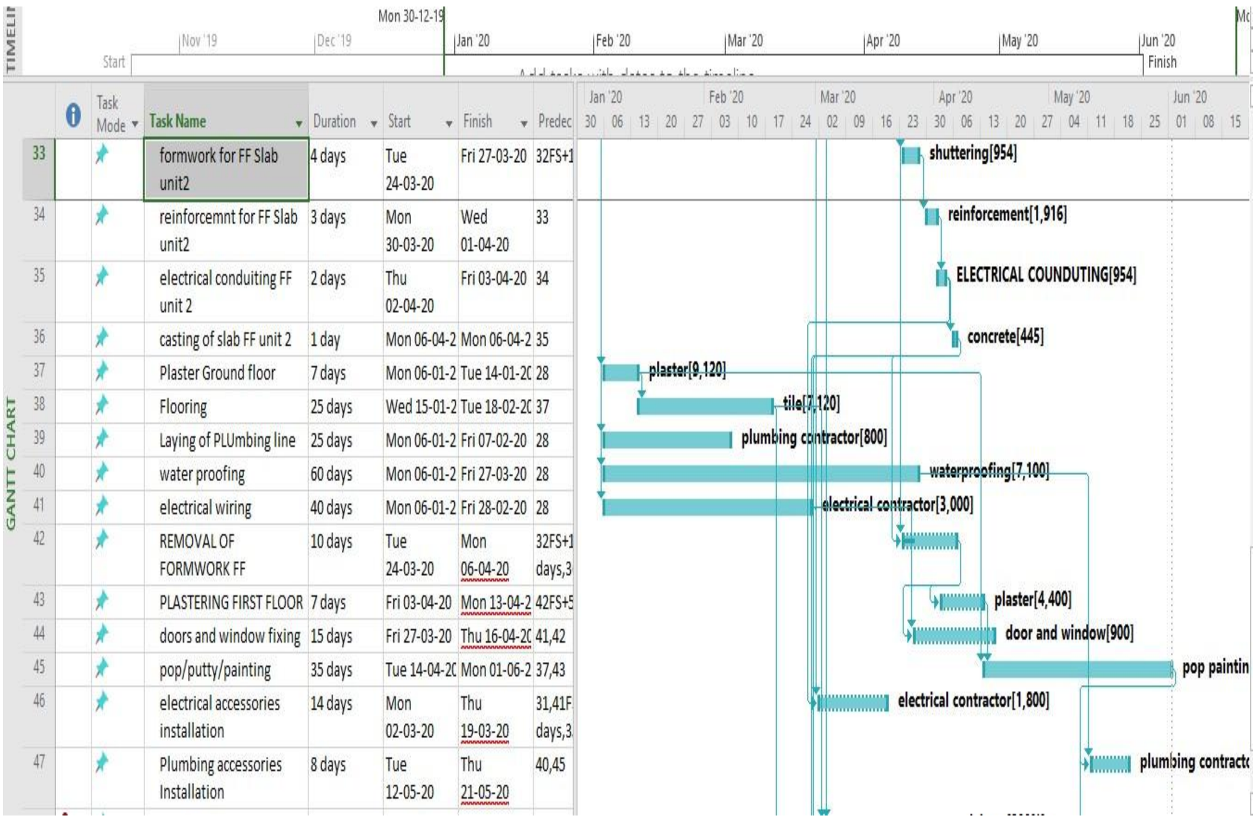
- Two units commenced and after the completion of first two units, next two unit starts simultaneous.
- Demand of fund is non-linear.
- Work progresses in medium pace.
- Suitable for project with almost all of fund is available at hand no dependencies of fund on external sources.



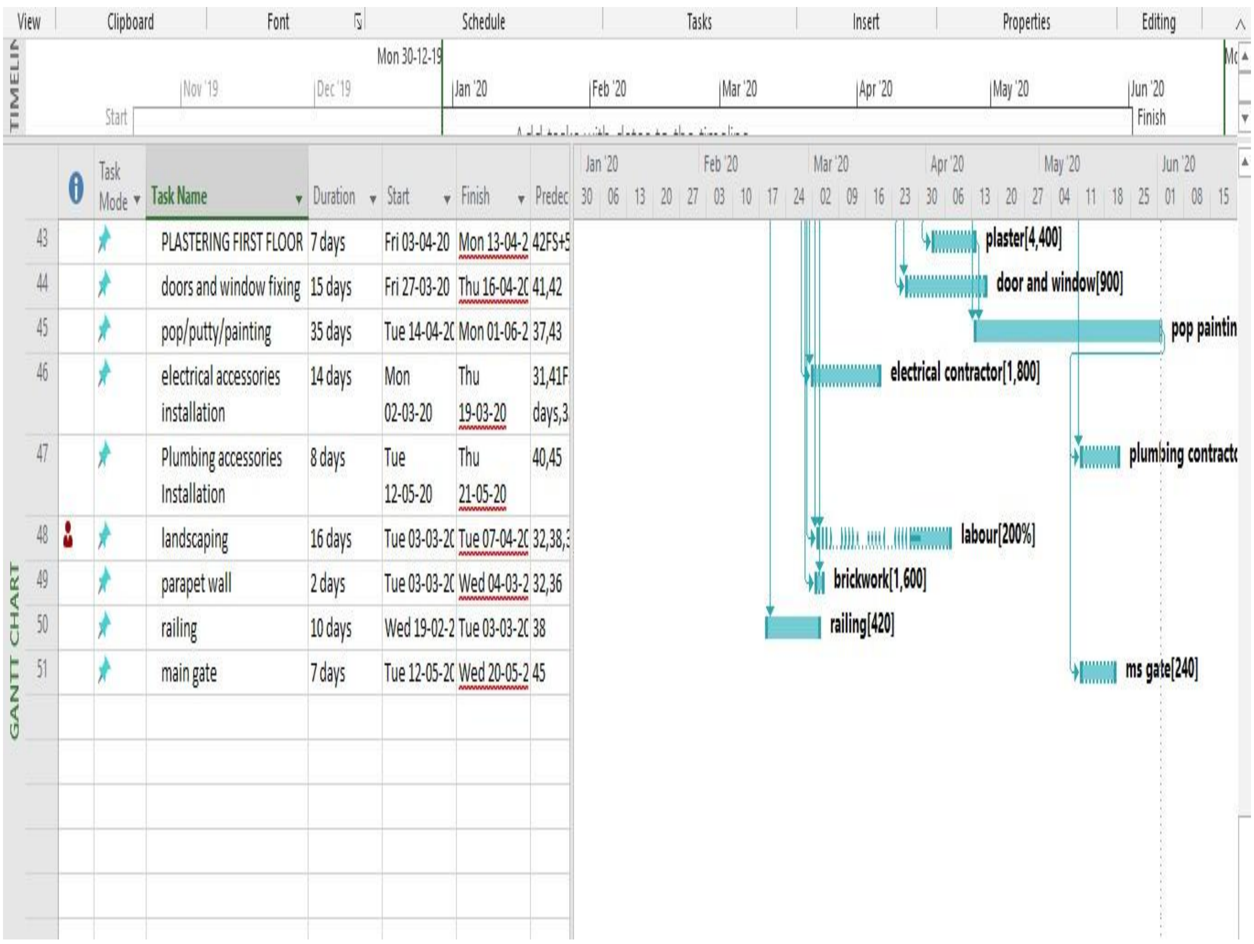
ID	Task Name	Duration	Start	Finish	Predec
1	UNIT 1 and UNIT 2	153 days	Mon 21-10-1	Wed 20-05-2	
2	Clearing of site	2 days	Mon 21-10-1	Thu 24-10-19	
3	Layout unit 1	3.5 days	Wed 23-10-1	Wed 30-10-1	2
4	Layout unit2	3 days	Fri 25-10-19	Wed 30-10-1	3SS+2
5	excavation OF SOIL	8 days	Fri 25-10-19	Tue 05-11-19	3
6	PCC	5 days	Mon 28-10-1	Fri 01-11-19	3,5SS+
7	Foundation casting	10 days	Fri 01-11-19	Thu 14-11-19	6
8	Brickwork in substructure	12 days	Mon 04-11-1	Tue 19-11-19	7SS
9	form work tie beam	3 days	Wed 20-11-1	Fri 22-11-19	7,8
10	tie beam reinforcement	2 days	Fri 22-11-19	Mon 25-11-1	9SS+2
11	casting of tie beam	1 day	Tue 26-11-19	Tue 26-11-19	10
12	Column reinforcement GF	6 days	Wed 27-11-19	Wed 04-12-19	11
13	column casting	6 days	Fri 29-11-19	Fri 06-12-19	11FS+2
14	brickwork groumd floor	12 days	Tue 03-12-19	Wed 18-12-1	13SS+2
15	door and window frame fixing	12 days	Thu 05-12-19	Fri 20-12-19	14SS+2
16	formwork for GF Slab	4 days	Thu 19-12-19	Tue 24-12-19	14
17	reinforcemnt for gf Slab	3 days	Wed 25-12-1	Fri 27-12-19	16
18	electrical conduiting	14 days	Mon 30-12-1	Thu 16-01-20	17



ID	Task Name	Duration	Start	Finish	Predec
19	casting of slab	1 day	Thu 02-01-20	Thu 02-01-20	18SS+3
20	formwork for GF Slab unit 2	4 days	Fri 24-01-20	Wed 29-01-20	19FS+1
21	reinforcemnt for gf Slab unit 2	3 days	Thu 30-01-20	Mon 03-02-20	20
22	electrical conduiting unit 2	14 days	Tue 04-02-20	Fri 21-02-20	21
23	casting of slab unit 2	1 day	Fri 07-02-20	Fri 07-02-20	22SS+3
24	Column reinforcement FF	6 days	Fri 03-01-20	Fri 10-01-20	19,23
25	column casting	6 days	Mon 13-01-2	Mon 20-01-2	24
26	brickwork first floor	15 days	Tue 21-01-20	Mon 10-02-2	25
27	door and window frame fixing FF	15 days	Fri 24-01-20	Thu 13-02-20	26SS+3
28	removal of GF foam work	1 day	Fri 03-01-20	Fri 03-01-20	19,23
29	formwork for FF Slab unit 1	4 days	Tue 18-02-20	Fri 21-02-20	27
30	reinforcemnt for FF Slab unit 1	3 days	Mon 24-02-20	Wed 26-02-20	29
31	electrical conduiting FF unit 1	2 days	Thu 27-02-20	Fri 28-02-20	30
32	casting of slab FF unit	1 day	Mon 02-03-2	Mon 02-03-2	31



ID	Task Name	Duration	Start	Finish	Predec
33	formwork for FF Slab unit2	4 days	Tue 24-03-20	Fri 27-03-20	32FS+1
34	reinforcemnt for FF Slab unit2	3 days	Mon 30-03-20	Wed 01-04-20	33
35	electrical conduiting FF unit 2	2 days	Thu 02-04-20	Fri 03-04-20	34
36	casting of slab FF unit 2	1 day	Mon 06-04-2	Mon 06-04-2	35
37	Plaster Ground floor	7 days	Mon 06-01-2	Tue 14-01-2(	28
38	Flooring	25 days	Wed 15-01-2	Tue 18-02-2(	37
39	Laying of PLUmbing line	25 days	Mon 06-01-2	Fri 07-02-20	28
40	water proofing	60 days	Mon 06-01-2	Fri 27-03-20	28
41	electrical wiring	40 days	Mon 06-01-2	Fri 28-02-20	28
42	REMOVAL OF FORMWORK FF	10 days	Tue 24-03-20	Mon 06-04-20	32FS+1 days,3
43	PLASTERING FIRST FLOOR	7 days	Fri 03-04-20	Mon 13-04-2	42FS+5
44	doors and window fixing	15 days	Fri 27-03-20	Thu 16-04-2(	41,42
45	pop/putty/painting	35 days	Tue 14-04-2(	Mon 01-06-2	37,43
46	electrical accessories installation	14 days	Mon 02-03-20	Thu 19-03-20	31,41F days,3
47	Plumbing accessories Installation	8 days	Tue 12-05-20	Thu 21-05-20	40,45



ID	Task Name	Duration	Start	Finish	Predec
43	PLASTERING FIRST FLOOR	7 days	Fri 03-04-20	Mon 13-04-2	42FS+5
44	doors and window fixing	15 days	Fri 27-03-20	Thu 16-04-2(	41,42
45	pop/putty/painting	35 days	Tue 14-04-2(	Mon 01-06-2	37,43
46	electrical accessories installation	14 days	Mon 02-03-20	Thu 19-03-20	31,41F days,3
47	Plumbing accessories Installation	8 days	Tue 12-05-20	Thu 21-05-20	40,45
48	landscaping	16 days	Tue 03-03-2(	Tue 07-04-2(	32,38,:
49	parapet wall	2 days	Tue 03-03-2(	Wed 04-03-2	32,36
50	railing	10 days	Wed 19-02-2	Tue 03-03-2(	38
51	main gate	7 days	Tue 12-05-2(	Wed 20-05-2	45

Fig. 5.4 WBS and GANTT chart unit 1 & 2

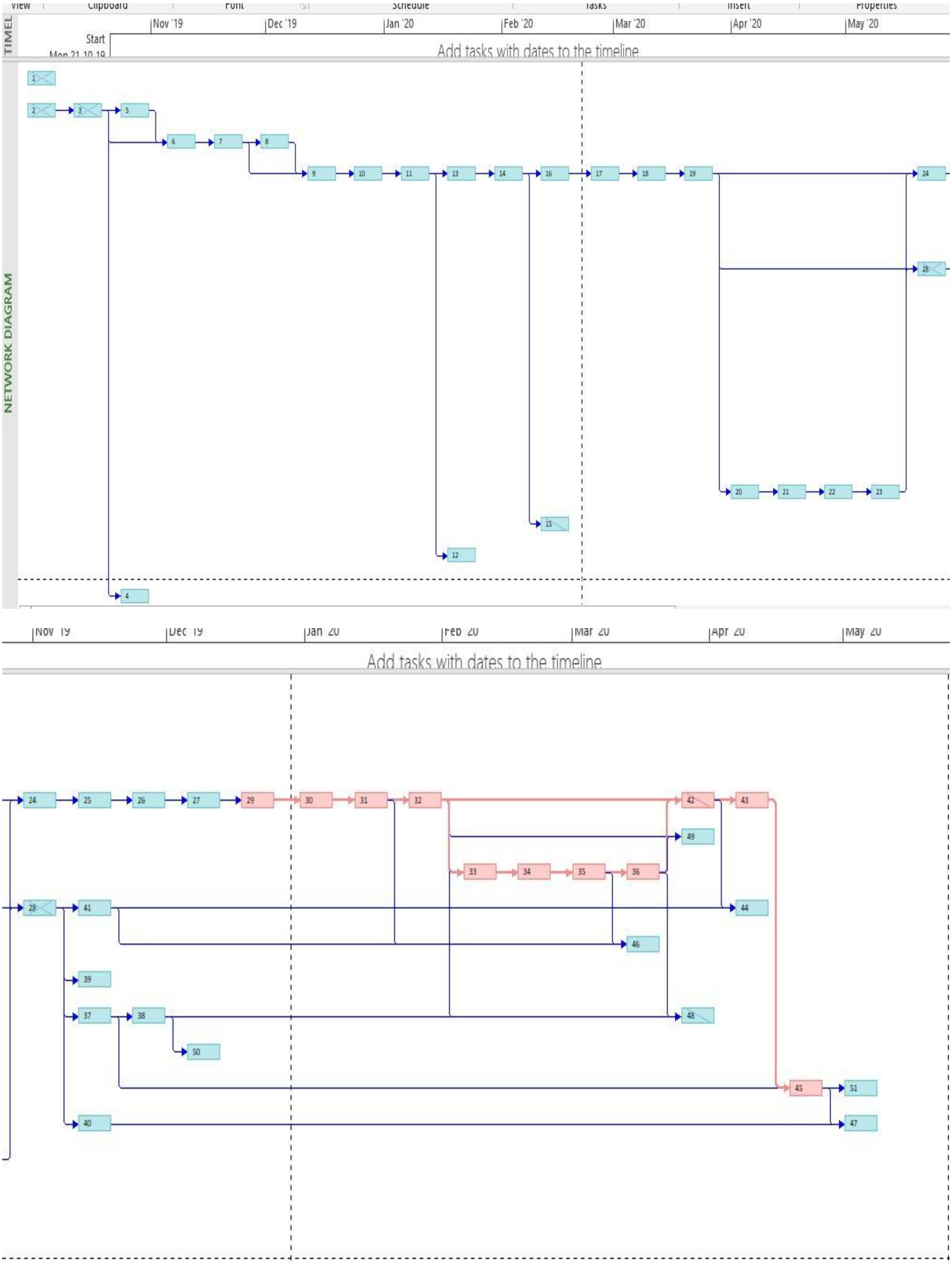
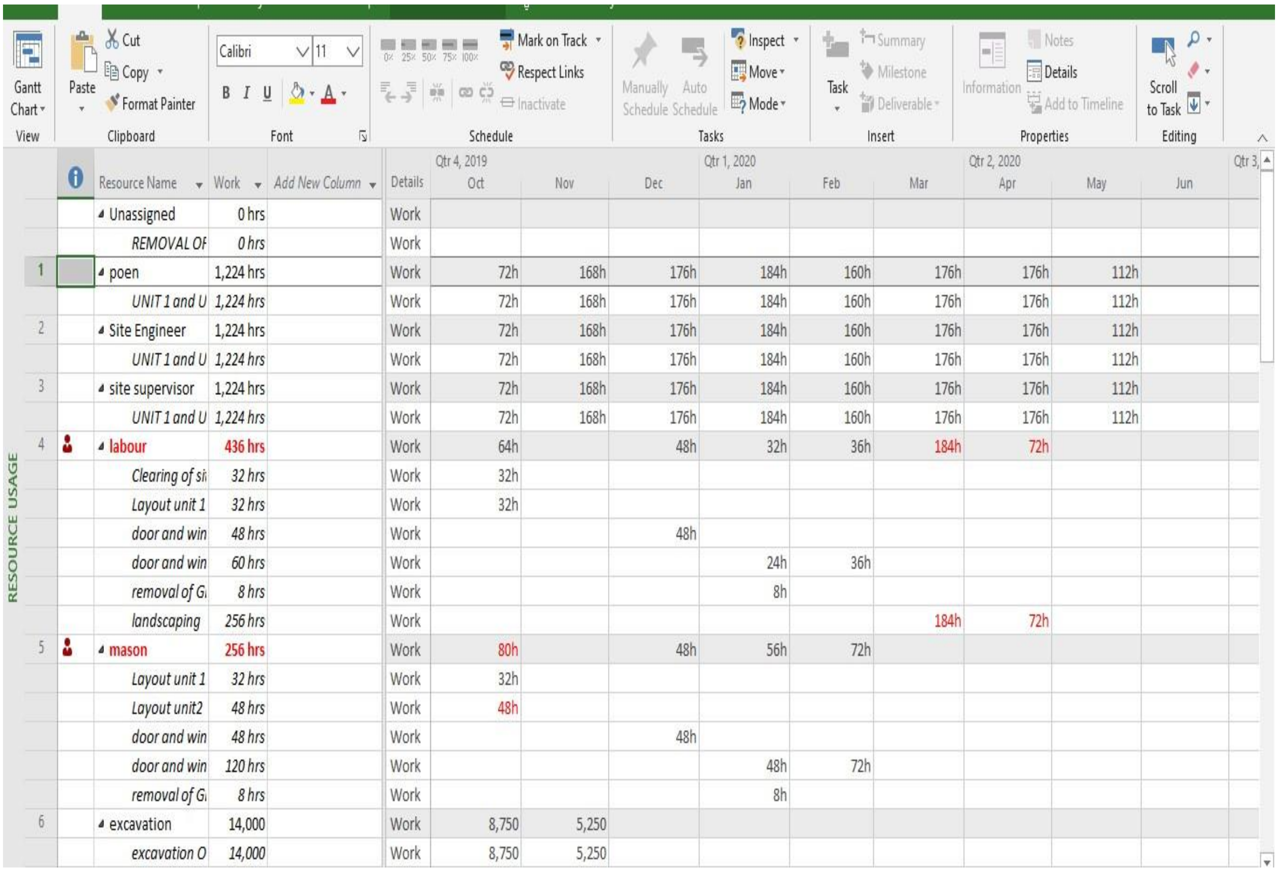
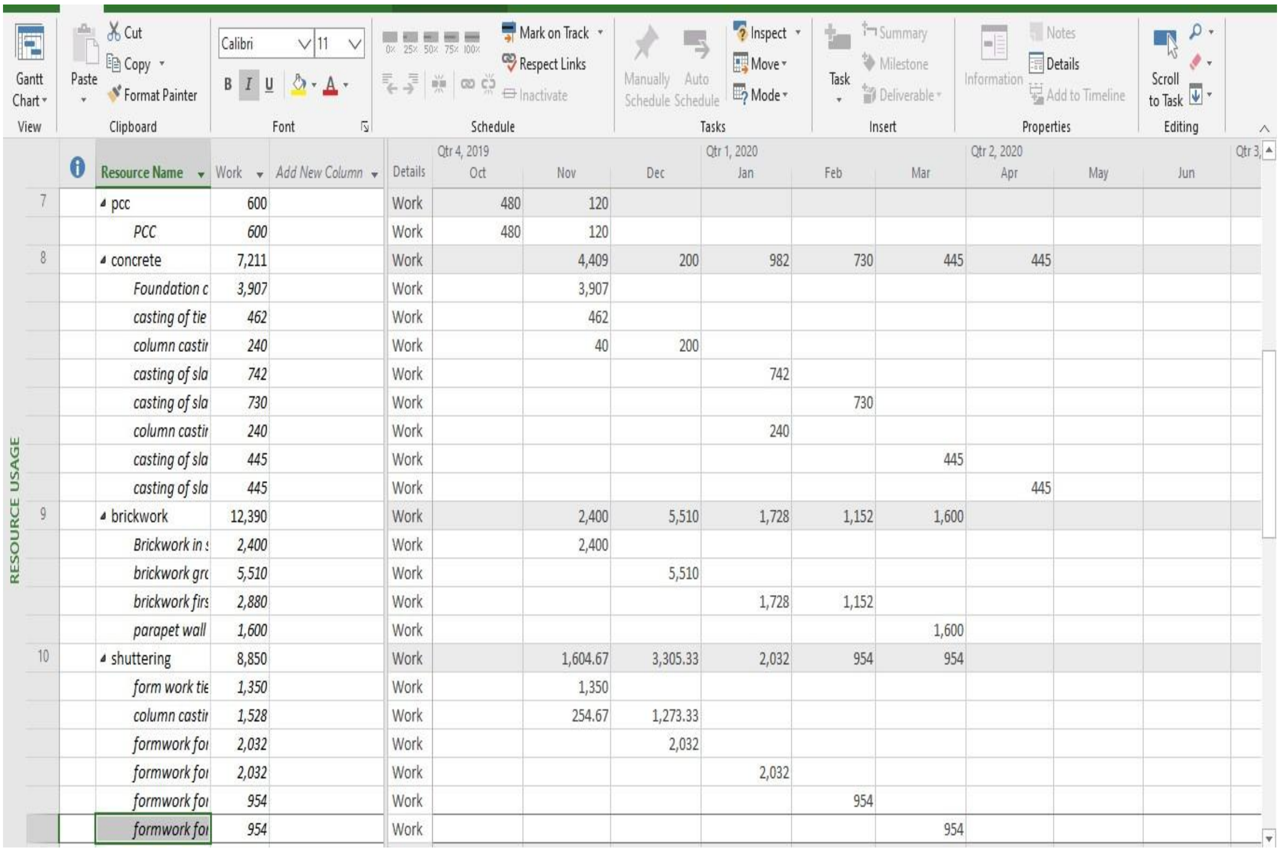


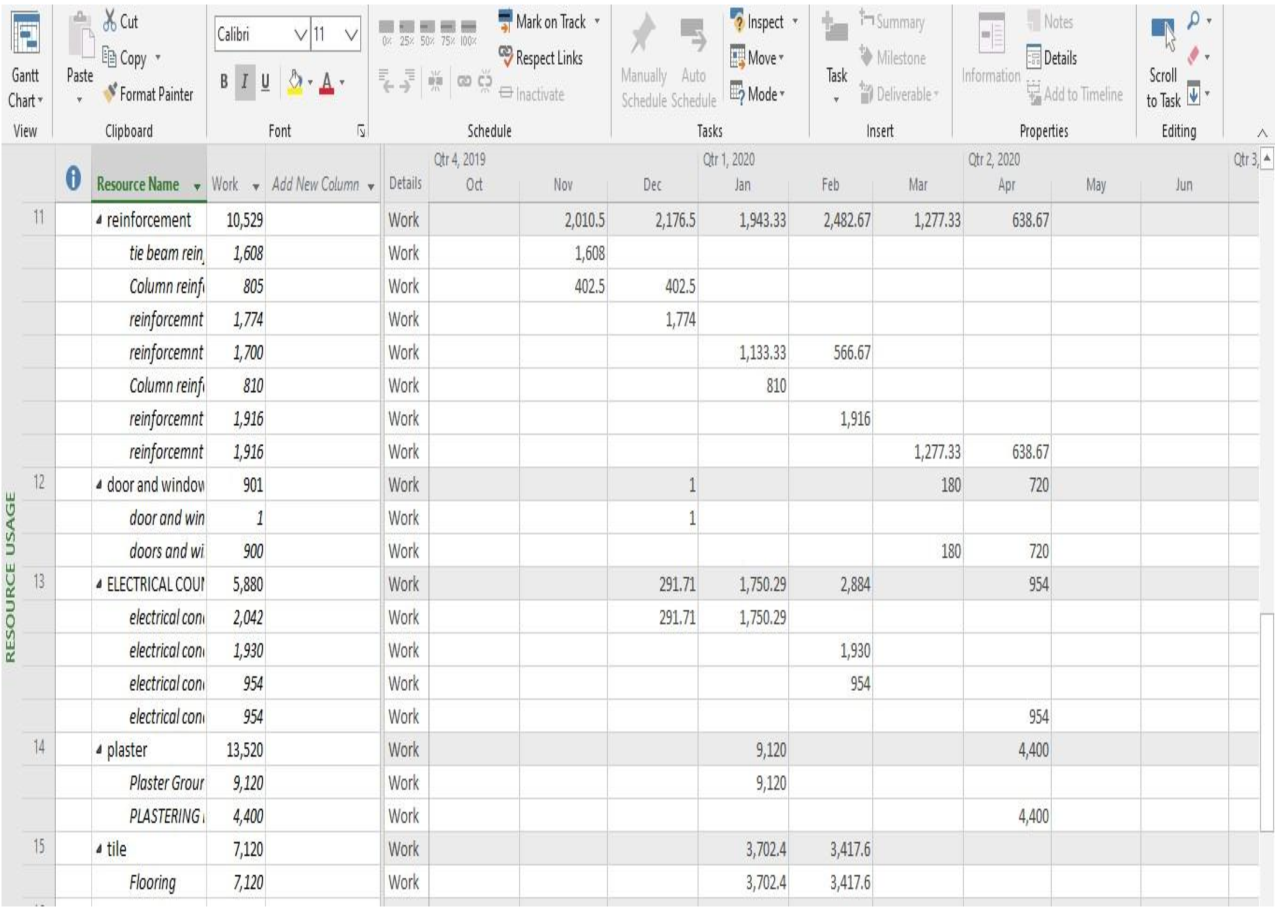
Fig. 5.5 Activity chart unit-1 & 2



ID	Resource Name	Work	Details	Oct (Qtr 4, 2019)	Nov	Dec	Jan (Qtr 1, 2020)	Feb	Mar	Apr (Qtr 2, 2020)	May	Jun
	Unassigned	0 hrs	Work									
	REMOVAL OF	0 hrs	Work									
1	poen	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
2	Site Engineer	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
3	site supervisor	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
4	labour	436 hrs	Work	64h		48h	32h	36h	184h	72h		
	Clearing of si	32 hrs	Work	32h								
	Layout unit 1	32 hrs	Work	32h								
	door and win	48 hrs	Work			48h						
	door and win	60 hrs	Work				24h	36h				
	removal of G	8 hrs	Work				8h					
	landscaping	256 hrs	Work						184h	72h		
5	mason	256 hrs	Work	80h		48h	56h	72h				
	Layout unit 1	32 hrs	Work	32h								
	Layout unit2	48 hrs	Work	48h								
	door and win	48 hrs	Work			48h						
	door and win	120 hrs	Work				48h	72h				
	removal of G	8 hrs	Work				8h					
6	excavation	14,000	Work	8,750	5,250							
	excavation O	14,000	Work	8,750	5,250							

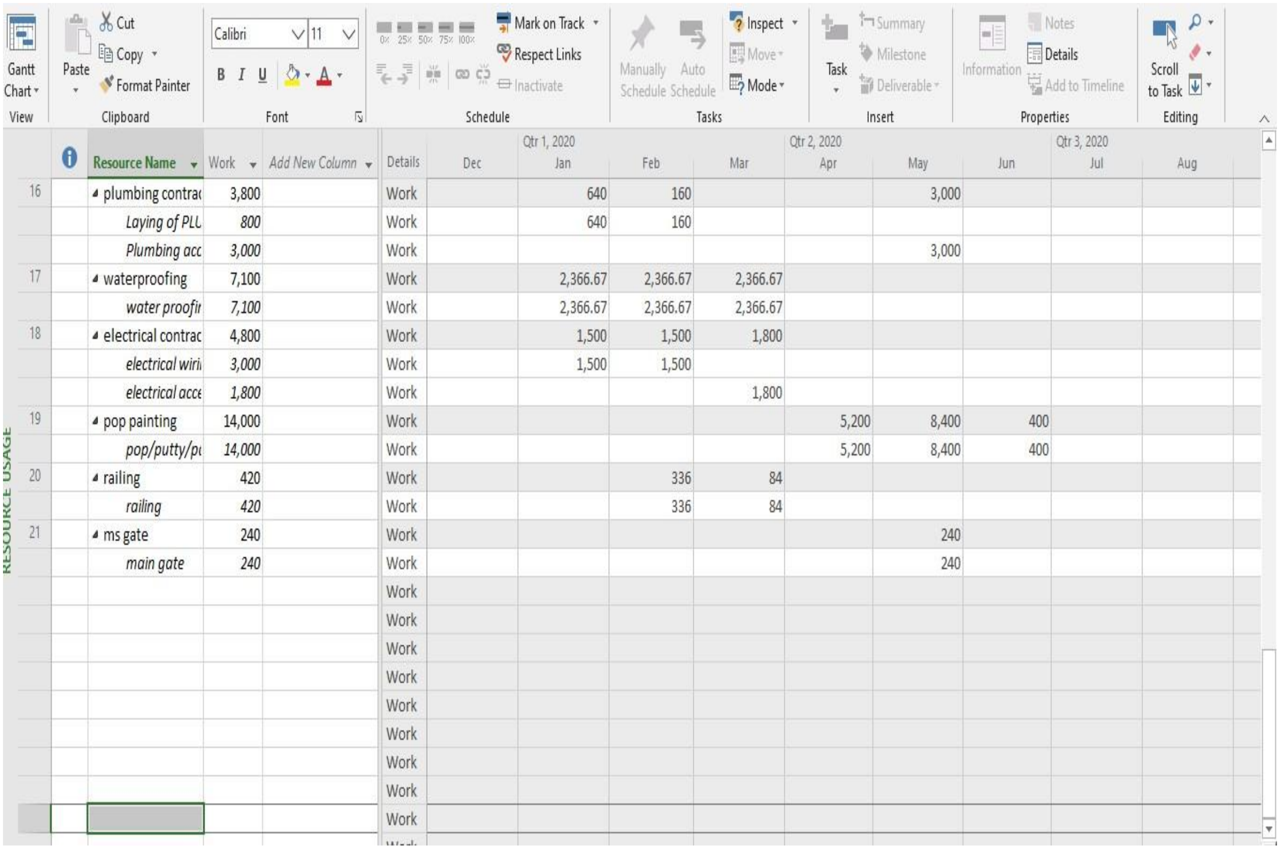


ID	Resource Name	Work	Details	Oct (Qtr 4, 2019)	Nov	Dec	Jan (Qtr 1, 2020)	Feb	Mar	Apr (Qtr 2, 2020)	May	Jun
7	pcc	600	Work	480	120							
	PCC	600	Work	480	120							
8	concrete	7,211	Work		4,409	200	982	730	445	445		
	Foundation c	3,907	Work		3,907							
	casting of tie	462	Work		462							
	column castir	240	Work		40	200						
	casting of sla	742	Work				742					
	casting of sla	730	Work					730				
	column castir	240	Work				240					
	casting of sla	445	Work						445			
	casting of sla	445	Work							445		
9	brickwork	12,390	Work		2,400	5,510	1,728	1,152	1,600			
	Brickwork in	2,400	Work		2,400							
	brickwork gr	5,510	Work			5,510						
	brickwork firs	2,880	Work				1,728	1,152				
	parapet wall	1,600	Work						1,600			
10	shuttering	8,850	Work		1,604.67	3,305.33	2,032	954	954			
	form work tie	1,350	Work		1,350							
	column castir	1,528	Work		254.67	1,273.33						
	formwork for	2,032	Work			2,032						
	formwork for	2,032	Work				2,032					
	formwork for	954	Work					954				
	formwork for	954	Work						954			



RESOURCE USAGE

	Resource Name	Work	Details	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
11	reinforcement	10,529	Work		2,010.5	2,176.5	1,943.33	2,482.67	1,277.33	638.67		
	tie beam rein	1,608	Work		1,608							
	Column reinf	805	Work		402.5	402.5						
	reinforcemnt	1,774	Work			1,774						
	reinforcemnt	1,700	Work				1,133.33	566.67				
	Column reinf	810	Work				810					
	reinforcemnt	1,916	Work					1,916				
	reinforcemnt	1,916	Work						1,277.33	638.67		
12	door and windov	901	Work			1			180	720		
	door and win	1	Work			1						
	doors and wi	900	Work						180	720		
13	ELECTRICAL COUI	5,880	Work			291.71	1,750.29	2,884		954		
	electrical con	2,042	Work			291.71	1,750.29					
	electrical con	1,930	Work					1,930				
	electrical con	954	Work					954				
	electrical con	954	Work							954		
14	plaster	13,520	Work				9,120			4,400		
	Plaster Grour	9,120	Work				9,120					
	PLASTERING	4,400	Work							4,400		
15	tile	7,120	Work				3,702.4	3,417.6				
	Flooring	7,120	Work				3,702.4	3,417.6				



RESOURCE USAGE

	Resource Name	Work	Details	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
16	plumbing contra	3,800	Work		640	160			3,000			
	Laying of PLL	800	Work		640	160						
	Plumbing acc	3,000	Work						3,000			
17	waterproofing	7,100	Work		2,366.67	2,366.67	2,366.67					
	water proofir	7,100	Work		2,366.67	2,366.67	2,366.67					
18	electrical contrac	4,800	Work		1,500	1,500	1,800					
	electrical wiri	3,000	Work		1,500	1,500						
	electrical acce	1,800	Work				1,800					
19	pop painting	14,000	Work					5,200	8,400	400		
	pop/putty/pi	14,000	Work					5,200	8,400	400		
20	railing	420	Work			336	84					
	railing	420	Work			336	84					
21	ms gate	240	Work						240			
	main gate	240	Work						240			

Fig 5.6: Resource allocation chart Unit1 and Unit2

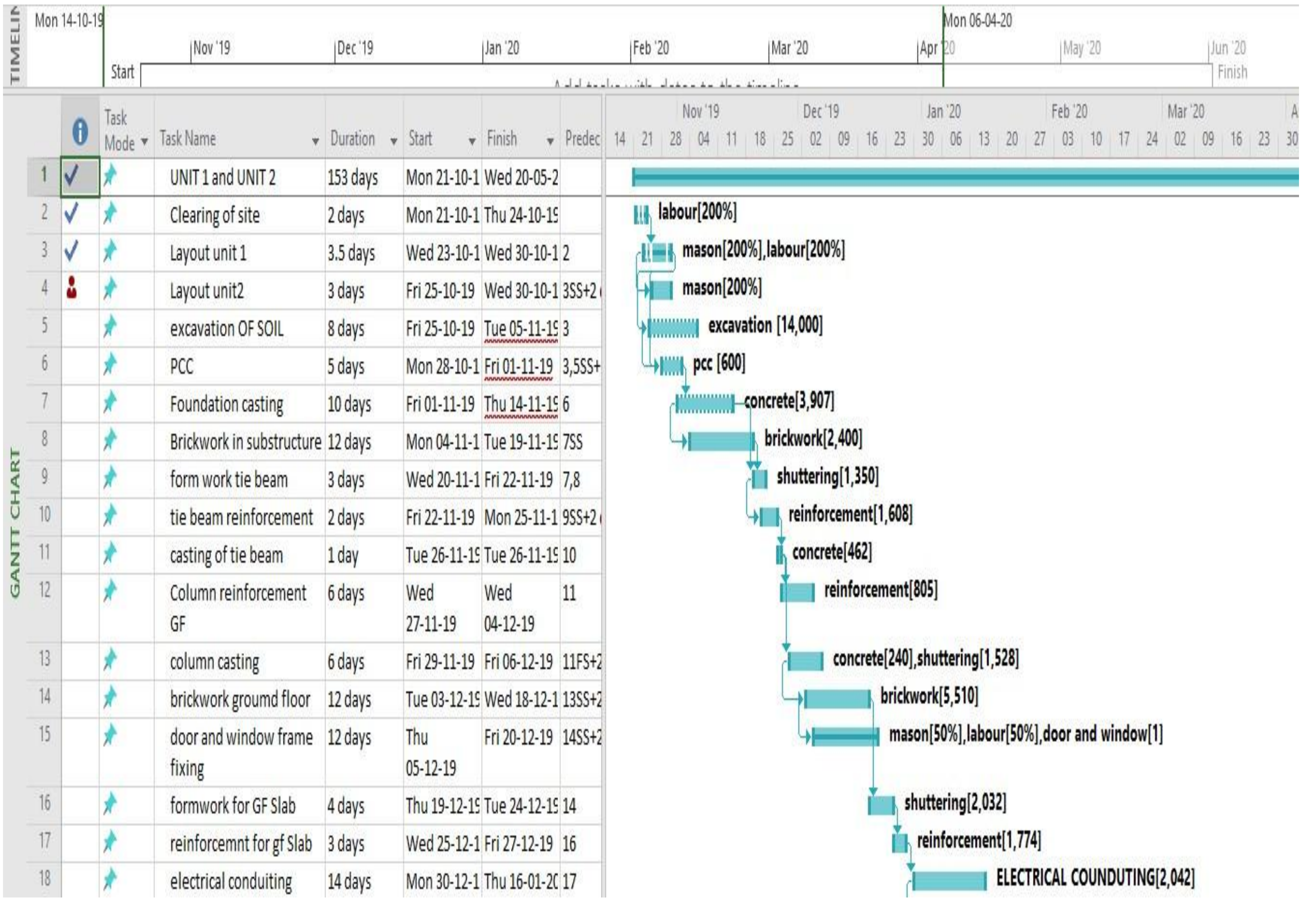
5.5 SEQUENCE-3 THREE BY TWO

In this sequence work of only one unit is commenced and after the completion of first unit, second unit starts and so on. The details of single unit is provided in the previous chapter. Work Breakdown Structure for one unit is shown in fig 5.7. The listing of all related activities and their relationship along with duration is represented in the Gantt Chart shown in same figure.

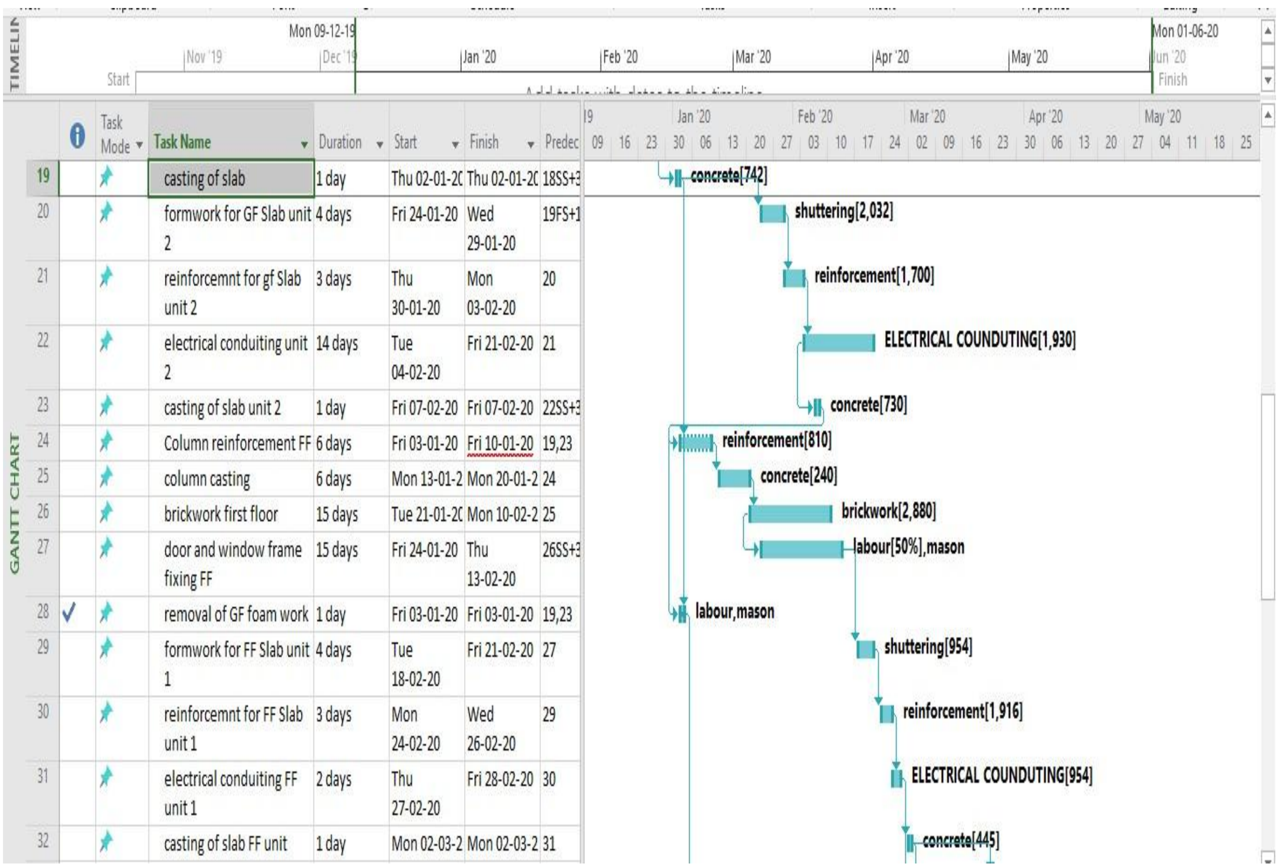
Figure 5.8 shown the activity chart for unit3. Activity chart consist of different paths.It allows the project manger to gauge the importance of various paths in terms of resources, labour and time. The longest path in the activity chart is the critical path. Any delay in activities of this path due to shortage of labour or material would eventually lead to increase in the duration of whole project. While activities in other path have lag period i.e completion of such can be delayed but by lag period only.

Figure 5.9 shows the Resource Allocation Chart of unit4. In this chart listing of all the resources required in the project is done. Along with the listing of resources, a time line is also developed representing the resources required at a point of time. It allows project manager to gather fund for resources required at a point of time.

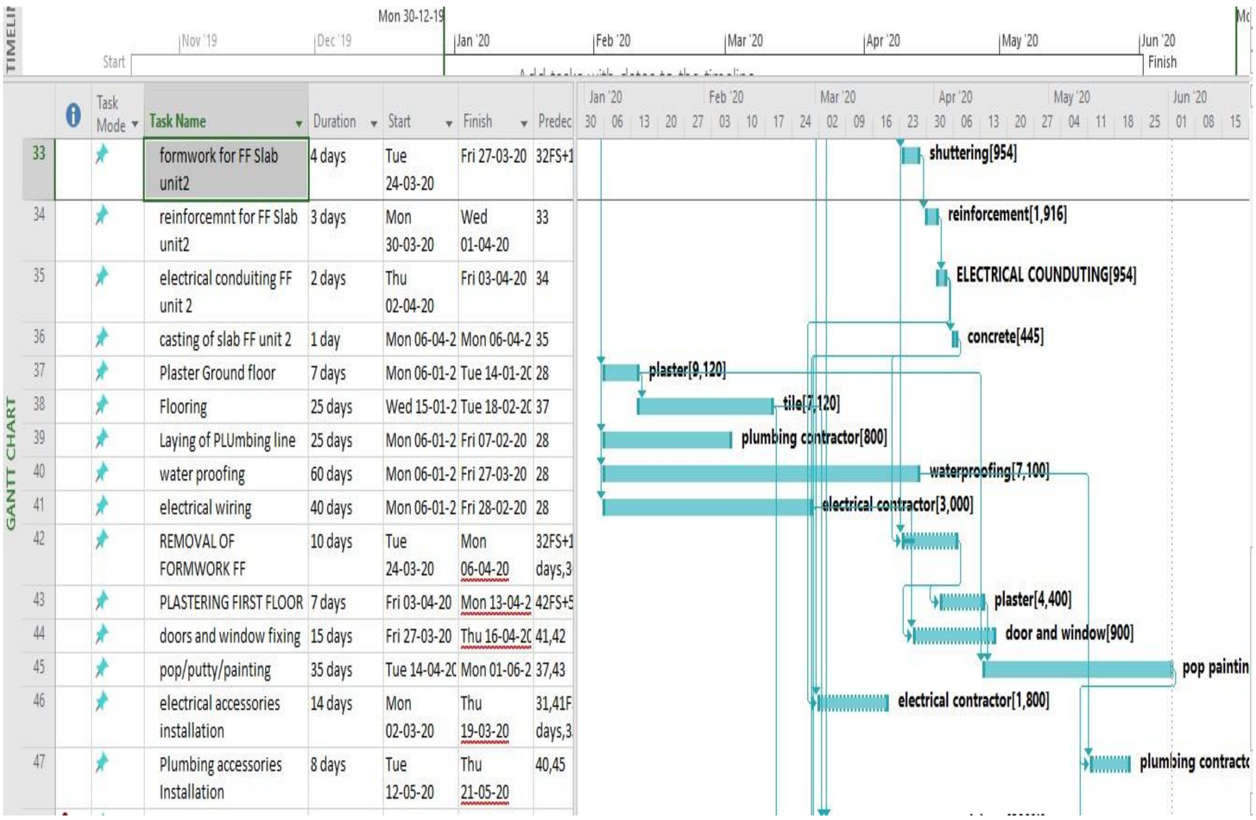
- Three units commenced and after the completion of first three units, remaining three units unit starts simultaneously.
- Demand of fund is non-linear and inclined.
- Work progresses in fast pace.
- Suitable for project with at least half of fund is available and part fund are to be arranged.



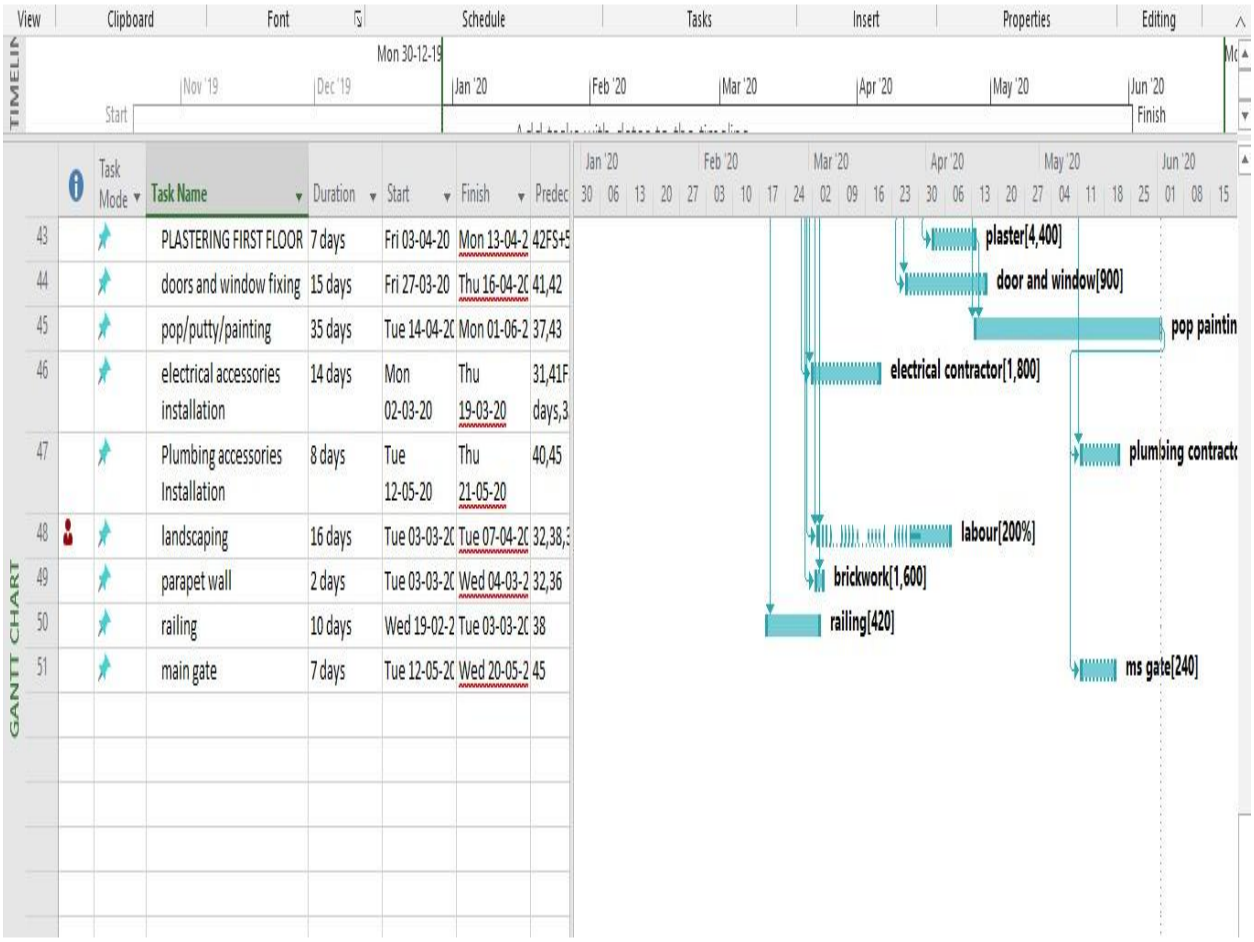
ID	Task Name	Duration	Start	Finish	Predec
1	UNIT 1 and UNIT 2	153 days	Mon 21-10-1	Wed 20-05-2	
2	Clearing of site	2 days	Mon 21-10-1	Thu 24-10-19	
3	Layout unit 1	3.5 days	Wed 23-10-1	Wed 30-10-1	2
4	Layout unit2	3 days	Fri 25-10-19	Wed 30-10-1	3SS+2
5	excavation OF SOIL	8 days	Fri 25-10-19	Tue 05-11-19	3
6	PCC	5 days	Mon 28-10-1	Fri 01-11-19	3,5SS+
7	Foundation casting	10 days	Fri 01-11-19	Thu 14-11-19	6
8	Brickwork in substructure	12 days	Mon 04-11-1	Tue 19-11-19	7SS
9	form work tie beam	3 days	Wed 20-11-1	Fri 22-11-19	7,8
10	tie beam reinforcement	2 days	Fri 22-11-19	Mon 25-11-1	9SS+2
11	casting of tie beam	1 day	Tue 26-11-19	Tue 26-11-19	10
12	Column reinforcement GF	6 days	Wed 27-11-19	Wed 04-12-19	11
13	column casting	6 days	Fri 29-11-19	Fri 06-12-19	11FS+2
14	brickwork groumd floor	12 days	Tue 03-12-19	Wed 18-12-1	13SS+2
15	door and window frame fixing	12 days	Thu 05-12-19	Fri 20-12-19	14SS+2
16	formwork for GF Slab	4 days	Thu 19-12-19	Tue 24-12-19	14
17	reinforcemnt for gf Slab	3 days	Wed 25-12-1	Fri 27-12-19	16
18	electrical conduiting	14 days	Mon 30-12-1	Thu 16-01-20	17



ID	Task Name	Duration	Start	Finish	Predec
19	casting of slab	1 day	Thu 02-01-2	Thu 02-01-2	18SS+3
20	formwork for GF Slab unit 2	4 days	Fri 24-01-20	Wed 29-01-20	19FS+1
21	reinforcemnt for gf Slab unit 2	3 days	Thu 30-01-20	Mon 03-02-20	20
22	electrical conduiting unit 2	14 days	Tue 04-02-20	Fri 21-02-20	21
23	casting of slab unit 2	1 day	Fri 07-02-20	Fri 07-02-20	22SS+3
24	Column reinforcement FF	6 days	Fri 03-01-20	Fri 10-01-20	19,23
25	column casting	6 days	Mon 13-01-2	Mon 20-01-2	24
26	brickwork first floor	15 days	Tue 21-01-2	Mon 10-02-2	25
27	door and window frame fixing FF	15 days	Fri 24-01-20	Thu 13-02-20	26SS+3
28	removal of GF foam work	1 day	Fri 03-01-20	Fri 03-01-20	19,23
29	formwork for FF Slab unit 1	4 days	Tue 18-02-20	Fri 21-02-20	27
30	reinforcemnt for FF Slab unit 1	3 days	Mon 24-02-20	Wed 26-02-20	29
31	electrical conduiting FF unit 1	2 days	Thu 27-02-20	Fri 28-02-20	30
32	casting of slab FF unit	1 day	Mon 02-03-2	Mon 02-03-2	31



	Task Mode	Task Name	Duration	Start	Finish	Predec
33		formwork for FF Slab unit2	4 days	Tue 24-03-20	Fri 27-03-20	32FS+1
34		reinforcemnt for FF Slab unit2	3 days	Mon 30-03-20	Wed 01-04-20	33
35		electrical conduiting FF unit 2	2 days	Thu 02-04-20	Fri 03-04-20	34
36		casting of slab FF unit 2	1 day	Mon 06-04-2	Mon 06-04-2	35
37		Plaster Ground floor	7 days	Mon 06-01-2	Tue 14-01-2(	28
38		Flooring	25 days	Wed 15-01-2	Tue 18-02-2(	37
39		Laying of PLUmbing line	25 days	Mon 06-01-2	Fri 07-02-20	28
40		water proofing	60 days	Mon 06-01-2	Fri 27-03-20	28
41		electrical wiring	40 days	Mon 06-01-2	Fri 28-02-20	28
42		REMOVAL OF FORMWORK FF	10 days	Tue 24-03-20	Mon 06-04-20	32FS+1 days,3
43		PLASTERING FIRST FLOOR	7 days	Fri 03-04-20	Mon 13-04-2	42FS+5
44		doors and window fixing	15 days	Fri 27-03-20	Thu 16-04-2(	41,42
45		pop/putty/painting	35 days	Tue 14-04-2(	Mon 01-06-2	37,43
46		electrical accessories installation	14 days	Mon 02-03-20	Thu 19-03-20	31,41F days,3
47		Plumbing accessories Installation	8 days	Tue 12-05-20	Thu 21-05-20	40,45



	Task Mode	Task Name	Duration	Start	Finish	Predec
43		PLASTERING FIRST FLOOR	7 days	Fri 03-04-20	Mon 13-04-2	42FS+5
44		doors and window fixing	15 days	Fri 27-03-20	Thu 16-04-2(	41,42
45		pop/putty/painting	35 days	Tue 14-04-2(	Mon 01-06-2	37,43
46		electrical accessories installation	14 days	Mon 02-03-20	Thu 19-03-20	31,41F days,3
47		Plumbing accessories Installation	8 days	Tue 12-05-20	Thu 21-05-20	40,45
48		landscaping	16 days	Tue 03-03-2(	Tue 07-04-2(	32,38,3
49		parapet wall	2 days	Tue 03-03-2(	Wed 04-03-2	32,36
50		railing	10 days	Wed 19-02-2	Tue 03-03-2(	38
51		main gate	7 days	Tue 12-05-2(	Wed 20-05-2	45

Fig. 5.7 WBS and GANTT chart unit 1, 2 & 3

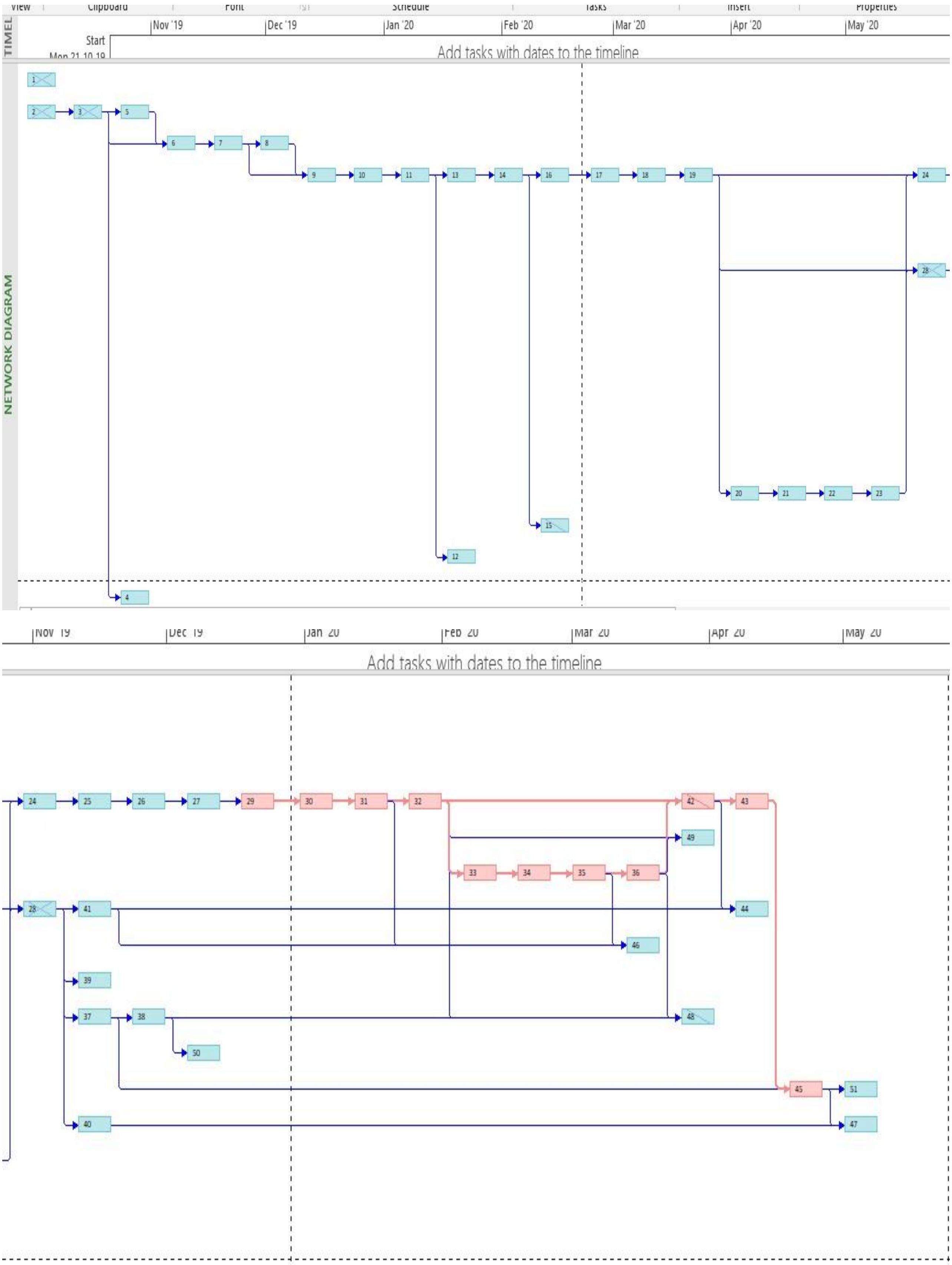
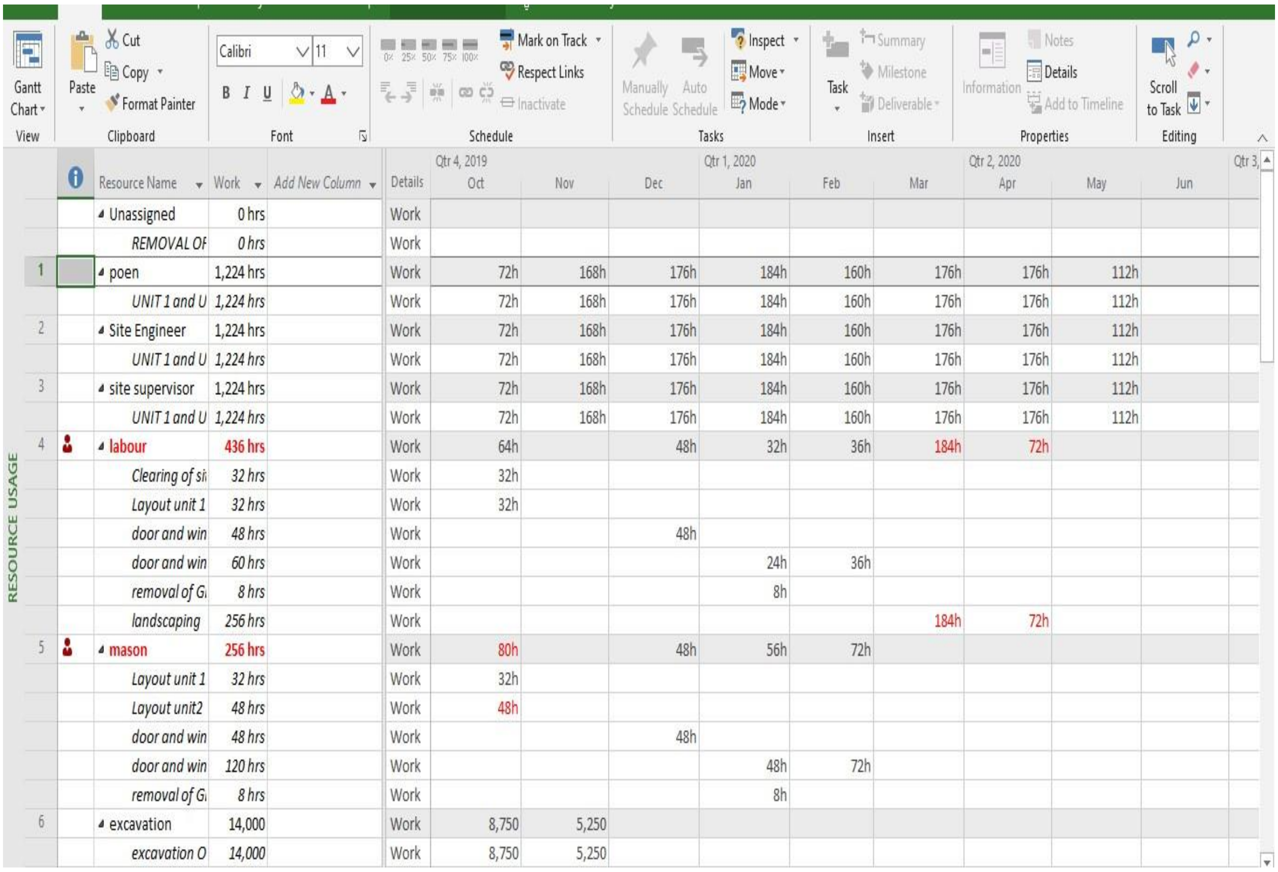
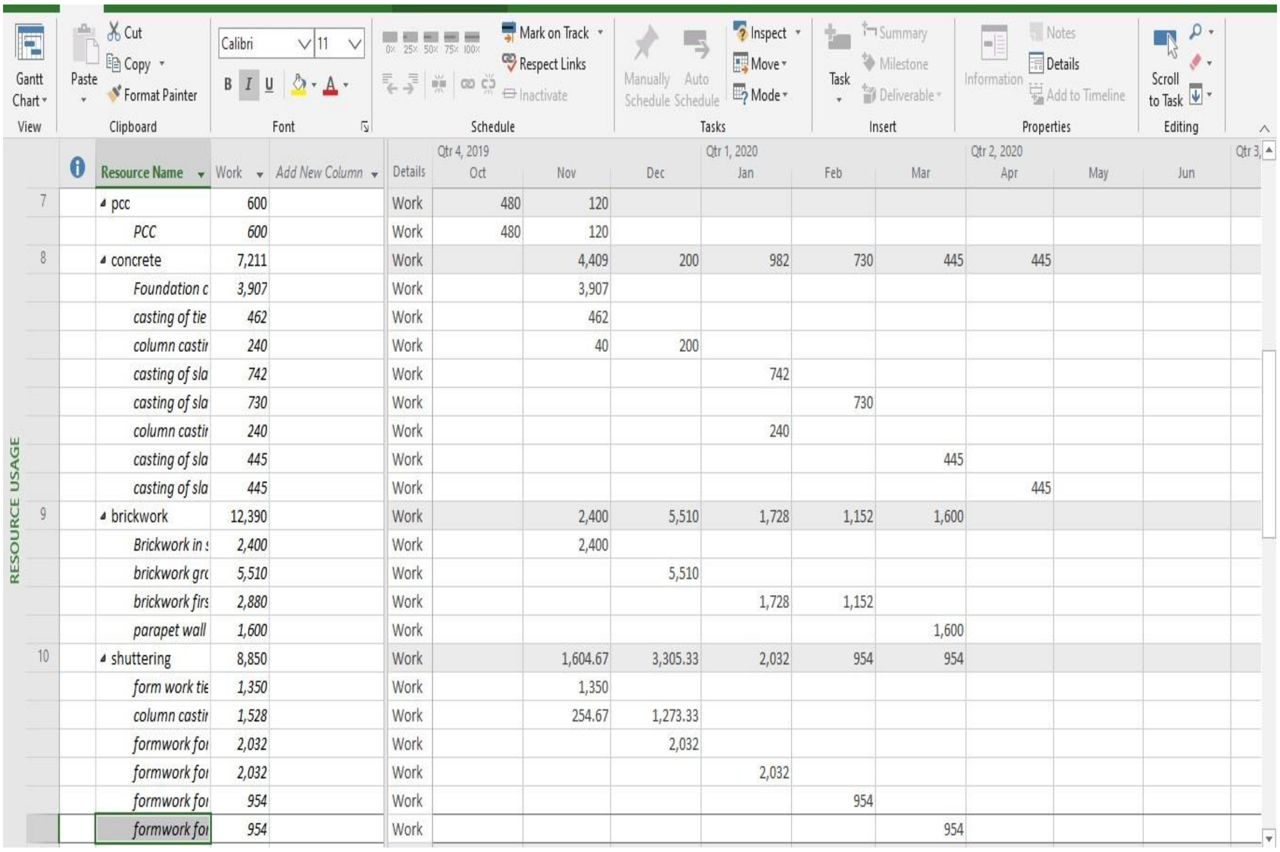


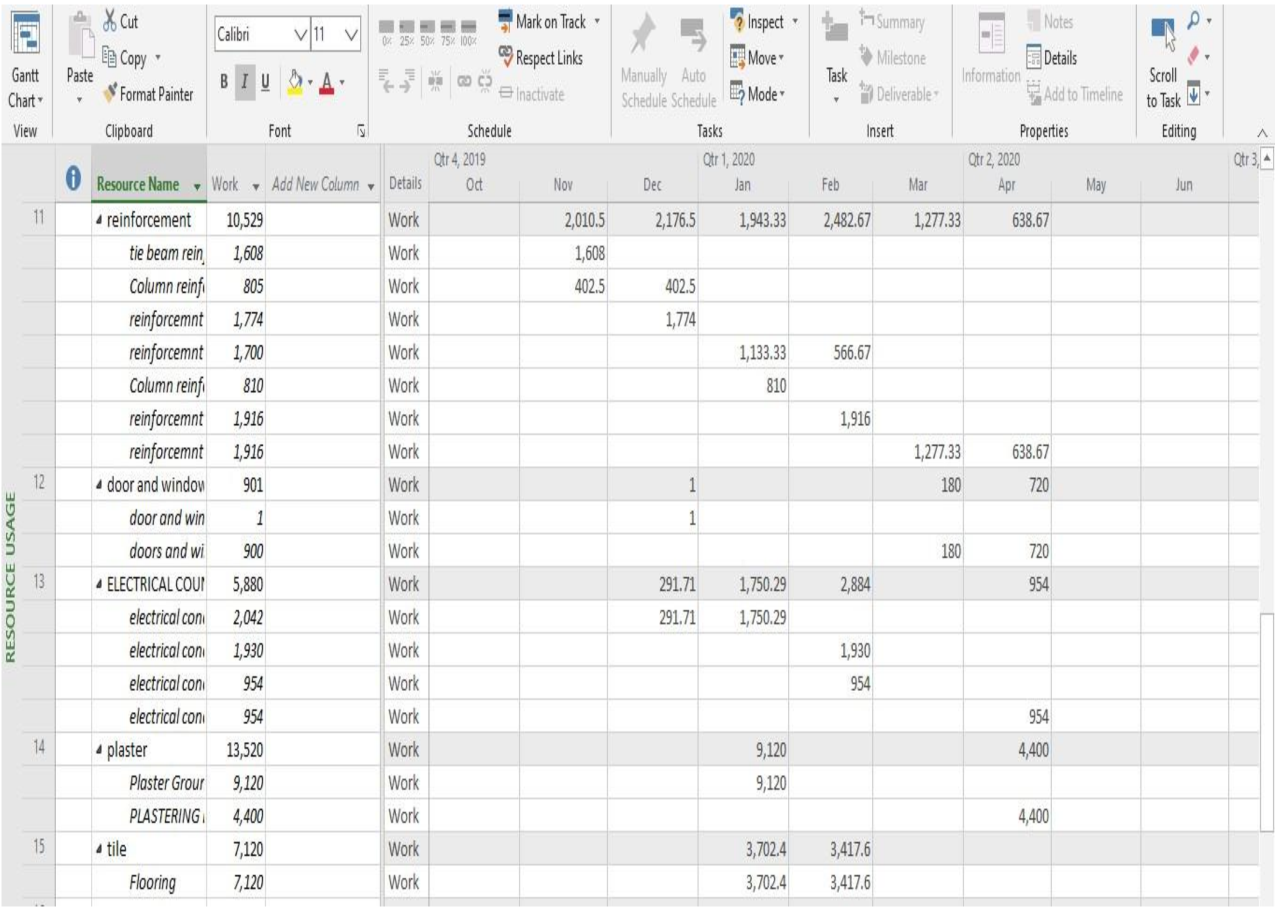
Fig. 5.8Activity chart unit-1 ,2 & 3



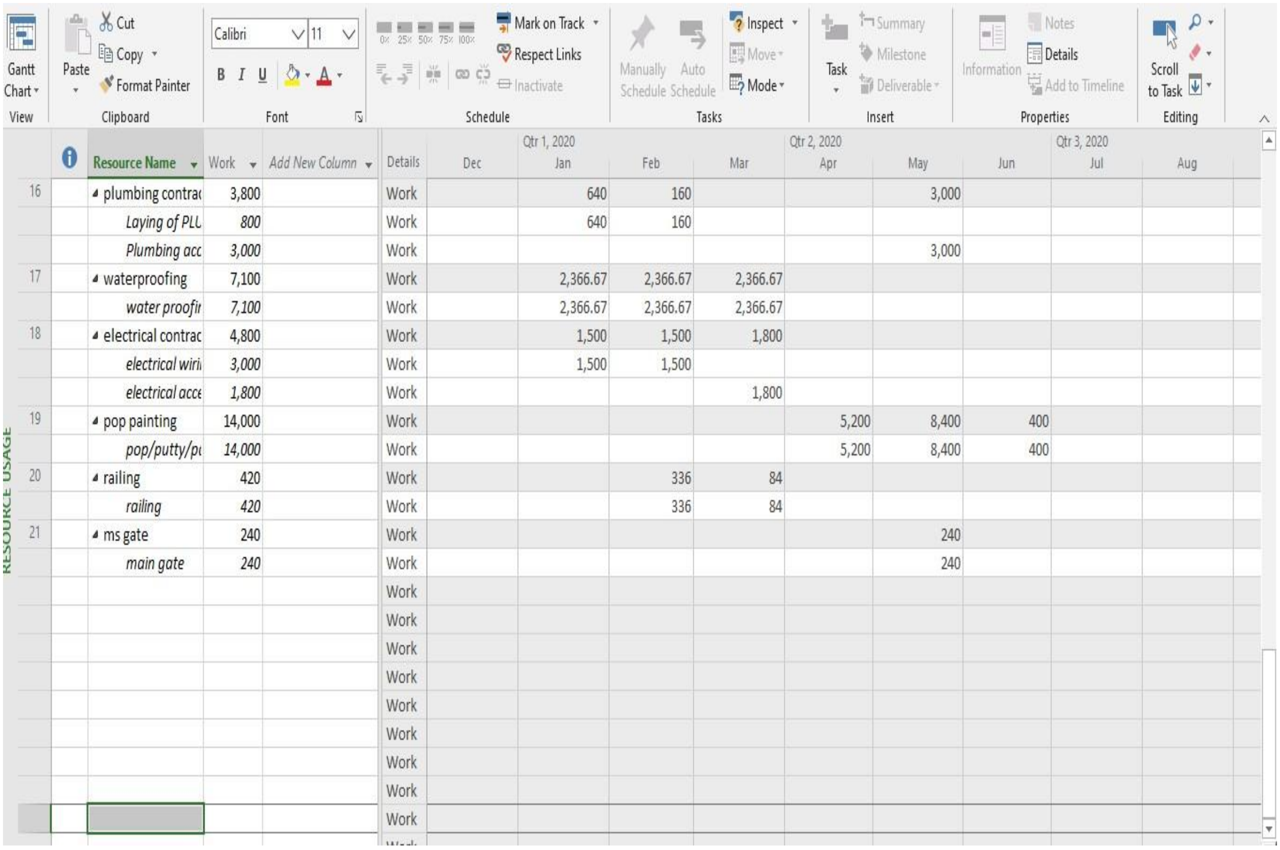
ID	Resource Name	Work	Details	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
	Unassigned	0 hrs	Work									
	REMOVAL OF	0 hrs	Work									
1	poen	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
2	Site Engineer	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
3	site supervisor	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
	UNIT 1 and U	1,224 hrs	Work	72h	168h	176h	184h	160h	176h	176h	112h	
4	labour	436 hrs	Work	64h		48h	32h	36h	184h	72h		
	Clearing of si	32 hrs	Work	32h								
	Layout unit 1	32 hrs	Work	32h								
	door and win	48 hrs	Work			48h						
	door and win	60 hrs	Work				24h	36h				
	removal of G	8 hrs	Work				8h					
	landscaping	256 hrs	Work						184h	72h		
5	mason	256 hrs	Work	80h		48h	56h	72h				
	Layout unit 1	32 hrs	Work	32h								
	Layout unit2	48 hrs	Work	48h								
	door and win	48 hrs	Work			48h						
	door and win	120 hrs	Work				48h	72h				
	removal of G	8 hrs	Work				8h					
6	excavation	14,000	Work	8,750	5,250							
	excavation O	14,000	Work	8,750	5,250							



ID	Resource Name	Work	Details	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
7	pcc	600	Work	480	120							
	PCC	600	Work	480	120							
8	concrete	7,211	Work		4,409	200	982	730	445	445		
	Foundation c	3,907	Work		3,907							
	casting of tie	462	Work		462							
	column castir	240	Work		40	200						
	casting of sla	742	Work				742					
	casting of sla	730	Work					730				
	column castir	240	Work				240					
	casting of sla	445	Work						445			
	casting of sla	445	Work							445		
9	brickwork	12,390	Work		2,400	5,510	1,728	1,152	1,600			
	Brickwork in s	2,400	Work		2,400							
	brickwork grc	5,510	Work			5,510						
	brickwork firs	2,880	Work				1,728	1,152				
	parapet wall	1,600	Work						1,600			
10	shuttering	8,850	Work		1,604.67	3,305.33	2,032	954	954			
	form work tie	1,350	Work		1,350							
	column castir	1,528	Work		254.67	1,273.33						
	formwork foi	2,032	Work			2,032						
	formwork foi	2,032	Work				2,032					
	formwork foi	954	Work					954				
	formwork foi	954	Work						954			



	Resource Name	Work	Add New Column	Details	Qtr 4, 2019 Oct	Nov	Dec	Qtr 1, 2020 Jan	Feb	Mar	Qtr 2, 2020 Apr	May	Jun
11	◢ reinforcement	10,529		Work		2,010.5	2,176.5	1,943.33	2,482.67	1,277.33	638.67		
	tie beam rein	1,608		Work		1,608							
	Column reinf	805		Work		402.5	402.5						
	reinforcemnt	1,774		Work			1,774						
	reinforcemnt	1,700		Work				1,133.33	566.67				
	Column reinf	810		Work				810					
	reinforcemnt	1,916		Work					1,916				
	reinforcemnt	1,916		Work						1,277.33	638.67		
12	◢ door and windov	901		Work			1			180	720		
	door and win	1		Work			1						
	doors and wi	900		Work						180	720		
13	◢ ELECTRICAL COUI	5,880		Work			291.71	1,750.29	2,884		954		
	electrical con	2,042		Work			291.71	1,750.29					
	electrical con	1,930		Work					1,930				
	electrical con	954		Work					954				
	electrical con	954		Work							954		
14	◢ plaster	13,520		Work				9,120			4,400		
	Plaster Grour	9,120		Work				9,120					
	PLASTERING	4,400		Work							4,400		
15	◢ tile	7,120		Work				3,702.4	3,417.6				
	Flooring	7,120		Work				3,702.4	3,417.6				



	Resource Name	Work	Add New Column	Details	Dec	Qtr 1, 2020 Jan	Feb	Mar	Qtr 2, 2020 Apr	May	Jun	Qtr 3, 2020 Jul	Aug
16	◢ plumbing contrac	3,800		Work		640	160			3,000			
	Laying of PLU	800		Work		640	160						
	Plumbing acc	3,000		Work						3,000			
17	◢ waterproofing	7,100		Work		2,366.67	2,366.67	2,366.67					
	water proofir	7,100		Work		2,366.67	2,366.67	2,366.67					
18	◢ electrical contrac	4,800		Work		1,500	1,500	1,800					
	electrical wiri	3,000		Work		1,500	1,500						
	electrical acce	1,800		Work				1,800					
19	◢ pop painting	14,000		Work					5,200	8,400	400		
	pop/putty/pı	14,000		Work					5,200	8,400	400		
20	◢ railing	420		Work			336	84					
	railing	420		Work			336	84					
21	◢ ms gate	240		Work						240			
	main gate	240		Work						240			
				Work									
				Work									
				Work									
				Work									
				Work									
				Work									
				Work									
				Work									
				Work									

Fig 5.9: Resource allocation chart Unit1 ,Unit2 and Unit3

CHAPTER-6

RESULTS AND CONCLUSION

In this study, same project comprising of six repetitive units is planned with three different sequences as explained previously. It is seen that with detailed planning and development of the mentioned sequences yielded completely variant path, duration cost and resources requirements.For the purpose of comparison between these sequences, it is done on the following parameters namely cost, duration, critical path and critical resources.

6.1 COST AND DURATION

The cost for the three sequence is provided in table 6.1. It is seen that the cost of the sequence 1, which takes single unit sequentially, is highest. The total cost for sequence 2 is moderate while with sequence 3 project is costing the lowest. While for the duration of different sequences the total duration of first sequence is longest while sequence2 and sequence 3 takes lesser time. Since in the 1 X 6 approach no unit run parallel thus highest duration.While in 2 X 3 and 3 X 2 approach multiple units run simultaneously thus takes short time for completion. Following are the finding with the three sequences:-

1. It is pointed out that the overall cost of work reduces with the duration of project. This reduction is attributed to the reduction in rate of item with larger quantity, lower transportation cost of material and labour and also lower overhead cost.

2. It is also observed that the rate of reduction in cost increases with the quantum of work taken up simultaneously. But it is not recommended to to so as the mobilization of large workforce may lead to wastage of resources as well as labour.

S.NO	TYPE OF SEQUENCE	COST	DURATION
1	Sequence 1 (1 X 6)	27,778,188.00	918
2	Sequence 2 (2 X 3)	25,430,400.00	483
3	Sequence 3 (3 X 2)	23,654,980.00	350

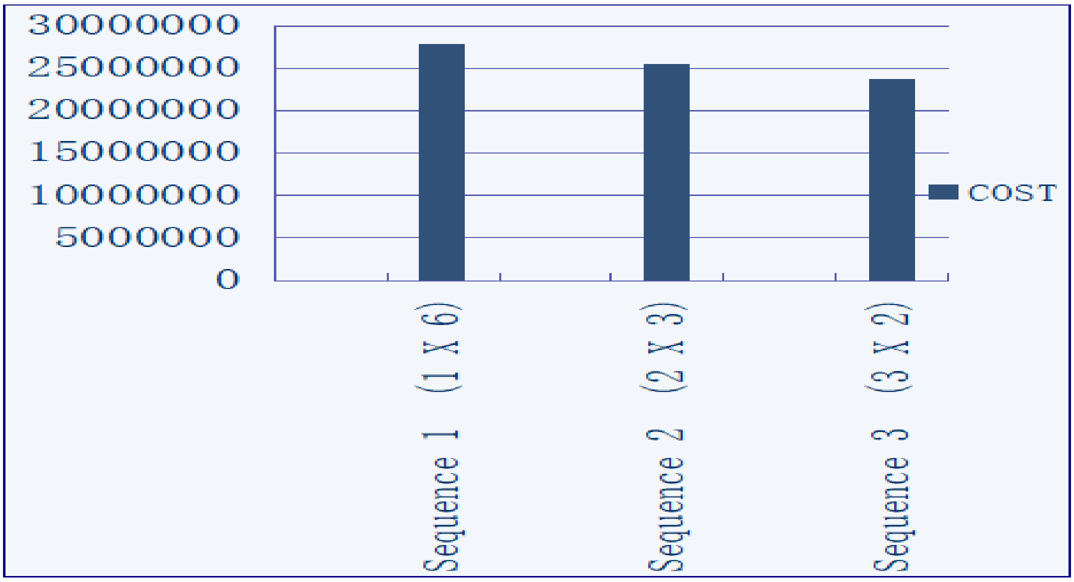
Table 6.1: Cost and Duration

6.2 CRITICAL PATH AND CRITICAL RESOURCES

The critical path for the three sequences shows variation in terms of count of activities as well as the duration of critical path. The critical path for the first sequence have smallest number of activities in critical path at a time and also the duration is the longest. The critical resource in this sequence are also less as the activities are also less. For the second sequence, the no of activities is in between the other two sequences and the duration of critical path is moderate. The critical resources for this sequence are greater than the previous sequence. The third sequence with largest quantum of work in it has largest no of activities in its critical path with the smallest duration. Also the pool of critical resources is largest for this sequence.It is to be pointed out that the lag time between the non critical activities is smallest for the third sequences underlining the fact that the schedule of work is very compact. The execution team need to be on their toes for such execution.

S.NO	TYPE OF SEQUENCE	NO OF ACTIVITIES IN CRITICAL PATH
1	Sequence 1 (1 X 6)	27
2	Sequence 2 (2 X 3)	34
3	Sequence 3 (3 X 2)	43

Table 6.2: Critical Activities


30000000
25000000
20000000
15000000
10000000
5000000
0
COST
Sequence 1 (1 X 6)
Sequence 2 (2 X 3)
Sequence 3 (3 X 2)

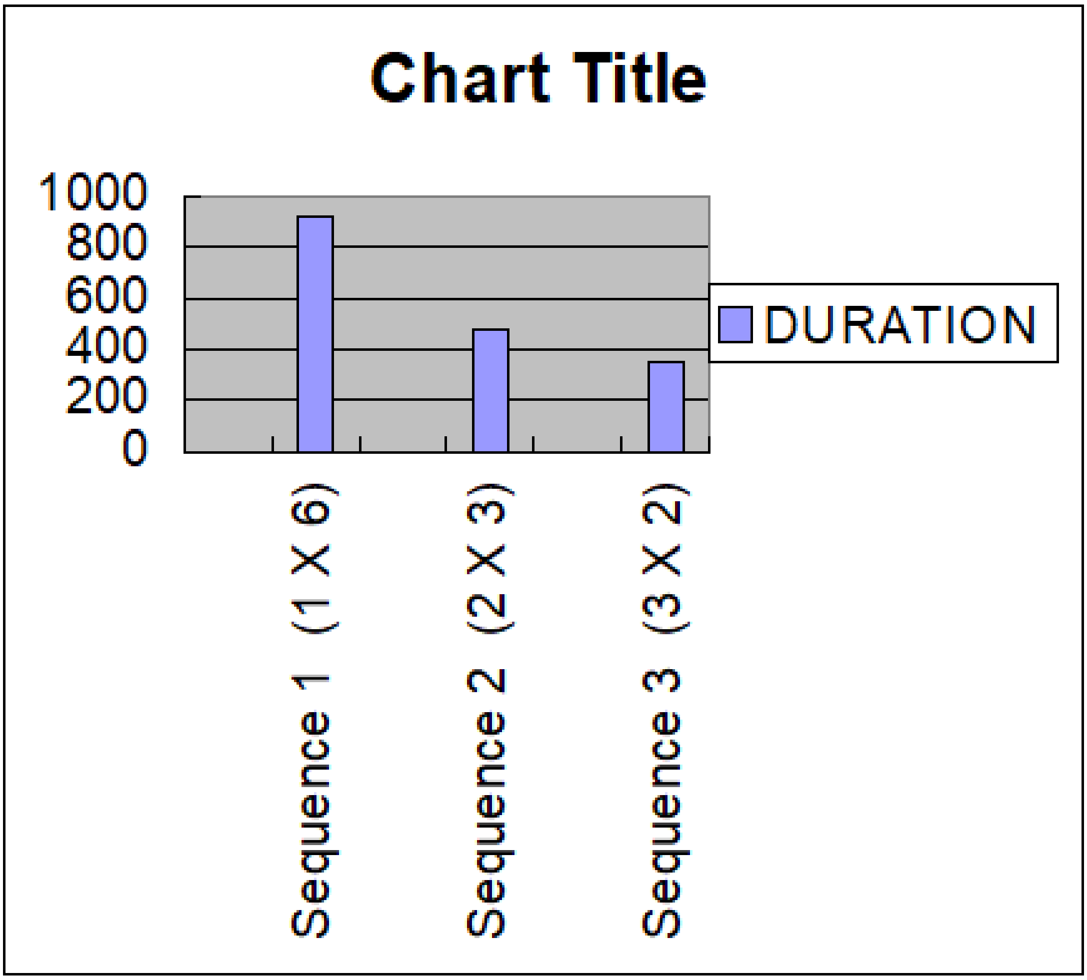


Chart Title
1000
800
600
400
200
0
DURATION
Sequence 1 (1 X 6)
Sequence 2 (2 X 3)
Sequence 3 (3 X 2)

6.3 CONCLUSION

In this dissertation a repetitive multi-unit project of six units is planned with three different Sequences. Comparison is drawn between the sequences for parameter of cost, duration, resource and critical path. Following conclusion are drawn from this study:-

1. The cost of work increases with lengthening the duration of work.
2. Pool of critical resources and the no of critical activities increases with decreases in duration.
3. Lag time between the non critical activities shorten with reduces duration of project.
4. Sequence one with 1 X 6 approach is suitable for the project where fund are to be arranged along with the progress of project.

Sequence three with 3 X 3 approach is suitable for such project where the fund for project is at front available and it is imperative to get the work completed .

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