Scheduling of Repititive Non-serial activities of Multistorey ParkingandEstimated Cost

A Thesis

Submitted in partial fulfilment of the requirements for the award of the degree of

MASTERS OF TECHNOLOGY

In

CONSTRUCTION MANAGEMENT

Under the supervision of

Dr.Gyani Jail Singh

Associate Professor

By

Aarush Sood

(Roll No. 152612)

Department of Civil Engineering

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT SOLAN – 173 234

HIMACHAL PRADESH, INDIA

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DECLARATION

I hereby declare that the work reported in the M.tech thesis entitled "**Scheduling of Repititive Non-serial activities of Multistorey ParkingandEstimated Cost"** submitted at **JayPee University of Information Technology, Waknaghat, Solan(H.P)** is an authentic record of my work carried out under the supervision of **Dr.Gyani Jail Singh.** I have not submitted this work elsewhere for any other degree or diploma.

Date:-

Place:-

Aarush Sood
Roll No.-152612
Department of Civil Engineering
JayPee University of Information Technology
Waknaghat, Solan(H.P)

CERTIFICATE

This is to certify that the work which is being presented in the project title **"Scheduling of Repetitive Non-serial activities of Multi-storey Parking and Estimated Cost**" in partial fulfilment of the requirements for the award of the degree of Masters of technology in Construction Management and submitted in Civil Engineering Department, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out **by Aarush Sood** during a period from August 2016 to October 2016 under the supervision of **Mr. Dr.Gyani Jail Sing**h Assistant Professor, Civil Engineering Department, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of my knowledge.

Date: -

Dr.Gyani Jail Singh
Professor
Department of Civil Engineering
JUIT Waknaghat

Dr.Ashok Kumar Gupta
Professor and Head
Department of Civil Engineering
JUIT, Waknaghat

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ABSTRACT

As the construction is increasing day by day in this modern world so due to this scheduling is required for the project before the construction phase starts for our convenience. Scheduling can be done in software like is done in this study by Microsoft project. With the help of this software it is easy to determine the total estimated days of the project along with the critical path is also known and main focus should be given on that activities for the completion of the work in under given time. And during the construction phase we can regularly check the ongoing work and how much work has been completed and which labour is being used in that specific activity. This is also helpful in calculating the total labour required for the project which is helpful in estimating the cost of the project.

KEY WORDS: Activities, Repetitive Project, Non-Repetitive Project, Scheduling, Microsoft Project software, Cost estimation, Critical Path

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CHAPTER 1

CONSTRUCTION MANAGEMENT

1.1 INTRODUCTION

Time and cost are considered to be substantial success factors of building construction projects. Against the background of this statement important roles are played by time and cost planning for each building construction project. Thus, cost planning must be understood as a process that generally starts with the definition of the budget, which is based on the requirements of the owner and its financial possibilities. Therefore, a cost estimate based on these requirements is needed in an early phase of the project. Scheduling of a project plays an important role in construction industry especially for larger project and in same way cost also plays an important role to determine the estimated cost of the project under the given constraints, by maximizing desired factors and minimizing undesired ones. It is not the point that the cost is minimized or at the maximum return but it is better in both cost reduction and maximizing the return. Cost is one of the major factors in the construction industry or any other industry. To determine the cost of the project, we need to determine the number of activities of the project which are to be implemented on that specific project and minimization of cost is the final objective for optimum use of available resources.Minimizing the overall project cost is a major priority for the project participants. This is important because while reducing project duration reduces its indirect cost, this reduction may increase its direct cost, which in many cases results in higher overall project cost. In fact, accelerating a project can be achieved by expediting a number of selected activities. This can be achieved by increasing the crew size or introducing an overtime policy, that could be coupled with impact costs resulting from higher premium rates for overtime hours and reduced productivity due to site congestion or crowding and overtime effect.The objective of optimization is to find the minimum total direct costs for which the reduction of certain time (amount of time overrun) can be achieved.

In the traditional time network techniques such as critical path method (CPM) is being used throughout the construction industry for scheduling and controlling all types of construction projects. In this method, we can identify the critical activities of the project that constitute the critical path of the project. Activities of the project having the total float value '0' are the critical activities, which mean that any delay in those activities can delay our project to some extent. The series of those critical activities are known as critical path. It is the longest path through the network and the shortest allowable time for the completion of the project. This helps us to concentrate and prioritise critical activities while allocating the project resources. There are for types of relationship between any pair of activities. They are: finish to start, start to start, starts to finish and finish to finish. Some activities could be critical during a fraction of its duration and have a float on the remainder of its duration. This fraction of the duration having the float could be either at the beginning or at the end of its duration. This information is very useful to the planners when allocating the required resources. If work on the activity having an internal float at the beginning is started too early there will be many interruptions in the work resulting in additional expenditure in hiring and firing. By indicating the internal float, planners could avoid these costly interruptions.

1.2 ACTIVITIES

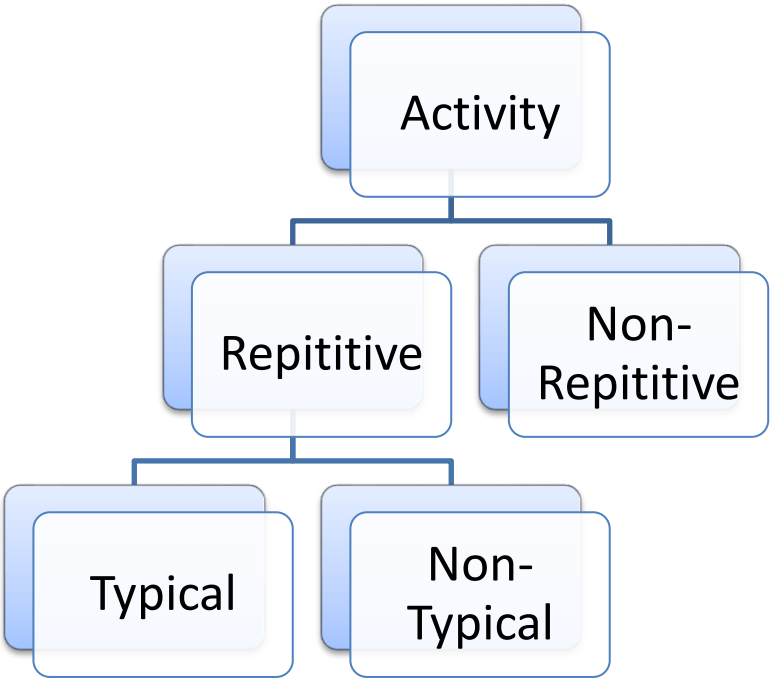


Figure.1.1 Type of Activities

According to the figure above activities can be divided in to two parts:

a. Repetitive Activities
b. Non Repetitive Activities

a) **Repetitive Activities**: these activities are defined as the serial or non-serial activities which repeat itself after a fixed interval of time.

Repetitive activities can be divided into two categories:

1. Typical: projects that are repetitive due to uniform repetition of work throughout the project (e.g. multiple similar houses and high rise buildings having same or typical floors)
2. Non- Typical: projects that are repetitive due to their geometrical plan rather than same unit of work (e.g. highway and pipeline projects)

b) **Non Repetitive Activities**: these are the activity which does not repeat itself in same unit of work. These activities are related to each other in some way (e.g. activities that are required to make single floor residential building.

1.3 SCHEDULING

The project schedule is the tool that conveys what work should be performed,which resources of the organization will perform the work and the time allotments in which that work should be performed.The project schedule should mirror the majority of the work associated with delivering the project on time.Without a full and finish plan,the project manager will be not able convey the entire effort, as far as cost and resources, important to convey the project.

Project management software like Microsoft Project, Primavera, Gantt chart etc. permit project managers to track project schedules, resources, budgets and project related assets in real time.The project timetable can be seen and upgraded by team members associated with the project keeping everybody all around educated on the general project status.

Construction Duration

The construction duration is defined as the duration from when work begins at the construction site until the work comes to an end. There is a relationship between duration and costs. This means that building construction costs rise with increasing construction duration and/or decrease with a drop in construction duration. In addition, it is well known in practice that this relationship can quickly be pushed to its limit. The assumption is that there is optimal construction duration for each project. If this duration is reduced beyond its optimal length, building construction costs will generally rise. In this connection, a construction duration that is too long, as well as one that is too short, can negatively influence building construction costs and the project's success.

1.4 RESOURCES

The resources needed to successfully manage a construction project are manpower, machines, materials and money, information, and management decisions. These must be integrated and utilized in the most efficient manner in order to complete a project on schedule and on budget. Typically, resource planning has been tied to scheduling methods. In the critical path method (CPM), resource planning has been accomplished through the use of techniques that level or smooth resources used during the duration of the project.

There are two common approaches to resource levelling. The first approach is used when there are unlimited resources and maintenance of an even or "level" use of resources over the course of the project is desired. In this procedure the project duration is not increased. The second approach, called resource allocation, is used when there are limited resources and the project duration can be change according to allotment of the resources. Due to the resource-driven nature of construction management, the construction manager must develop a plan of action for directing and controlling resources of workers, machines, and materials in a coordinated and timely fashion in order to deliver a project within the limited funding and time available. Hence, aside from a technology and process focus i.e., what is to be done and how, a resource-use focus i.e., who is to do it with what must be adequately considered in describing a construction method or operation in a project plan. Nevertheless, the most popular project planning methods—the critical-path method CPM and the related network diagramming techniques PERT. CPM assumes limitless availability of resources. This assumption is not valid in most practical situations, in which there exist definite limits on the amount of resources available and these resources are shared by a number of activities or even projects. To overcome this recognized drawback, which brings about unrealistic or impossible CPM schedules, analytical or heuristic techniques for resources allocating/levelling on CPM network plans have also been developed since the early 1960s. These techniques generally consist of two stages. First, the project is broken down into distinct activities that are logically or technologically related to one another according to the construction process/method without imposing resource constraints e.g., the superstructure follows the substructure; the concrete pouring succeeds the formwork and reinforcement. Second, basic CPM scheduling calculations are made for early and late start and finish dates and total and

free float times, based on which the project is rescheduled so that a limited number of resources can be efficiently utilized while minimizing the unavoidable extension of project duration also known as resource allocation!; or the start times of certain activities are adjusted within the float limits for a levelled resource profile also known as resource levelling.

CPM technique assumes that the resources are unlimited in a project and can be assigned for the project activities. But in reality, the sources which are to be used in the project are limited. Sometimes the activity can be delayed due to non-availability of the resources. So keeping in mind about the resources we have to sequence the project and assign the available resources to the critical activities first as they play a major role in determining the total completion time of the project.

Resource-Constrained Critical-Path Method Scheduling

Limited-resource allocation algorithms aim to find the CPM schedule duration that is shortest as well as consistent with specified resource limits.An alternative approach to resource-constrained CPM scheduling is the use of heuristic methods that apply priority rules based on activity characteristics, such as the ‘‘minimum total slack’’ rule, to prioritize activities that compete for limited resources. The resulting schedule satisfies the technological constraints and the resource constraints but is not optimal in terms of achieving the shortest project duration. The total floats (TF) earliest start times (EST), and latest start times (LST) as calculated from the CPM analysis usually serve as part of the criteria in the heuristic priority rules. Abeyasinghe in 2000 presented a new heuristic approach that does not require CPM calculations but used Gantt charts combined with an intermediate tool called ancillary networks to facilitate the process of resource-loading CPM, instead of using priority rules. Their method also attempted to define a critical path in the sense of the classic CPM by identifying the path with the longest activity duration.

Project Level: At the project level, the objective is to identify the optimum crew formation for each activity in the project, and consequently the global optimum solution. This is achieved in two paths; forward and backward. The forward path starts with the first activity, and propagates through all activities, investigating all crew formations and assignments, as described above. The local optimum solution for the last activity is identified as the global optimum solution, and the backward path is initiated. The objective of the backward path is to scan the local optimum solutions that were identified in the forward path, i.e., identify the optimum crew formation and crew assignments for each activity, along with the optimum crew formation and assignment scenario for its preceding activities. The above procedure is repeated for all activities, until the optimum crew formation and assignment scenario for the first activity are identified.

1.5 NEED OF THE STUDY

In the modern world the construction of the projects are increasing day by day which faces many problems occurs during the construction phase due to lack of pre planning of the project. The activities which are being used in a specific construction should be determined before the construction work starts and scheduling can be done of the project and total estimated days can be determined using the software like Microsoft Project (MSP). MSP can help us to determine the critical path of the project and the resources which are to be used in that project. This helps us to concentrate and prioritise critical activities while allocating the project resources. As we know cost plays an important part in construction project and estimated cost can be determined using this software, which can be optimized after that by resource levelling or smoothening which can reduce or cost total number of days of the project which can increase or decrease direct and indirect cost . Hence it plays an important role in construction industry and there is an urgent need of MSP and cost optimization of a project.

1.6 PRE-REQUISITES FOR THE STUDY

1. Activities which are being used in the single storey building.
2. AutoCAD for Site plan.
3. Microsoft Project software for scheduling the activities of a single storey building.
4. Labour rates as per CPWD.
5. Carriage charges which is analysed as per HPSOR-2016
6. Market rates of different materials which are used in this project.

CHAPTER 2

LITERATURE REVIEW

- **SrilalPerera,1983[1]**

  In his exchange the essayist remarks on the benefits of demonstrating between connections and conditions between exercises on a period scaled timetable and the restrictions of the customary Gantt bar diagram. In any case, the creator's Opportunity Scaled Movement On-Bolt/Promising Start plan does not show any interior buoys. A few exercises could be basic amid a small amount of its length and have a buoy on the rest of its term. This portion of the length having the buoy could be either toward the start or toward the finish of its span. This data is exceptionally valuable to the organizers while distributing the required assets. In the event that work on the movement having an inward buoy toward the start is begun too soon there will be numerous intrusions in the work bringing about extra consumption in enlisting and discharging. By showing the inner buoy, organizers could stay away from these expensive interferences.

- **Amir Tavakoli, Member, ASCE 1990[2]**

  In his paper Amir Tavakoli had given rules for advance of planning and control of bureau of transportation (Speck) development ventures. These rules depend on best current practices and administration methods and are adjusted to mirror their on location usage and the down to earth parts of every day field records. These rules are illustrated and talked about in the accompanying ranges: (1) Advance planning (counting the utilization of bar outlines); (2) observing of advance (S-bends); (3) catching of efficiency rates and their usage; (4) the criticism procedure; (5) settlement of cases and debate through documentation; and (6) PC use and applications. The procurement of correlated subtle elements, the investigation of that information, and the use of it to viably oversee present and future ventures are the consequences of the usage of these rules. While the rules give a structure to Dab and their most continuous

sorts of development, adaptability inside the rules takes into consideration extension of development venture size and sort and takes into consideration expanding levels of use that accompanies proceeded with utilize.

- **L. J. R. Cole,1991[3],**

  In this paper L.J.R. Cole has discussed about the characteristics of construction work, the models presently in use, the requirements of contractors and six case studies. He also shown by the case studies which he had followed, that most projects can be modelled successfully, using either critical path or the flow line models. But, critical path is best suited to one-off non-repetitive projects, and flow line is best suited to repetitive projects. However, as most contracts have dual characteristics, no single system can meet all of a contractor's requirements for the planning and monitoring of construction work. In his paper he concludes with the general observations that: Few contractors use planning techniques to their full potential; critical path methods are best suited to non-repetitive projects; flow line is best.

- **Osama Moselhi, a Member, ASCE, and Khaled EI-Rayes**, **1993[4]**

  In this paper the dynamic programming definitions have been created and are equipped for recognizing, from an arrangement of conceivable options, the ideal group measure for every movement in a monotonous venture. The advancement criteria of these plans are, be that as it may, restricted to the minimization of the general term of the venture. While this may prompt the minimization of the roundabout cost of the venture, it doesn't ensure its general least cost. Their goal was to introduce a model that consolidates cost as a vital choice variable in the advancement procedure. They have used element programming and play out the arrangement in two phases: initial a forward procedure to distinguish nearby least conditions, and afterward a retrogressive procedure to guarantee a general least state. The primary stage is like that utilized as a part of time-cost exchange off examination, and a basic checking and choosing procedure is utilized as a part of the second stage. The aftereffects of the principal examination, was discovered indistinguishable to those acquired utilizing past element programming detailing. The consequences of the second investigation affirm that limiting a venture general term does not ensure its base general cost suited to repetitive projects; and as most contracts have dual

characteristics, no single system can meet all a contractor's requirements for planning and monitoring construction work.

- **Walid Y. ThabeP and Yvan J. Beliveau, Members, ASCE,1994[5]**

  The scheduling of repetitive activities in multi-story projects is controlled by the logical sequence defined between the activities of the same floor, termed horizontal logic, and between activities on different floors, termed vertical logic. This paper described a formalized scheduling procedure to computerize knowledge about horizontal and vertical constraints for scheduling repetitive work in multi-storey projects. The proposed procedure is entitled horizontal and vertical constraints scheduling (HVLS). The HVLS procedure only applies to scheduling repetitive activities on typical floors, or linear portion, of multi-story projects. The nonlinear portion cannot be scheduled using the proposed procedure and should be integrated if an overall scheduling model is intended for this type of construction. Another limitation of the proposed procedure is the consistency of work flow direction. The procedure schedules activities based on a constant workflow direction; either upward or downward, and does not provide for a varying of the workflow direction of crews. This may not be the case for some construction trades that may adopt inconsistent, but continuous, workflow direction to move between the different floors depending on the available work areas.

- **Robert B. Harris; Fellow, ASCE, and Photios G. Ioannou,z Member, ASCE,1998[6]**

  Construction contractors often need to model multiunit projects wherein activities repeat from unit to unit. These activities need to be scheduled so that their required resources are continuously used once they arrive on the construction site. The use of typical CPM scheduling techniques cannot ensure this continuity in resource utilization because only technical precedence and resource availability constraints are shown in CPM networks. The RSM recognizes the additional resource continuity constraint that cannot be shown in a network, and thus provides for continuous resource usage. RSM is presented here as a scheduling method that simplifies and generalizes several variously named, multiunit scheduling techniques that have been

cited in past publications. It incorporates commonly accepted activity precedence concepts from CPM, and can be applied to both vertical and horizontal projects that may contain either discrete or continuous activities.

- **Kris G. MattilaandDuley M. Abraham,1998[7]**

  In this paper they have presents a strategy to level the assets of a common parkway development extend that was arranged and booked utilizing the direct planning technique. The controlling action way was recognized utilizing the straight booking model. The whole number direct programming asset levelling has been utilized as a part of this paper which utilizes the ideas of rate buoy and movement skim. This is conceivable in light of the fact that the generation rates of non-controlling direct exercises, or fragments of non-controlling straight exercises, in a straight timetable can shift (diminish) contingent upon the rate buoy of that movement. Since the creation rate of an action relies on upon the quantity of assets utilized on that action, the measure of rate buoy that might be utilized relies on upon the quantity of accessible assets. On the off chance that exercises have normal assets, then rate buoy can be utilized to accomplish better asset usage.

- **TarekHegazy, Member, ASCE, and TolgaErsahin,2001[8]**

  In their paper they have exhibited another approach for the demonstrating and enhancement of a general calendar, considering CPM, TCT, asset assignment, asset levelling, and income investigations, at the same time. The proposed demonstrate utilizes spreadsheets and the GAs system to make it simple for it's the improvement and the enhancement. The GAs procedure was utilized to decide the ideal calendar that limits the aggregate venture cost under time, cost, and asset imperatives at the same time. They have directed many analyses on a contextual analysis extend, and promote experimentation on undertakings with different sizes uncovered the consistency and great execution of the model and the GAs enhancement. In this review, spreadsheets and GAs speak to a basic and down to earth blend for development applications. This mix can't just offer simple to-utilize, flexible, and straightforward models, additionally best in class systems without their hidden complexities.

- **Khaled El-Rayes, Member, ASCE, and Osama Moselhi, Fellow, ASCE,2001[9]**

  In this they have examined around a robotized demonstrate which has been produced for improving asset use for monotonous development ventures. The model depends on a dynamic programming plan, intended to distinguish an ideal group development and interference choice for every action in the venture that prompts least venture span. The model consolidates a planning calculation and an intrusion calculation. The booking calculation agrees to employment rationale, team accessibility, and group work coherence limitations. The interference calculation produces an arrangement of attainable intrusion vectors for each group development to be utilized as a moment state variable in the dynamic programming definition. This calculation (1) is mechanized and along these lines eases the requirement for the client to give an arrangement of intrusion vectors in a self-assertive way preceding booking; (2) altogether decreases the quantity of interference vectors in a levelheaded way, making the improvement procedure doable; and (3) empowers the era of the ideal arrangement. A venture case from the writing was dissected to exhibit the utilization of the model and show its capacities. The examination comes about demonstrate that the proposed show beats those portrayed in the writing.

- **Ming Lu and Heng Li,2003[10]**

  In their paper they have focused on the long-standing booking issue of how to consider asset abilities and accessibility in CPM planning by proposing the RACPM, in which the measurement of assets are considered notwithstanding action and time in development arranging. RACPM characterizes the begin/complete circumstances and the buoys as asset movement qualities in light of the asset innovation consolidated priority connections. Subsequently, in this paper the RACPM can be promptly identify with the exemplary CPM to decipher and use a RACPM plan for practice and has been exhibited in an example utilization of building a footbridge. The impact on the venture span and movement buoys of fluctuated asset accessibility can be concentrated through running RACPM on various situations of assets. This conceivably prompts an incorporated planning and cost-assessing process that will deliver practical timetables, gauges, and control spending plans for development.

- **TarekHegazy, M.ASCE; and EhabKamarah,2008[11]**

  In this paper they have made a down to earth show for booking and cost advancement of tall structure development. The model's goal is to limit add up to development cost, while regarding the time and asset imperatives of a venture. For adaptability, the model enables every movement to have three option development strategies, from modest and ease back to quick and costly. At the centre of the model is a planning calculation for asset task along the skyscraper floors so that work progression is kept up while regarding the building's vertical requirements and the particular way of the basic centre exercises. For cost enhancement, the model uses a non-conventional improvement method, hereditary calculations, which suits substantial scale issues. Itemized display definition is exhibited in this paper alongside its execution in an easy to-utilize PC framework. A reasonable contextual investigation of an elevated structure is utilized to demonstrate the framework's components, intense streamlining capacity, and the model's new introduction of natty gritty asset assignments and exercises' advance information.

CAPTER 3

OBJECTIVE AND RESEARCH METHODOLOGY

3.1 INTRODUCTION

This study deals with the scheduling and cost optimization of the single storey building. In this study firstly the number of activities are determined which are used for making single storey residential building. Once the activities are determined scheduling of the project is done with the help of the software i.e. Microsoft Project 2010 and hence the total number of estimated days can be determined. After that it the excel sheet is made in Microsoft Excel 2010 to determine the earliest starting time (EST), earliest finishing time (EFT), latest starting time (EFT), latest finishing time (LFT). These are used to determine the total float (TF) and free float (FF). With the help of these we can determine the critical path so that we can give main focus on the critical activities during construction phase because any delay in the critical activity can cause delay in the total duration of the project which can increase our indirect and direct cost. After that resources are allotted to each activity in Microsoft project according to their work and requirements. After that total labour cost and total material cost has been determined by the rate analysis technique spread on excel sheet with the help of market prices of materials used this construction project, total carriage charges of materials and total labour charges as per state level. Hence total estimated cost has been determined of the project.

3.1.2. OBJECTIVES OF THE STUDY

1. To determine the critical path, total number of days, total float (TF), free float (FT), slack and activity based CPM of the project using Microsoft Project software.
2. To determine the Bills of Quantity (BOQ) which can be made on excel 2010 spreadsheet. And with that resource allocation and resource levelling can also be done.

3. To perform the Earned Value Management by determining its parameters which shows information about the project at regular interval when the construction is going on.
4. To determine the graph between the different cumulative cost of the project with regular time interval.

3.2 METHODOLOGY FOLLOWED

3.2.1 AutoCAD: firstly the site plan from the construction site was determined and drawn on the AutoCAD with dimensions of every room.

3.2.2 Microsoft Project: Firstly the activities are determined from the construction site which is required to construct single storey residential building. After that scheduling has been done in Microsoft project software with respect to relations between activities which are of four types firstly finish to start, secondly start to finish, thirdly start to start and lastly finish to finish activities. When the scheduling has been completed critical activities are determined and critical path (shown by red bars) is also known. Then the resources are allotted according to their work and requirements with their daily wages according to state labour rates and when all resources are allotted then from the resource sheet or resource graph it is checked whether any resources are over-allocated or not. After that resource levelling has been done with constraints i.e. without changing the number of days of the project which was 130 days and without constraints which changes the total estimated days of the project due to which labour is required for more number of days.

After that activity based network diagram has been made in Microsoft Word.

3.2.3 Microsoft Excel: All the activities are listed in one column and their duration are noted in another column. With the help of these duration the total float (TF) and free float (FF) are calculated, for that the earliest starting time (EST), earliest finishing time (EFT), latest starting time (EFT), and latest finishing time (LFT) are had been found out. EST is determined for the current activity by taking the maximum or higher priority from the EFTs of predecessor activities and is carried out by forward pass processing. After that LST is carried out by backward pass processing and duration of an activity is added to

find the LFT. LST is carried out by lower priority or minimum value of the successor activity LST value.The backward pass processing requires the definition of the resource-activity combined precedence relationships, based on which the latest finish time LFT and the latest start time (LST) for resources working on each activity are determined and floats (TF/FF) subsequently computed. The resource-constrained precedence relationships between activities, differing from the technology-constrained ones in the original CPM, can be defined as follows: For one current activity, its resource-constrained successor activities include the immediately following activities that in part or in total involve the resources used in the current activity.

3.2.4 Estimation: Estimation of cost of the building is done by rate analysis. It is done using the MS EXCEL 2010 for detailed estimation of quantities.Unit quantity method of estimation is used in which quantities of various items of work are calculated in their respective units and rate of each item can be determined from the Himachal Pradesh Public Work Department Schedule of Rate (HPSOR). Then the quantities and the rates are multiplied to arrive at the total cost of an item of work. Hence total civil work cost is calculated.

3.2.5 Earned Value Management (EVM):

To perform EVM, three values need to be determined

- **Planned Value (PV or BCWS)** - budgeted costs of the work scheduled
- **Actual Costs (AC or ACWP)**- actual costs of the work performed
- **Earned Value (EV or BCWP)**- budgeted costs of the work performed

When these values are known then Earned Value analysis can be known which can be determined by the following formulae. They are given in the following table below:

Table 3.1 Earned value Analysis

Parameters	**Formulae**
Cost Variance (CV)	CV = EV – AC
Cost Performance Index (CPI)	CPI = EV / AC
Schedule Variance (SV)	SV = EV – PV
Schedule Performance Index (SPI)	SPI = EV / PV
Estimate at Completion (EAC)	EAC = AC + ETC
Estimate to Complete	(BAC - EV) / CPI

These parameters have their own significance which is discussed in chapter 5.

WORKING METHOD OF NON REPETITIVE PROJECT

4.1 AutoCAD

Site plan drawn with the help of AutoCAD:

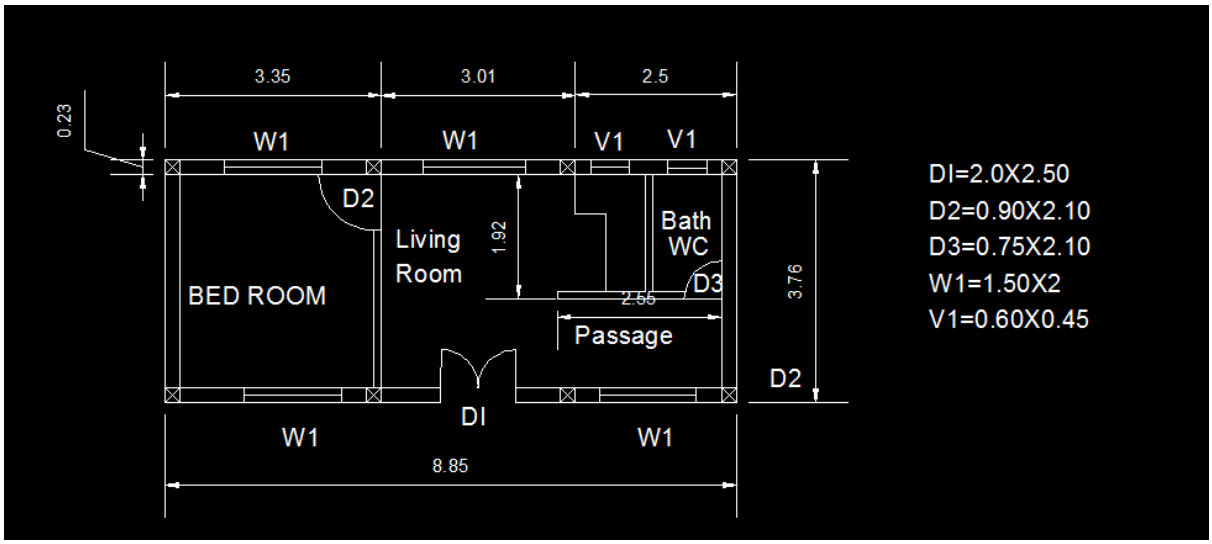


Figure 4.1 Site Plan

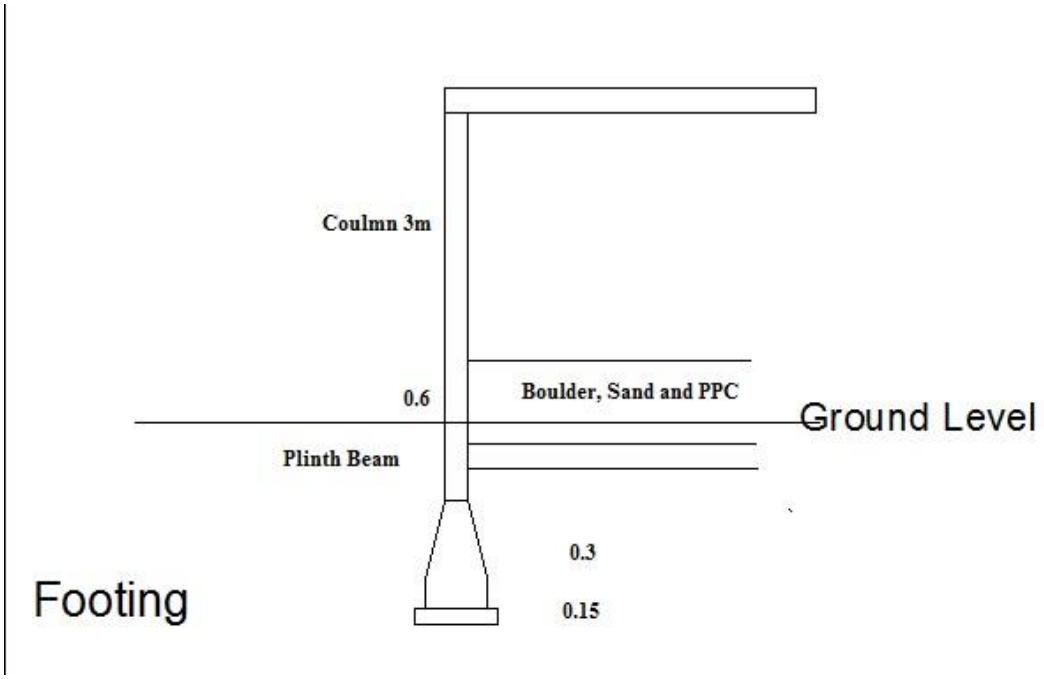


Figure 4.2 Foundation Drawing

4.2 Microsoft Project

Scheduling has been done with the help of this software.

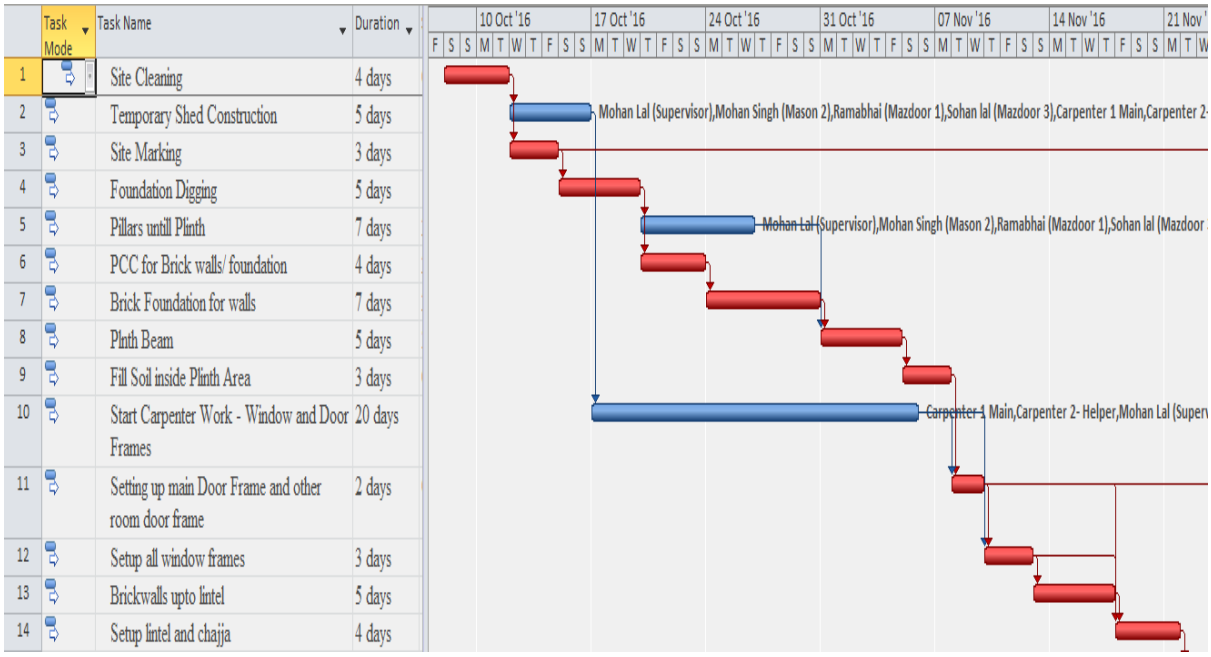


Figure 4.3 Project Schedule (A)

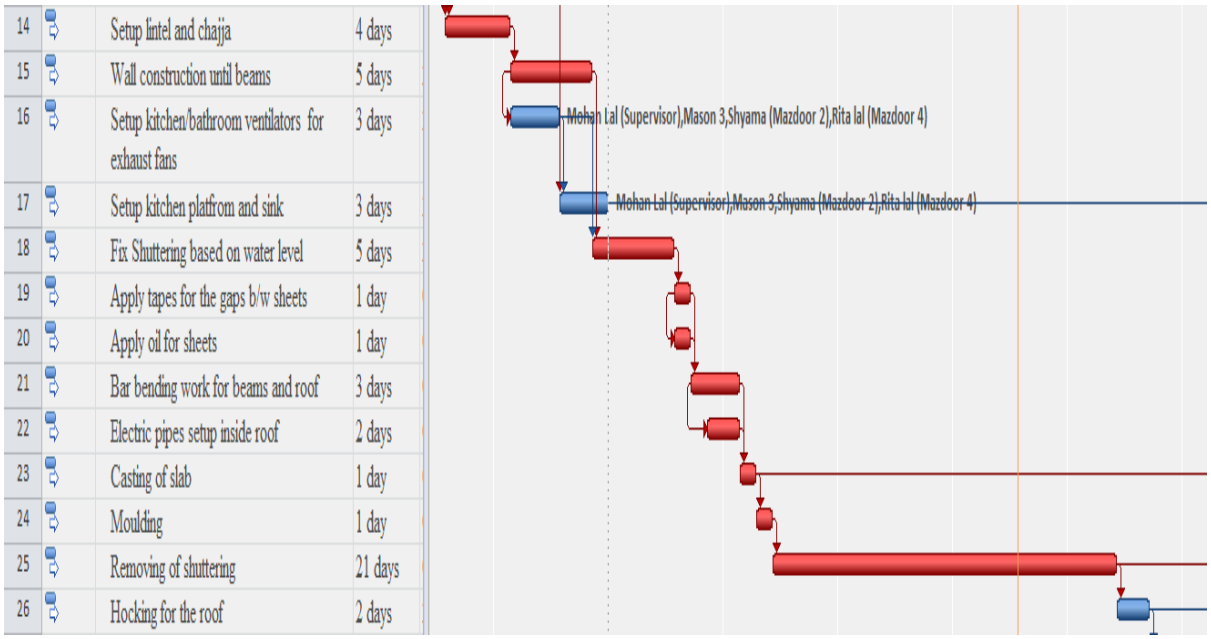
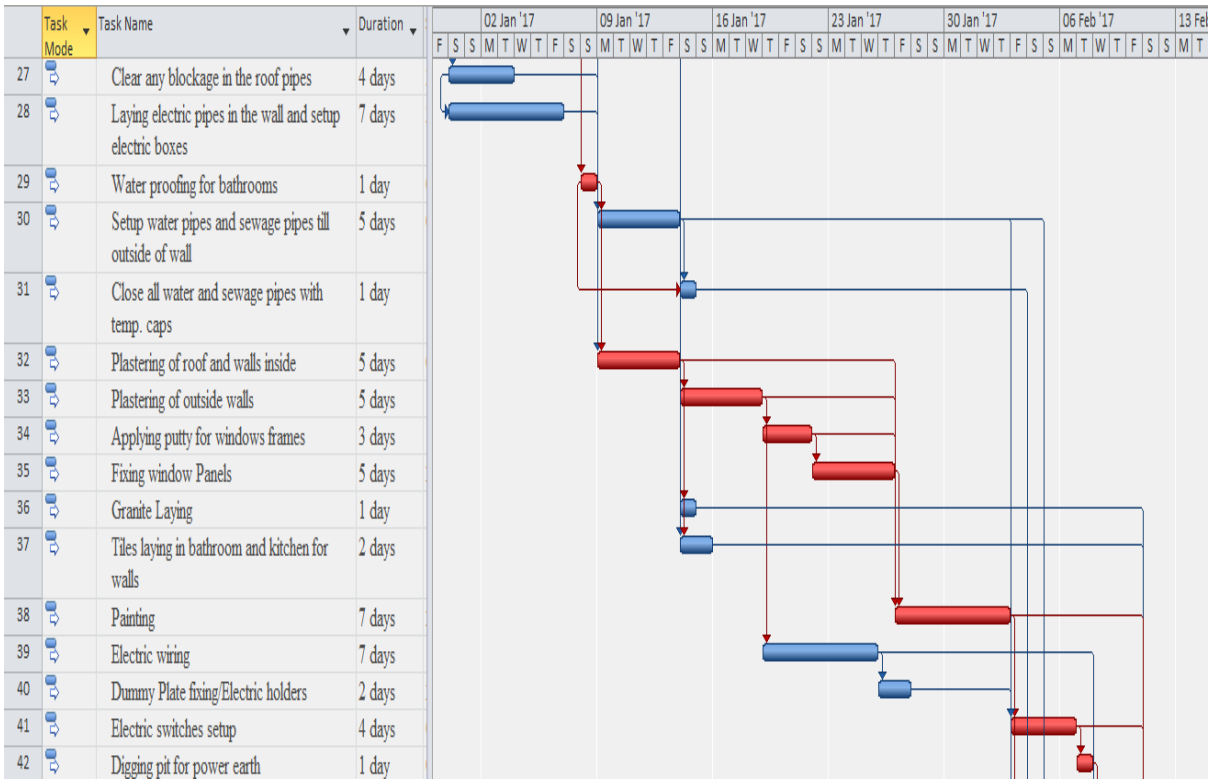
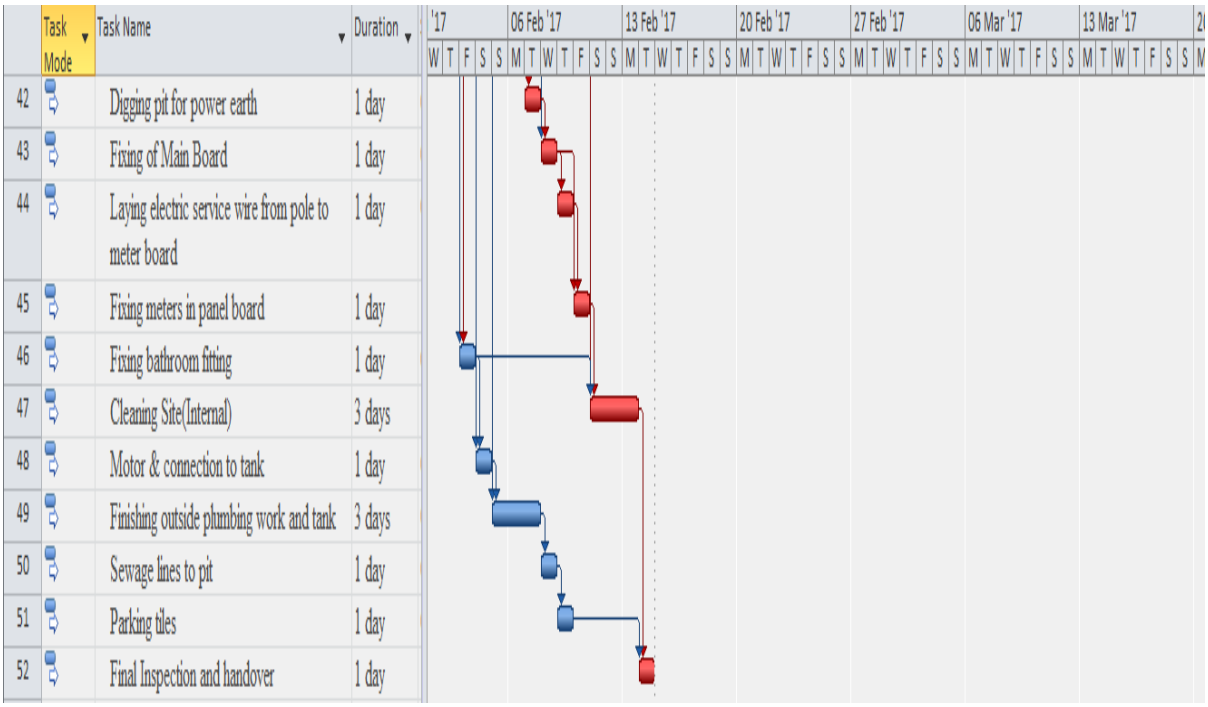


Figure 4.4 Project Schedule (B)



	Task Mode	Task Name	Duration
27		Clear any blockage in the roof pipes	4 days
28		Laying electric pipes in the wall and setup electric boxes	7 days
29		Water proofing for bathrooms	1 day
30		Setup water pipes and sewage pipes till outside of wall	5 days
31		Close all water and sewage pipes with temp. caps	1 day
32		Plastering of roof and walls inside	5 days
33		Plastering of outside walls	5 days
34		Applying putty for windows frames	3 days
35		Fixing window Panels	5 days
36		Granite Laying	1 day
37		Tiles laying in bathroom and kitchen for walls	2 days
38		Painting	7 days
39		Electric wiring	7 days
40		Dummy Plate fixing/Electric holders	2 days
41		Electric switches setup	4 days
42		Digging pit for power earth	1 day

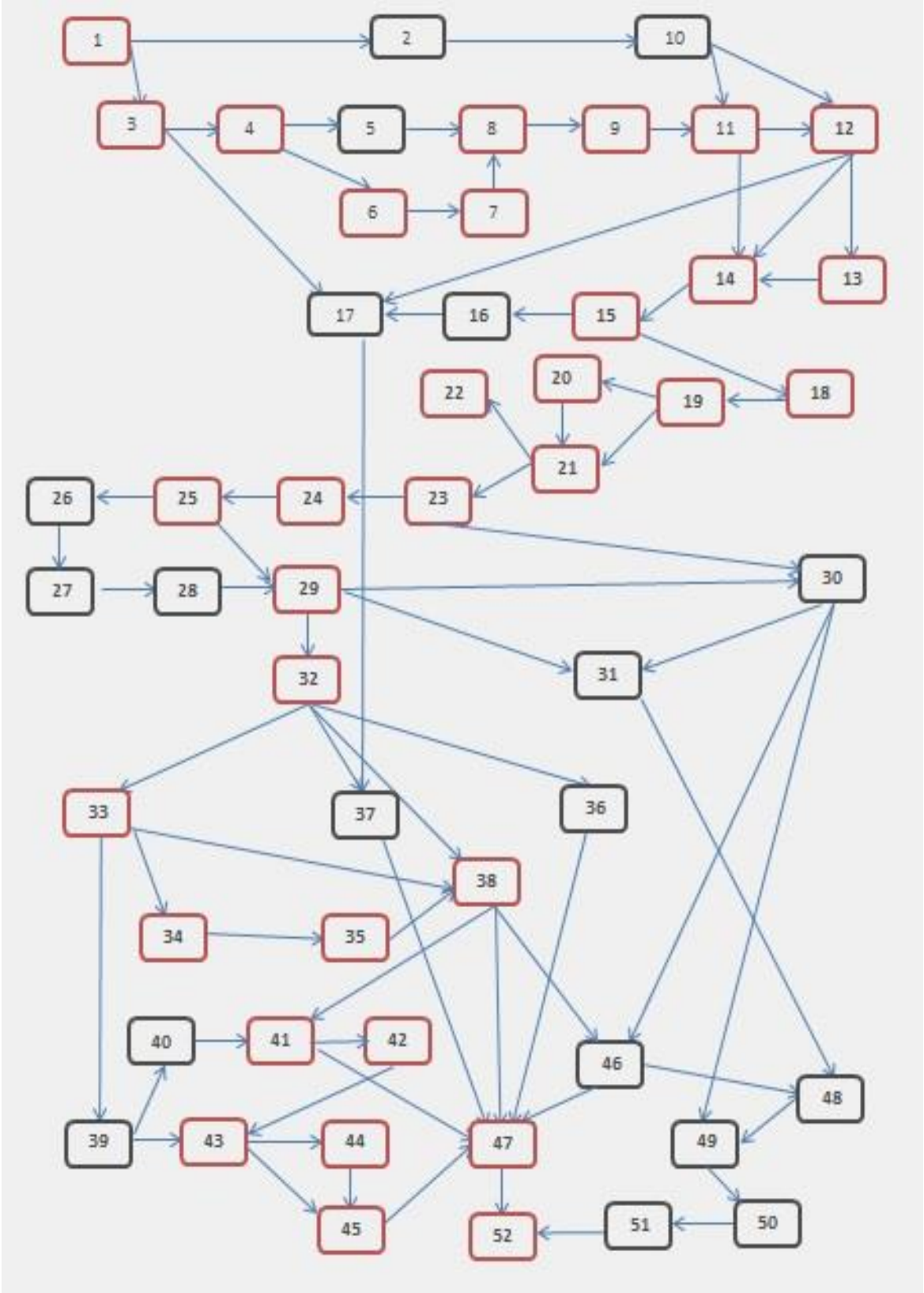
Figure 4.5 Project Schedule (C)



	Task Mode	Task Name	Duration
42		Digging pit for power earth	1 day
43		Fixing of Main Board	1 day
44		Laying electric service wire from pole to meter board	1 day
45		Fixing meters in panel board	1 day
46		Fixing bathroom fitting	1 day
47		Cleaning Site(Internal)	3 days
48		Motor & connection to tank	1 day
49		Finishing outside plumbing work and tank	3 days
50		Sewage lines to pit	1 day
51		Parking tiles	1 day
52		Final Inspection and handover	1 day

Figure 4.6 Project Schedule (D)

4.3 ACTIVITY BASED NETWORK DIAGRAM



4.4 FLOAT CALCULATIONS

Table 4.1

Activity No.	Name	Duration	Predecessor	Type	Successors	Type	EST	EFT	LST	LFT	TF	FF
1	Site Cleaning	4			2 3		0	4	0	4	0	0
2	Temporary Shed Construction	5	1		10		4	9	6	11	2	2
3	Site Marking	3	1		4		4	7	4	7	0	0
4	Foundation Digging	5	3		17 5 6		7	12	7	12	0	0
5	Pillars untill Plinth	7	4		8		12	19	16	23	4	4
6	PCC for Brick walls/ foundation	4	4		7		12	16	12	16	0	0
7	Brick Foundation for walls	7	6		8		16	23	16	23	0	0
8	Plnth Beam	5	5 7		9		23	28	23	28	0	0
9	Fill Soil inside Plinth Area	3	8		11		28	31	28	31	0	0
10	Start Carpenter Work - Window and Door Frames	20	2		11 12		9	29	11	31	2	2
11	Setting up main Door Frame and other room door frame	2	9 10		12 14 17		31	33	31	33	0	0
12	Setup all window frames	3	10 11		13 14		33	36	33	36	0	0
13	Brickwallsupto lintel	5	12		14		36	41	36	41	0	0
14	Setup lintel and chajja	4	11 12 14		15		41	45	41	45	0	0
15	Wall construction until beams	5	14		16 18	SS=0	45	50	45	50	0	0
16	Setup kitchen/bathroom ventilators for exhaust fans	3	15	SS=0	17 18		45	48	50	53	5	5

17	Setup kitchen platfrom and sink	3	3 11 16		37		48	51	109	112	61	61
18	Fix Shuttering based on water level	5	15 16		19		50	55	50	55	0	0
19	Apply tapes for the gaps b/w sheets	1	18		20 21	SS=0	55	56	55	56	0	0
20	Apply oil for sheets	1	19	SS=0	21		55	56	55	56	0	0
21	Bar bending work for beams and roof	3	19 20		22 23	SS=1	56	59	56	59	0	0
22	Electric pipes setup inside roof	2	21	SS=1	23		57	59	57	59	0	0
23	Casting of slab	1	21 22		24 30		59	60	59	60	0	0
24	Moulding	1	23		25		60	61	60	61	0	0
25	Removing of shuttering	21	24		26 29	FS=10	61	82	61	82	0	0
26	Hocking for the roof	2	25		27 32		82	84	85	87	3	3
27	laying electric pipes in the wall and setup electric boxes	7	26		28 30		84	91	87	94	3	3
28	Clear any blockage in the roof pipes	4	27	SS=0	32		84	88	87	93	3	3
29	Water proofing for bathrooms	1	25	FS=10	30 31	SS=0	92	93	92	93	0	0
30	Setup water pipes and sewage pipes till outside of wall	5	23 27 29		32 46 49 31		93	98	117	122 124	2	2 4
31	Close all water and sewage pipes with temp. Caps	1	29 30	SS=0	48		98	99	122	123 124	2	2 4
32	Plastering of roof and walls	5	26		33		9	9	9	9	0	0

	inside						3	8	3	8		
			28		36							
			29		37							
					38							
								1		1		
			32		34		9	0	9	0		
33	Plastering of outside walls	5					8	3	8	3	0	0
					38							
					39							
							1	1	1	1		
	Applying putty for		33		35		0	0	0	0		
34	windows frames	3					3	6	3	6	0	0
					38							
							1	1	1	1		
			34		38		0	1	0	1		
35	Fixing window Panels	5					6	1	6	1	0	0
									1	1		
			32		47		9	9	0	0	1	1
36	Granite Laying	1					8	9	8	9	0	0
									1	1		
	Tiles laying in bathroom		17		47		5	5	0	1	5	5
37	and kitchen for walls	2					1	7	9	1	8	8
							1	1	1	1		
			32		46		1	1	1	1		
38	Painting	7					1	8	1	8	0	0
			33		41							
			34		47							
			35									
							1	1	1	1		
			33		43		0	1	0	1		
39	Electric wiring	7					3	0	9	6	6	6
					40							
							1	1	1	1		
	Dummy Plate		39		41		1	1	1	1		
40	fixing/Electric holders	2					0	2	6	8	6	6
							1	1	1	1		
			38		42		1	2	1	2		
41	Electric switches setup	4					8	2	8	2	0	0
			40		47							
							1	1	1	1		
			41		43		2	2	2	2		
42	Digging pit for power earth	1					2	3	2	3	0	0
							1	1	1	1		
			39		44		2	2	2	2		
43	Fixing of Main Board	1					3	4	3	4	0	0
			42		45							
							1	1	1	1		
	Laying electric service wire		43		45		2	2	2	2		
44	from pole to meter board	1					4	5	4	5	0	0
							1	1	1	1		
	Fixing meters in panel		43		47		2	2	2	2		
45	board	1					5	6	5	6	0	0

			44									
									1	1		
			30		48		9	9	2	2	2	2
46	Fixing bathroom fitting	1					8	9	2	3	4	4
					47							
							1	1	1	1		
			36		52		2	2	2	2		
47	Cleaning Site(Internal)	3					6	9	6	9	0	0
			37									
			38									
			41									
			45									
			46									
								1	1	1		
			31		49		9	0	2	2	2	2
48	Motor & connection to tank	1					9	0	3	4	4	4
			46									
							1	1	1	1		
	Finishing outside plumbing		30		50		0	0	2	2	2	2
49	work and tank	3					0	3	4	7	4	4
			48									
							1	1	1	1		
			49		51		0	0	2	2	2	2
50	Sewage lines to pit	1					3	4	7	8	4	4
							1	1	1	1		
			50		52		0	0	2	2	2	2
51	Parking tiles	1					4	5	8	9	4	4
							1	1	1	1		
	Final Inspection and		47				2	3	2	3		
52	handover	1					9	0	9	0	0	0
			51									

4.5 COST ESTIMATION

Table 4.2

BILL OF QUANTITY

S. No.	Description of items	Unit	Quantity	Rate	Amount
	Civil Works				
1	Excavation in foundation trenches etc. in earth work upto all lifts stacking the excavated soil not more than 3.00 metre clear from edge of the excavation and then returning the stacked soil in 15cm layers when required into the plinth sides of foundation etc.,	Cum	29.71	334.80	9946.46
2	Filling in plinth with sand under floors including watering, ramming consolidating and dressing complete including carriage of material upto all leads and lifts and as per direction of Engineer in charge.	Cum	2.77	1902.50	5276.66
3	Stone/ Boulder filling of selected hard stone under floors including carriage of material upto all leads and lifts and as per direction of Engineer in charge.	Cum	5.12	1476.00	7557.37
4	Providing form work with steel plates 3.15mm.thick welded with angle iron in frame 30x30x5 mm. so as to give a fair finish including centering, shuttering, strutting and propping etc. with wooden battens and ballies, height of propping and centering below supporting floor to ceiling in all height and removal of the same for in situ-reinforced concrete & plain concrete work.				0.00
a)	Foundation, footings basis of columns etc. and mass concrete.	sqm	42.90	160.00	6864.00
b)	Columns,	sqm	22.08	279.72	6176.32
c)	Beams.	sqm	21.32	283.00	6032.54

5	Providing and laying cement concrete 1:4:8 (1 cement : 4 sand: 8 graded stone aggregate 40mm nominal size) and curing complete excluding cost of form work in foundation and plinth including carriage of material upto all leads and lifts and as per direction of Engineer in charge.	Cum	4.20	4670.00	19603.49
6	Providing and laying damp proof course 38mm thick with cement concrete 1:2:4 (1 cement:2 sand:4 stone aggregate 12.5mm nominal size) and curing complete, including carriage of material in all leads and lifts and as per direction of Engineer In charge.	sqm	8.87	301.10	2670.40
7	Providing and laying RCC M-20 mix design and curing complete excluding cost of form work and reinforcement, including carriage of material in all leads and lifts and height as per direction of Engineer In charge.				0.00
a)	Foundations, footings bases of columns and the like and mass concrete.	Cum	5.38	6752.00	36334.00
b)	Suspended Floor roofs, landing and shelves and their support balconies, beams, girders, bressumers and cantilever up to all levels.	Cum	3.48	6794.00	23648.69
c)	Column, pillars, posts and struts up to all levels.	Cum	1.27	7021.00	8913.86
8	Providing Tor steel reinforcement Fe-500 (Tata / SAIL or equivalent make) for RCC works including bending, binding and placing in position complete including cost of binding wire with carriage of materials upto all leads and lifts and as per direction of Engineer in charge.	Kg	1706.39	77.00	131392.14
9	Providing all materials and applying a coat of hot bitumen (mexphalt 80/ 100 or equivalent) using 1.70 kg per square metre on Damp Proof Course (DPC) after cleaning the surface with a piece of cloth lightly soaked with kerosene including carriage of material upto all leads and lifts and as per direction of Engineer incharge	sqm	8.87	111.20	986.21

10	Brick work using common burnt clay building bricks (2nd class) in **Super structure** in cement mortar 1:5 (1 cement: 5 sand), up to all height including carriage of material upto all leads and lifts as per direction of Engineer in charge.	Cum	15.21	6105.30	92861.00
11	Half brick masonry using common burnt clay building bricks (2nd class) in CM 1:3 (1 cement : 3 sand) in **super structure** upto all levels**,** including carriage of material upto all leads and lifts and as per direction of Engineer in charge.	sqm	19.52	699.75	13655.62
12	Providing and fixing of Fibre Glass Reinforced plastic (FRP) Door Frames of three legged of cross-section 90mm x 45mm having single rebate of 32mm x 15mm to receive shutter of 30mm thickness .The laminate doorframe moulded with fire resistant grade unsaturated polyester resin and chopped mat. Doorframe laminate shall be 2mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fibreglass from all sides. MS stat shall be provided at the bottom to sturdy the frame. Work shall include carriage of material upto all lead and lifts and shall be executed as per direction of Engineer in charge.	Rmt	4.95	441.00	2182.95
13	Providing and fixing 30mm thick fibreglass reinforced plastic (FRP) flush door shutter in different plain and wood finish made with fire retardant grade unsaturated polyester resin, moulded to 3mm thick FRP laminate all around, with suitable wooden blocks inside at required places for fixing of fittings and polyurethane foam (PUF) / Polystyrene foam to be used as filler material throughout the hollow panel, casted monolithically with testing parameters of FRP laminate conforming to Table - 3 of IS: 14856 : 2000, all complete including carriage upto all leads and lifts and as per direction of Engineer-in-charge.	sqm	1.58	2582.00	4066.65

14	Providing & fixing wood work in frames of doors, windows, clerestory, windows and other frames wrought, framed and fixed in position including carriage of material upto all leads and lifts and as per direction of Engineer incharge. 2nd Class Deodar Wood	Cum	0.35	100630.40	34755.22
15	Providing and fixing panelled glazed or panelled and glazed shutters for doors windows and clerestory windows. Including black enamelled iron butt hinges with necessary screws including carriage of material in all leads and lifts and asper direction of Engineer Incharge. a) 40mm thick 2nd class deodar wood	sqm	16.93	4246.30	71889.86
16	Providing and fixing aluminium tower bolts (barrel type) (ISI Mark) anodized transparent or dyed to required shade and colour with screws, including carriage of material in all leads and lifts and as per direction of Engineer In charge.				0.00
	200x10mm	Each	2.00	100.00	200.00
	150X10mm	Each	3.00	77.00	231.00
17	Providing and fixing aluminium handles (ISI Mark) anodized transparent or dyed to required colour & shade with necessary screws etc complete including carriage of material in all leads and lifts and as per direction of Engineer In charge.				0.00
	150mm	Each	8.00	91.00	728.00
18	Providing 40x3 mm flat iron hold fast 40cm long including fixing to frame with 10mm diameter bolts & nuts and wooden plugs and embedding in cement concrete 1:3:6 (1 cement : 3 sand: 6 graded stone aggregate 20mm nominal size) block of 30x10x15cm size, including carriage of material upto all leads and lifts and as per direction of Engineer In charge.	Each	25.00	85.10	2127.50
19	Providing and fixing 100mm aluminium floor door stopper (double rod) ISI marked with rubber cushion screws etc. to suit shutter thickness shutter thickness including carriage of	Each	3.00	83.00	249.00

	material in all leads and lifts and as per direction of Engineer In charge.				
20	Providing and fixing Locks (Link, Godrej or equivalent Indian make ISI marked), size not less than 75mm, with necessary screws etc complete, including carriage of material upto all leads and lifts and as per direction of Engineer incharge.	Each	1.00	1299.50	1299.50
21	Vitrified Tiles flooring over a base of 20 mm (average) thick base of cement mortar 1:4 (1 cement :4 sand) laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete and carriage of material upto all leads and lifts and as per direction of Engineer in charge 25mm thick	sqm	27.74	1675.90	46481.76
22	Vitrified tiles in risers of steps, skirting dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement :3 sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs including rubbing and polishing complete.	Sqm	25.57	1746.50	44664.12
23	Applying Birla or equivalent white wall care putty over plastered surface after thoroughly brushing the surface free from mortar drops, dust, loose materialss and other foreign matters sand papered smooth to give final matter finish to the surface complete,	sqm	90.86	45.10	4097.69
24	Distempering two coats with oil bound washable distemper of approved brand and manufacture and of required shade on undecorated wall surface to give an even shade over and including a priming coat with distemper primer of approved brand	sqm	90.86	55.00	4997.18
25	Applying priming with cement primer coat on new concrete/masonry/ asbestos cement/plastered surfaces after and including preparing the surface by thoroughly cleaning oil,grease,dirt and other foreign matter and sand papering	sqm	95.88	27.10	2598.35

26	Applying priming coat over new wood and wood based surfaces of approved brand and /Manufacture after and including preparing the surface by thoroughly cleaning oil, grease, dirt and other foreign matter) sand papering and knotting including carriage of material upto all leads and lifts and as per direction of Engineer in charge .	sqm	16.93	34.80	589.16
27	Painting two coats of approved brand and manufacture (excluding priming coat) on new wood and wood based surfaces, with ready mixed paint, brushing to give an even shade including cleaning of all dirt, dust and other foreign matters and papering and stopping	sqm	16.93	62.20	1053.05
	Total (in Rs)				**594129.76**
	Total (in Lacs)				**5.941**

Hence total cost of civil comes out to be approximately **5.9 lakhs Rupees.**

CHAPTER 5

WORKING METHOD OF REPETITIVE PROJECT

5.1 ABOUT SITE

Table 5.1

Level Name	Level Height	Capacity	Floor Height
2 Restaurants, Landscape	95	26 cars, 4 buses	3,6
P1	91.4	70 cars	3.6
P2	87.8	70 cars	3.6
P3	84.2	70 cars	3.6
P4	80.6	76 cars	3.6
P5	77	76 cars	3.6
P6	73.4	76 cars	3.6
P7	69.8	76 cars	3.6
P8	66.2	31cars	3.6
Office 1	62.6		3.6
Office 2	59		3.6

5.2 NO OF ACTIVITIES

	Task	Task Name	Duration	Start	Finish	Predecessors	ID
1		**Ground Floor**	**89 days**	**29-05-16**	**25-08-16**		**1**
2		**Column**	**17 days**	**29-05-16**	**14-06-16**		**2**
3		Layout	1 day	29-05-16	29-05-16		3
4		Reinforcement of Colu	15 days	29-05-16	12-06-16	3SS	4
5		Shuttering Of Column	15 days	30-05-16	13-06-16	4SS+1 day	5
6		Casting of Column	15 days	31-05-16	14-06-16	5SS+1 day	6
7		**Slab**	**34 days**	**01-06-16**	**04-07-16**		**7**
8		Beam/Slab Shuttering	8 days	01-06-16	08-06-16	6SS+1 day	8
9		Reinforcement of Bean	5 days	04-06-16	08-06-16	8SS+3 days	9
10		Electric Pipes laying	4 days	09-06-16	12-06-16	9,8	10
11		Casting of Beam/Slab	10 days	10-06-16	19-06-16	10SS+1 day	11
12		Moulding	1 day	20-06-16	20-06-16	11	12
13		Curing of Slab	14 days	21-06-16	04-07-16	12	13
14		**Brickwork and Frames**	**10 days**	**05-07-16**	**14-07-16**		**14**
15		Construction of Brick w	1 day	05-07-16	05-07-16	13	15
16		Fixing of Door Frames	1 day	06-07-16	06-07-16	15	16
17		Construction of parafet	10 days	05-07-16	14-07-16	13	17
18		Fixing of Window Fram	1 day	05-07-16	05-07-16	13	18
19		Brick work upto lintel	4 days	06-07-16	09-07-16	18	19
20		Casting of Lintel Beams	1 day	10-07-16	10-07-16	19,16,18	20
21		Brick work upto Beam l	4 days	11-07-16	14-07-16	20	21

Figure 5.1 Project Activities

22		**Services**	**17 days**	**15-07-16**	**31-07-16**		**22**
23		Electrical Conduting on	5 days	15-07-16	19-07-16	21	23
24		Water Supply Conduting	6 days	20-07-16	25-07-16	23	24
25		Sewerage Conduting	3 days	26-07-16	28-07-16	24	25
26		Fire Services	3 days	29-07-16	31-07-16	25	26
27		**Plastering**	**20 days**	**01-08-16**	**20-08-16**		**27**
28		Internal	10 days	01-08-16	10-08-16	26,17	28
29		External	10 days	11-08-16	20-08-16	28,17	29
30		Painting	5 days	21-08-16	25-08-16	29	30

Figure 5.2 Project Activities

For each floor these actitvities were followed.

5.3 SCHEDULLING IN MSP

	Task Mode	Task Name	Duration	Start	Finish	Predecessors	ID
1		Ground Floor	89 days	29-05-16	25-08-16		1
31		First Floor	89 days	05-07-16	01-10-16		31
61		Second Floor	89 days	11-08-16	07-11-16		61
91		Third Floor	89 days	17-09-16	14-12-16		91
121		Fourth Floor	89 days	24-10-16	20-01-17		121
151		Fifth Floor	89 days	30-11-16	26-02-17		151
181		Sixth Floor	89 days	06-01-17	04-04-17		181
211		Seventh Floor	89 days	12-02-17	11-05-17		211
241		Eighth Floor	86 days	21-03-17	14-06-17		241
271		Ninth Floor	89 days	27-04-17	24-07-17		271
301		Tenth Floor	89 days	03-06-17	30-08-17		301

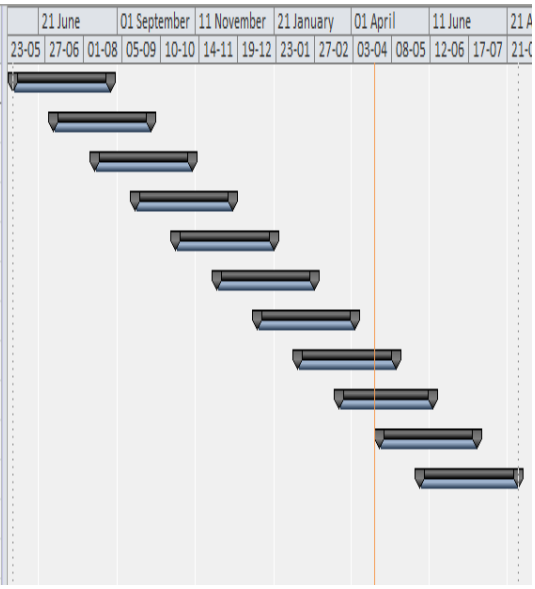
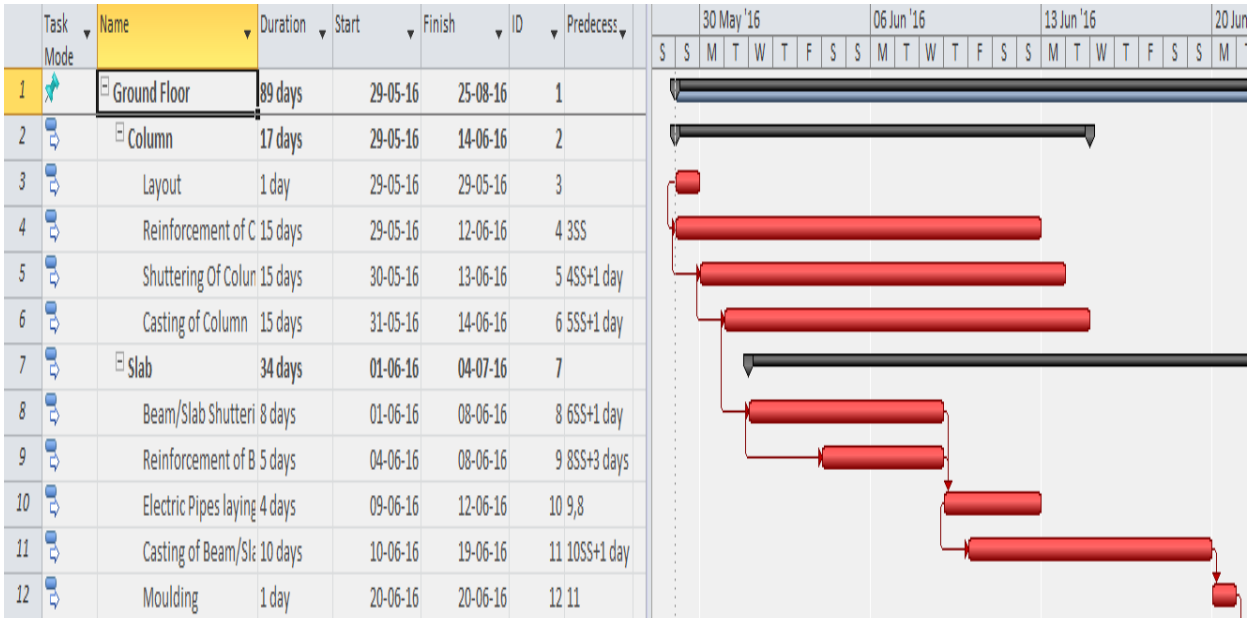


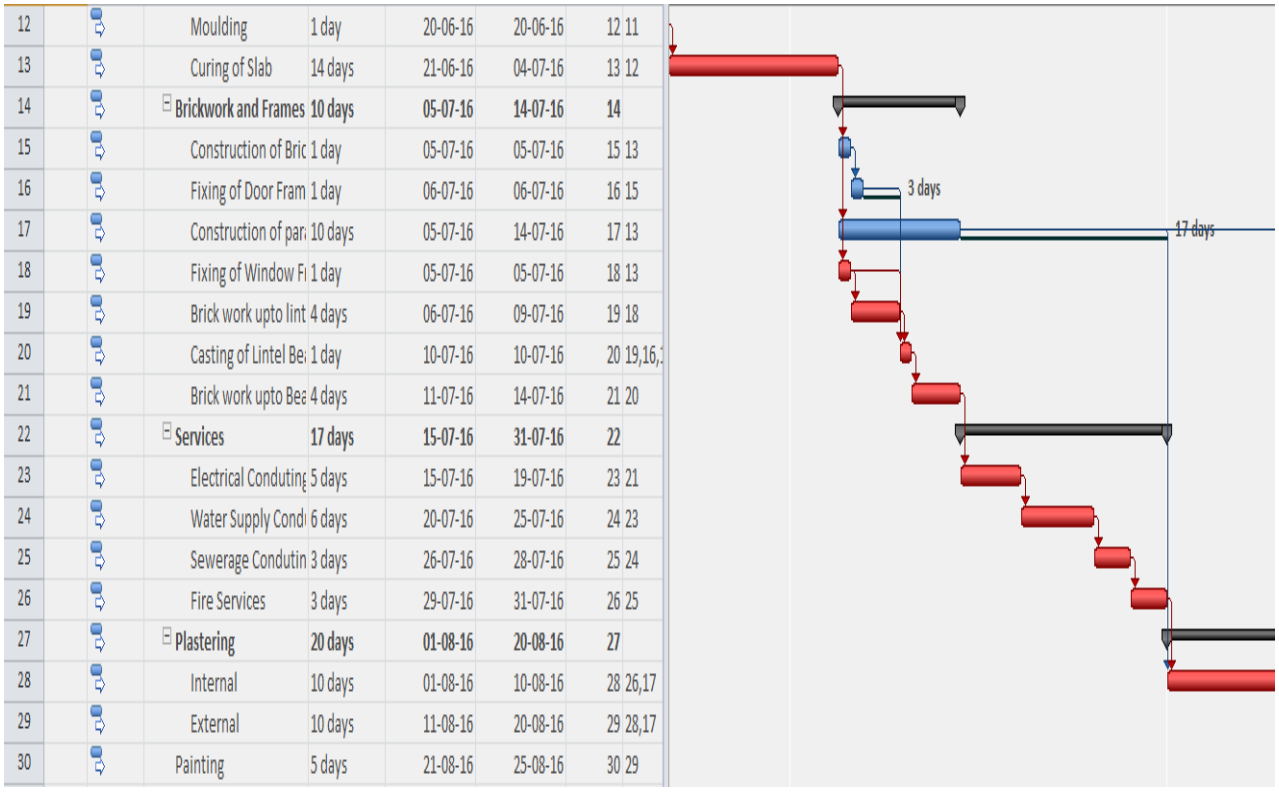
Figure 5.3 Project Schedule (A)

There are 11 number of floors in multistorey building.



	Task Mode	Name	Duration	Start	Finish	ID	Predecess
1		Ground Floor	89 days	29-05-16	25-08-16	1	
2		Column	17 days	29-05-16	14-06-16	2	
3		Layout	1 day	29-05-16	29-05-16	3	
4		Reinforcement of C	15 days	29-05-16	12-06-16	4	3SS
5		Shuttering Of Colun	15 days	30-05-16	13-06-16	5	4SS+1 day
6		Casting of Column	15 days	31-05-16	14-06-16	6	5SS+1 day
7		Slab	34 days	01-06-16	04-07-16	7	
8		Beam/Slab Shutteri	8 days	01-06-16	08-06-16	8	6SS+1 day
9		Reinforcement of B	5 days	04-06-16	08-06-16	9	8SS+3 days
10		Electric Pipes laying	4 days	09-06-16	12-06-16	10	9,8
11		Casting of Beam/Sl	10 days	10-06-16	19-06-16	11	10SS+1 day
12		Moulding	1 day	20-06-16	20-06-16	12	11

Figure 5.4 Project Schedule (B)



12	Moulding	1 day	20-06-16	20-06-16	12	11
13	Curing of Slab	14 days	21-06-16	04-07-16	13	12
14	Brickwork and Frames	10 days	05-07-16	14-07-16	14	
15	Construction of Bric	1 day	05-07-16	05-07-16	15	13
16	Fixing of Door Fram	1 day	06-07-16	06-07-16	16	15
17	Construction of par	10 days	05-07-16	14-07-16	17	13
18	Fixing of Window Fi	1 day	05-07-16	05-07-16	18	13
19	Brick work upto lint	4 days	06-07-16	09-07-16	19	18
20	Casting of Lintel Be	1 day	10-07-16	10-07-16	20	19,16,
21	Brick work upto Bea	4 days	11-07-16	14-07-16	21	20
22	Services	17 days	15-07-16	31-07-16	22	
23	Electrical Conduting	5 days	15-07-16	19-07-16	23	21
24	Water Supply Condi	6 days	20-07-16	25-07-16	24	23
25	Sewerage Condutin	3 days	26-07-16	28-07-16	25	24
26	Fire Services	3 days	29-07-16	31-07-16	26	25
27	Plastering	20 days	01-08-16	20-08-16	27	
28	Internal	10 days	01-08-16	10-08-16	28	26,17
29	External	10 days	11-08-16	20-08-16	29	28,17
30	Painting	5 days	21-08-16	25-08-16	30	29

Figure 5.5 Project Schedule (C)

Total Project Duration will be 458 Days.

5.4 NETWORK DIAGRAM

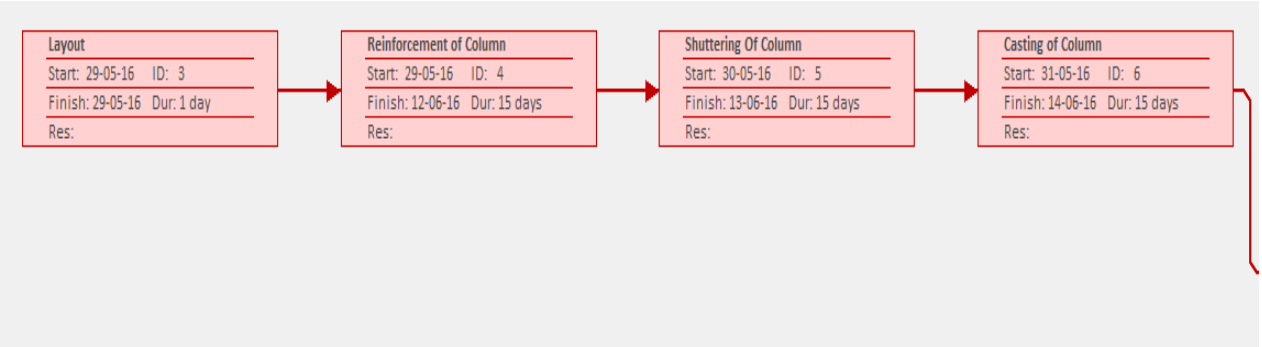


Figure 5.6 Network Diagram (A)

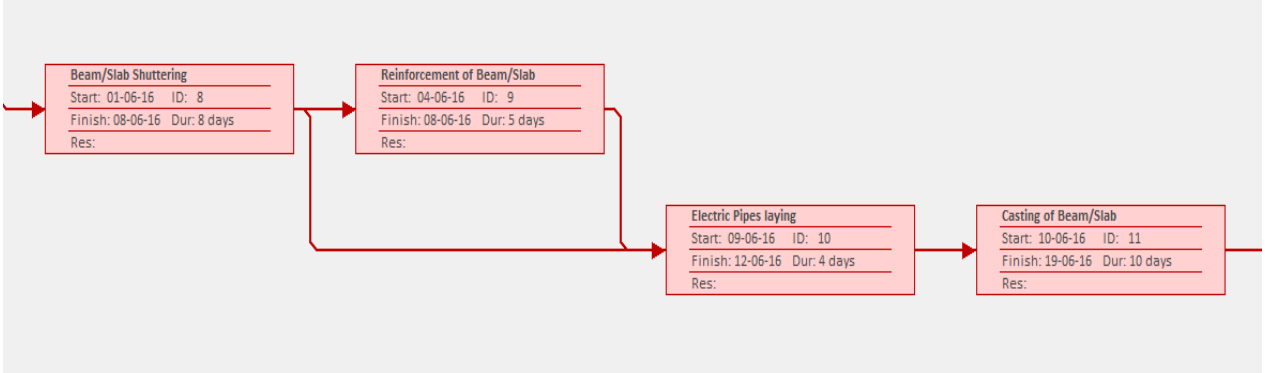


Figure 5.7 Network Diagram (B)

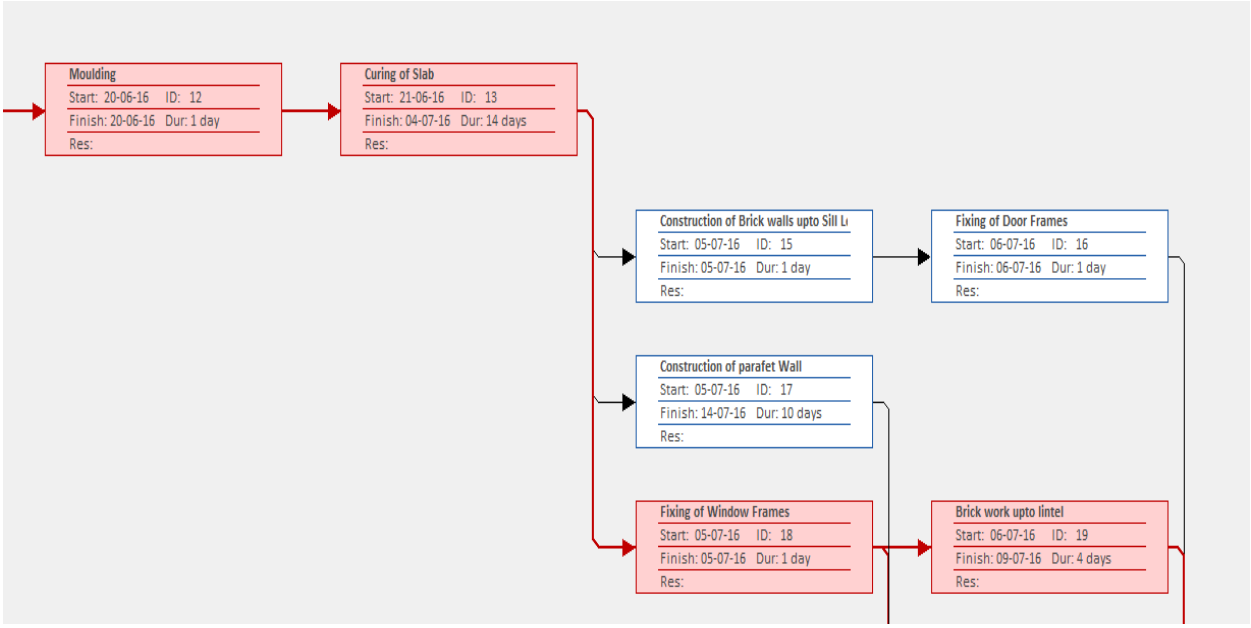


Figure 5.8 Network Diagram (C)

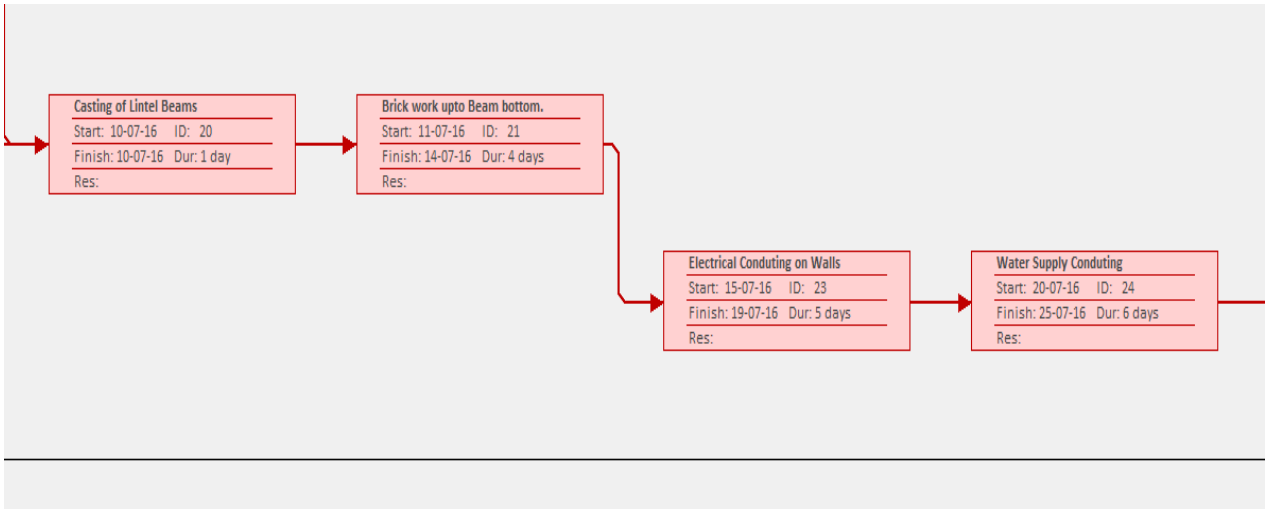


Figure 5.9 Network Diagram (D)

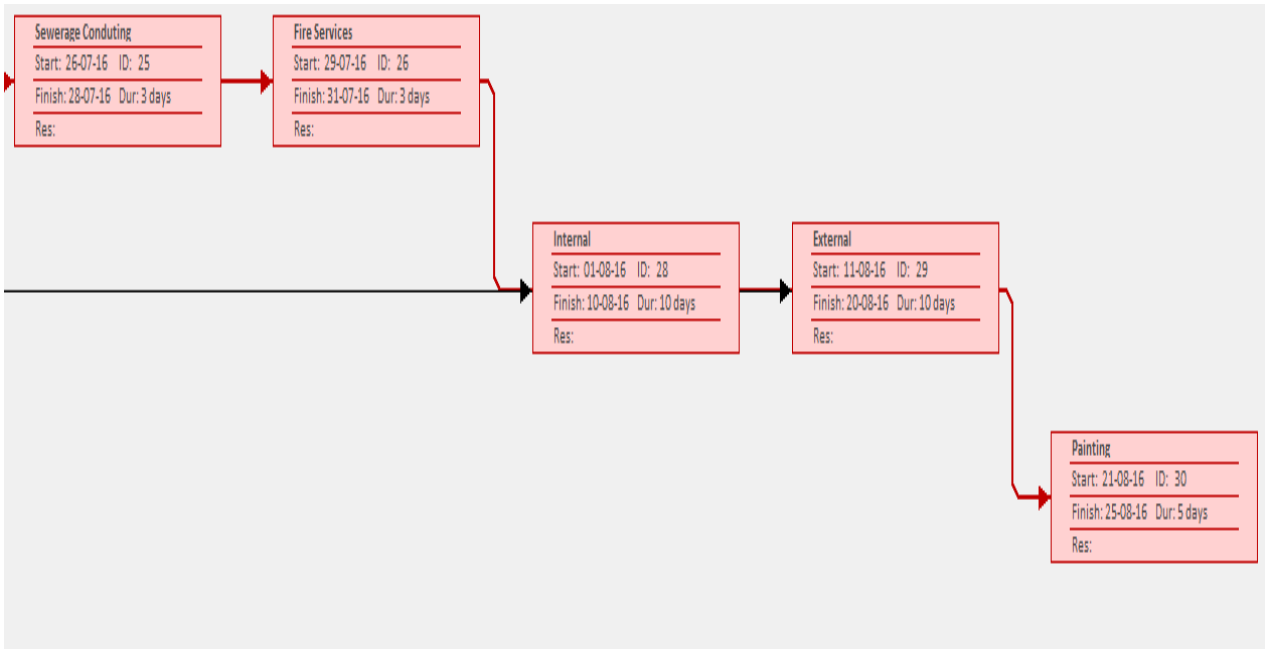


Figure 5.10 Network Diagram (E)

5.5 COST ESTIMATION

Table 5.1

BILLS OF QUANTITIES					
S No.	**Description of Work**	**Unit**	**Qty.**	**Rate (INR)**	**Amount (INR)**
1	2	3	4	5	6
	Civil Works				
1	Providing form work with steel plates 3.15mm.thick welded with angle iron in frame 30 mmx 30 mmx 5 mm. so as to give a fair finish including centering, shuttering, strutting and propping etc. with wooden battens and ballies, height of propping and centering below supporting floor to ceiling not exceeding 4 Mtrs. and removal of the same for in situ-reinforced concrete & plain concrete work in:(Shuttering as per the pattern specified in the Architectural Drawings including pointing, randering and finishing to smooth surfaces incharge including carriage of material upto all leads and lifts.				
A	Flat Surfaces such as soffit of suspended floor , roofs landings and the like floor etc. up to 200 mm in thickness	Sqm	45,711.30	345.00	1,57,70,398.50
B	Vertical Surfaces such as walls (any thicness) parrtitions and the like including atached pilasters butteressplinth and string cources and the like	Sqm	16,566.71	159.00	26,34,106.89
C	Cols / pillers posts and struts circuller and curved in plan	Sqm	7,798.07	289.82	22,60,051.29
E	staircases with sloping or stepped soffits including landings	Sqm	561.00	281.00	1,57,641.00
F	beams, cantilevers, gurders / lintels sides and soffits of beams beam hounchingscantilivers, bressumers and lintels not exceeding 1.00 m in depth in all height in floor	Sqm	25,479.35	281.00	71,59,697.21
G	edges of slab and breaks in floor etc.				
I	under 20 cm Vide	Rmt	1,596.20	110.00	1,75,582.00
Ii	above 20 cm Vide	Rmt	771.75	110.00	84,892.50

2	Providing and laying cement concrete mechanically mixed 1:4:8 (1 cement : 4 sand : 8 graded stone aggregate 40mm nominal size) curing complete excluding cost of form work in foundation and plinth including carriage of material in all leads and lifts	Cum	151.20	4,344.00	6,56,812.80
3	Providing and laying RCC 1:2:4 (1cement : 2 Sand : 4 Coarse aggregate) mechanically mixed including curing and all kinds of carriage, leads, lifts etc. but excluding the cost of form work and reinforced cement steel complete in all respects.				
A	Vertical Surfaces such as walls (any thickness) partition and the like including attached pillasteres buttress plinth and string courses and the like	Cum	1,872.47	5,571.00	1,04,31,530.37
4	R.C.C. M 25 (1:1.5:3) Providing and laying RCC M 25 mix design and curing complete excluding cost of form work and reinforcement including carriage of material upto leads and lifts				
A	Suspended Floor roofs, landing and shelves and and their support balconies, beams girders, bressumers and cantilever up to all floor levels	Cum	10,540.22	6,228.10	6,56,45,544.18
B	Vertical Surfaces such as walls (any thickness) partition and the like including attached pillasteres buttress plinth and string courses and the like	Cum	1,523.05	6,556.60	99,86,029.63
C	**MOLDINGS / CORNICES**				
I	Edges of slab / edges of cornices / mouldings ofchajjas or at break in floors exceeding 15 cm in girth.	Cum	122.83	6,228.10	7,64,997.52
Ii	Edges of slab / edges of cornices / mouldings ofchajjas or at break in floors not exceeding 15 cm in girth.	Cum	16.66	6,228.10	1,03,760.15
D	Stair Cases (except spiral stair cases) including landing but excluding preparing of the surface and finishing of nosing up to all floors levels. R.C.C. M30 (1:1:2)	Cum	179.29	6,683.30	11,98,248.86
5	Providing and laying RCC M 30 mix design and curing complete excluding cost of form work and reinforcement including carriage of material upto leads and lifts				
A	Columns, pillers, posts and struts and beams of free floors up to ground level up to all floor levels	Cum	1,262.95	6,746.00	85,19,862.05

6	Brick work using common burnt clay building bricks in CM 1:6 (1 cement:6 sand) 2nd class including carriage of material upto all leads and lifts.	Cum	1,220.22	6,735.10	82,18,303.72
7	Half brick masonry using common burnt clay building bricks in cm 1:4(1 cement 4 sand) 2nd class bricks including carriage of material upto all leads and lifts.	Sqm	5,416.41	846.10	45,82,821.77
8	Providing and laying random rubble masonry (uncoursed/brought to courses) with hard stone of approved quality in foundation and plinth in retaining walls/breast walls including racking out joints in cement mortal 1:6(1 cement:6 sand) including carriage of material in all leads and lifts	Cum	2,628.50	3,470.30	91,21,683.55
9	S.R. masonry coursed with hard stone of approved quality in foundation and plinth including racking out joint in cement mortar 1:5 (1 Cement : 5 Sand) including carriage of material in all leads and lifts.	Cum	135.00	8,619.40	11,63,619.00
10	Soling / Stone filling of selected hard stones under floors including carriage of material in all leads and lifts	Cum	1,906.20	1,316.00	25,08,559.20
11	Providng wood work in fram of false ceiling , partiting etc. sawn and put up in positin including carriage of materials complete in all respects				
A	2nd class Kail Wood	Cum	26.57	70,227.65	18,65,948.75
12	Providing and fixing redymadeKailwood planks 12mm th. With tongued and grooved jointing and screws (frame work and cover fillets to be measured and paid for seperately as per the direction of Er. In Charge) including cornices as per the design carriage of meterials complete in all respects.	Sqm	988.92	2,200.00	21,75,624.00
13	Providing and fixing redymade cup board including all fittings and accessories like handles, tower bolts, locks, ketchers and painting / polishing, mirrors etc. complete in all respectrs and all kinds of leads, lifts as per the architectural drawings / design / sizes and directions of Er. in Charge.	Each	36.00	7,533.00	2,71,188.00
14	Providing and fixing bison bord in expansion joint of approved quality with bult jointing and nails (frame work and cover fillets to be paid for seperately) bison board 10 mm thick.	Rmt	1,246.00	577.00	7,18,942.00

15	Providing and fixing in position 12 mm thick impregnated fiber board in expansion joints.	Rmt	1,246.00	50.00	62,300.00
16	Providing and fixing Expansion joint between slab by providing Aluminium cradle 250mm wide 1.6 mm thick and filling of the joint filled with bitumen filler or empregnated fibre board	Rmt	1,246.00	366.00	4,56,036.00
17 (a)	Providing and fixing anodized aluminium work for door, window, ventilators and partitions with extruded built up standard tabular and other sections of approved make conforming to IS 733 and IS 1285 anodized transparent or dyed to required shade according to IS 1868. (Minimum anodic coating of grade AC 15) fixed with raw plugs and screws or with fixing clips, or with expansion hold fasteners including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC/ neoprene felt etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically where ever required including cleat angle, aluminium, snap beading for glazing/panelling C.P. brass/stainless steel screws. All complete as per architectural drawings and the directions of Engineer-In-Charge.	Kg	4,436.62	385.60	17,10,760.67
B	For shutters of doors windows & ventilators including providing and fixing hinges/pivots and making provisions for fixing of fittings where ever required including the cost of PVC/neoprene gaskets as required	Kg	4,317.65	399.40	17,24,469.41
18	Providing and fixing glazing in aluminium door, window, ventilator shutter and partition etc. with PVC / Neoprene gasket etc. complete as per the architrctural drawings including carriage of material upto all leads and lifts and as per directions of Engineer in Charge.				
A	Glazing with glass panes of 5.50m thickness (weight not less than 13.75 kg / Sqm. Saint Govind or equivalent including carriage of material upto all leads and lifts as per detailed Drawings / directions of Engineer in Charge	Sqm	757.77	849.63	6,43,821.61
19	Providing and fixing anodized aluminium sliding door bolts anodized colour or shade with bolts and nuts screws etc complete including carriage of material in all lead and				

A	300mm×16mm	Each	232.00	250.60	58,139.20
20	Providing and fixing aluminium tower bolts (barrel type) anodized transparent or dyed to required shade and colour with screws comply with ISO standards including carriage of material upto all leads and lifts and as per detailed drawings / directions of Engineer in Charge.				
A	200 x 10 mm	Each	232.00	113.00	26,216.00
B	150 x 10 mm	Each	202.00	90.00	18,180.00
21	Providing and fixing 100mm bright finished Aluminium floor door stoper with rubber cusion screws etc. to suit shutter thickness complete comply with ISO standard including caarriage of material upto all leads and lifts and as per detailed drawings / directions of Engineer in Charge.	Each	107.00	76.00	8,132.00
22	Providing and fixing aluminium Handles anodized transparent or dyed to required colour and shade with necessary screws etc complete comply with ISO standard including crriage of material upto all leads and lifts complete as per detailed dtawings / directions of Engineer in Charge.				
A	125 mm	Each	214.00	82.96	17,752.92
B	100 mm	Each	202.00	71.00	14,342.00
23	Providing and fixing Brass Harison Lock ISI mark door size fixed with screws etc. complete including carriage of material in all leads and lifts and as per directions of Engineer in Charge.	Each	116.00	933.80	1,08,320.80
24	P/F Aluminium Grills (Jindle make) of required pattern in Aluminium frame of window etc. with nut and screws, incluidng carriage of material, with all lifts and leads as per specifications and as directed by Er. In Charge.	Sqm	245.70	1,671.18	4,10,609.94
25	P/F double action hydraulic floor spring fo approved brand and manufacturers (conferming to IS 6315) for Aluminium door including cost of cutting floor as required bending in floors and cover plates etc. complete as per the directions of Er. In charge including making good the floors.	Each	4.00	2,500.00	10,000.00

26	Providing SS powder coated railing for main staircase as detail with 50mm dia SS pipe (SS 304 Grade) at top level and five Nos 12mm dia pipes at Intermidiate level fixed with coupling arrangement to vertical balustrades of 25mm dia to be fixed on the stair case tread with SS coupling arrangement all complete as per the drawing and design welded joint of any shall be buffed to high mirron finish as per the approval of the Engineer incharge. All members to be powder coated to metalic shade as approved as per drawings and design complete in all respects.	Rmt	610.00	2,568.00	15,66,480.00
27	Providing and laying six courses waterproofing treatent with bitumen felt over roofs consisting of first, third & fifth courses of blon or resideual bitumen applied at 1.45 kg 1.20 and 1.45 kg per Sqm of area sespectively second and fourth course of proofing felt type 3 grade I (hessain base finished bitumen felt) sixth and final course of stone girt 6mm and down size or pea sized gravel spread at 6 Cum or (0.006 Cum)m per Sqm including grading complete as per entire satisfaction of Engineer in Charge.	Sqm	3,761.98	384.20	14,45,352.72
28	Providing and laying of brick bat filling of nominal size in foundations / plinth /sunkedportiong in position to fill the portion including all kinds of leads, lifts and carriage etc. complete in all respects as per directions / entire satisfactions of the Engineer in Charge.	Cum	281.54	1,249.00	3,51,643.46
29	60 mm thick cement concrete flooring with metalic concrete hardnertooping, under layer of 45mm thick cement concrete 1:2:4 (1 cement : 2 sand : 4 graded stone aggregare 20 mm nominal size) and top layer of 15mm thick metalic cement hardner consisting of mix 1:2 (1 cement hardner mix : 2 stone aggregate 6 mm nominal size) by volume, with which metalic hardening compound of approed quality is mixed in the ratio 4:1 (4 part of cement : 1 part of metallic floor hardening compound of approved quality by weight) including finishing complete including curing and provision wooden / steel stirrups complete and carriage of material upto all leads and	Sqm	38,070.66	527.50	2,00,82,273.15

29	Providing and laying 10mm thick anti skid tiles water proof stain and impact resistant heavy duty vitrifiedtilesKajaria or Nitco or equivalent 600 x 600 x 10 mm manufactured of approved shade and colour in flooring kerb laid over 12mm thick cement mortar 1:3 (1 cement : 3 sand) jointed with cement slurry mixed with pigment to match the shade of tiles as required complete upto floor two level including carriage of material upto all leads and lifts and as per direction of Enginnerincharge.	Sqm	5,518.77	1,670.00	92,16,345.90
30	Providing and laying 10mm thick anti skid tiles water proof stain and impact resistant heavy duty vitrifiedtilesKajaria or Nitco or equivalent 300 x 300 x 7.3 mm manufactured of approved shade and colour in flooring kerb laid over 12mm thick cement mortar 1:3 (1 cement : 3 sand) jointed with cement slurry mixed with pigment to match the shade of tiles as required complete upto floor two level including carriage of material upto all leads and lifts and as per direction of Enginnerincharge.	Sqm	738.23	1,118.00	8,25,341.14
31	Providing and laying White glazed tiles / Colour tiles Kajaria, Nitco or equivalent 6mm thick 300x300 x 7.30mm in skirting / walls rises of steps and dado 12mm thick cement mortar 1:3 (1 cement : 3 sand) and jointed with cement slurry mixed with matching pigmant including carriage and all kinds of leads, lifts and carriage materials up to the lead complete as per drawings / instructions / directions / of Engineer incharge	Sqm	2,600.50	1,299.40	33,79,089.70
32	Providing and laying flamed granite stone (Lakha Red / Z Black / Telephone black) in flooring 20mm (average) thickness base of cement mortar 1:4 (1 cement : 4 sand) laid over and jointed with grey cement slurry mixed pigment to match the shade of granite stone i/e rubbing , moulding and polishing complete including carriage of material up all leads, lifts etc as per directions of Engineer in Charge.	Sqm	1,013.94	4,894.70	49,62,932.12

33	Providing and laying plain granite stone (Lakha Red / Z Black / Telephone black) in flooring 20mm (average) thickness base of cement mortar 1:3 (1 cement : 3 sand) laid over and jointed with grey cement slurry mixed pigment to match the shade of granite stone i/e rubbing , moulding and polishing complete including carriage of material up all leads, lifts etc as per directions of Engineer in Charge.	Sqm	4,872.44	3,611.70	1,75,97,791.55
34	Stone soling hand packed under floor of selected hard stone as per the directions of Er. In Charge including all kinds of leads, lifts and all kinds of leads, lifts etc. complete in all respects.	Cum	300.00	1,316.00	3,94,800.00
35	Kota stone slab flooring 20 mm (average) thick base of cement mortar 1:4 (1 cement :4 sand) laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab. Including rubbing and polishing complete including carriage of material upto all leads and lifts	Sqm	504.00	1,531.90	7,72,077.60
36	Kota stone slab 25 mm thick in risers of steps,skirting dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement:3 sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs including rubbing and polishing including carriage of material upto all leads and lifts	Sqm	330.60	1,604.30	5,30,381.58
37	Providing and laying heavy duty pre-cast cement concrete interlocking paver block viberated, compacted upto M30 grade incluing border to curve block gray or coloured over sub-base of concrete with 25mm thck average thickness of cement mortar 1:4 (1cement : 4 sand) layed over and joined with net cement slurry mixed with pigment to match all the shade of clock including curing, rubbning and polishing complete including all kinds of leads, lifts etc. as per satisfaction of Engineer in Charge. 80mm thick	Sqm	1,020.00	1,449.00	14,77,980.00

38	Providing and laying heavy duty pre-cast cement concrete interlocking paver block viberated, compacted upto M30 grade incluing border to curve block gray or coloured over sub-base of concrete with 25mm thck average thickness of cement mortar 1:4 (1cement : 4 sand) layed over and joined with net cement slurry mixed with pigment to match all the shade of clock including curing, rubbning and polishing complete including all kinds of leads, lifts etc. as per satisfaction of Engineer in Charge. 60mm thick	Sqm	2,262.50	1,321.00	29,88,762.50
39	Providing and fixing 0.60 mm thick prepainted steel sheet (Tata Make) in roofing with hot dipped metallic zinc / aluminium-zinc alloy coated sheet with top coat of regular modified polyster (RNP) organic coating of 20 microns over 5 microns primer coating to back coat of polyster of 5 mocrons over 5 microns primer coating including fixing with self driven steel screws / prepainted iron J or L hooks or seam bolts with prepainted limpet and rubber washers complete with all accesoriees as required as per the detailed drawings / directions of Engineer - in - charge.	Sqm	2,923.00	913.00	26,68,699.00
40	Providing and fixing ridges or hips 60 cm overall with 0.60mm thick prepainted steel sheets in roofing withhot dipped metallic zinc / aluminium-zinc alloy coated sheet with top coat of regular modified polyster organic coating of 20 microns over 5 microns primer coating + back coat of polyster of 5 microns over 5 microns primer coating i/c fixing with prepainted iron J or L hooks, or seam bolts /driled screw &prepainted G.I. limpet and bitumen washers complete with all accessories as required as per the direction of Engineer in Charges.	Rmt	363.80	498.00	1,81,172.40
41	Providing and fixing valleys 90 cm overall with 0.60mm thick prepainted steel sheets in roofing withhot dipped metallic zinc / aluminium-zinc alloy coated sheet with top coat of regular modified polyster organic coating of 20 microns over 5 microns primer coating + back coat of polyster of 5 microns over 5 microns primer coating	Rmt	363.80	498.00	1,81,172.40

	i/cfixing with prepainted iron J or L hooks, or seam bolts /driled screw &prepainted G.I. limpet and bitumen washers complete with all accessories as required as per the direction.				
42	Providing and fixing flushing 38cm overall with 0.60mm thick prepainted sheet in roofing with hot dipped metallic zinc coated sheet with top coat of regular modified polyster organic coating of 20 microns over 5 microns primer coating + back coat of polyster of 5 microns over 5 microns primer coating i/c fixing with prepainted iron J or L hooks, bolts and nuts 6mm dia meter &prepainted G.I. limpet & bitumen washers complete with all accessories as required as per the direction of Engineer-in-Charge. Detail of cost for a length of 12.125 Rmt.	Rmt	139.00	378.30	52,583.70
43	Providing and fixing M.S. BP Sheet 1.66mm to 2mm thick in eaves board/facia/soffits/ceiling including cutting, fixing and welding to steel roof members and applying a coat of red lead primer complete as per the instruction of Engineer-in-charge including carriage of material upto all leads and lifts	Sqm	109.00	1,537.00	1,67,533.00
44	Steel work welded in built up sections, / hollow Section trusses and framed work including cutting, hoisting, fixing in position and applying a priming coat of red lead paint including carriage of material in all leads and lifts				
A	In trusses and trussed purlins in building including carriage of material in all leads and lifts	Qtl	847.90	8,039.00	68,16,268.10
B	In gratings framed guard bars ,ladders,raling (similers works)	Qtl	445.26	8,509.00	37,88,717.34
45	Providing and fixing pheneals 3" x 1'6" on top edges of roof as per design / directions fixed compelete including all kinds of leads, lifts etc.	Each	25.00	1,500.00	37,500.00
46	Providing and fixing on wall / face PVC (D-Plast) rain water pipes of working pressure not less than 4.5 kg/Sqm including filling the joints with approved adhesive compelte in all respective including pvc bends, shoes				

A	100 M MDia	Rmt	1,000.00	754.00	7,54,000.00
47	Supplying and fixing rolling shutters of approved make made of 80 mm X 1.25mm M.S laths interlocked together through their entire length and joined together at the specially designed pipe shaft, with brackets side guides and arrangements for inside and outside locking with push pull operation complete but excluding the of the top cover and spring.				
A	Shutters having width below 3.5 metres.	Sqm	58.32	974.10	56,809.51
B	Providing and fixing 27.5 cm long wire spring	Each	12.00	720.20	8,642.40
C	Providing and fixing top covers for rolling shutters	Each	6.00	486.70	2,920.20
D	providing and fixing wall bearing for rolling shutters	Each	12.00	807.70	9,692.40
	PAINTING AND POLISHING				
48	Painting two coats (excluding priming coat on new steel and other metal surfaces with enamel paint brushin to give an even shade including cleaning the surface of all dirt,dust				
a)	with white or other than white	Sqm	1,805.82	64.40	1,16,294.81
49	Polishing Two or more coats on new wooden surfaces with melamine polish of required shade to give an even shade including cleaning the surface of all dirt,dust and forien matters, sand papering smooth in including a coat of wood filler including of all kinds of leads, lifts etc. complete in all respects.	Sqm	988.92	638.00	6,30,930.96
50	15mm cement plaster in single coat on fair side of brick/concrete/stone walls for interior plasteringupto floor two level including arises, internal rounded angles, chamfers and/or rounded angles not exceeding 80mm in girth and finished even and smooth in cement mortar 1:6 (1 cement : 6 sand) above floor two level including carriage of material in all leads	Sqm	3,014.92	139.70	4,21,184.32

51	15mm cement plaster in single coat on fair side of brick/concrete/stone walls for interior plastering above floor two level including arises, internal rounded angles, chamfers and/or rounded angles not exceeding 80mm in girth and finished even and smooth in cement mortar 1:6 (1 cement : 6 sand) above floor two level including carriage of material in all leads and lifts	Sqm	21,348.00	139.70	29,82,315.60
52 a)	6mm thick Cement plaster to ceiling including sides and bottom of beams, soffits of stairs, ramps etc. with cement mortar 1:3 (1cement : 3 fine Sand) including curing and carriage, leads of all kinds of materials and scaffoldings etc. complete in all respects	Sqm	56,117.20	138.10	77,49,785.32
b)	Edges of slab / edges of cornices / mouldings ofchajjas or at break in floors exceeding 15 cm in girth.	Sqm	1,603.60	138.10	2,21,457.16
c)	Edges of slab / edges of cornices / mouldings ofchajjas or at break in floors not exceeding 15 cm in girth.	Sqm	2,299.75	138.10	3,17,595.48
53	20mm th. Cement Plaster in single coat on rough side of brick / stone masonarywithgrooves as per detailed drawings / instructions of Architect / Engineer in charge at site for exterior plastering upto all levels including arrises, internal rounded angles, chamfers and / or rounded angles not exceeding 80mm in girth and finished even and smooth in cement mortar 1:6 (1cement : 6 fine sand) including curing and carriage of materials to all leads, lifts and scaffoldings etc. complete in all respects.	Sqm	3,750.02	181.60	6,81,003.63
54	20mm th. Cement Plaster in single coat on rough side of brick / stone masonary Rough Cast as per detailed drawings / instructions of Architect / Engineer in charge at site for exterior plastering upto all levels including arrises, internal rounded angles, chamfers and / or rounded angles not exceeding 80mmin girth and finished even and smooth in cement mortar 1:6 (1cement : 6 fine sand) including curing and carriage of materials to all leads, lifts and scaffoldings etc. complete in all respects.	Sqm	561.60	181.60	1,01,986.56

55	Applying Birla white wall care putty over plastered surface after thoroughly brushing the surface free from mortar dropping dust loose materials and other foreign matter sand papered smooth to give final finish to the surface complete. including carriage of material in all lead and lifts	Sqm	58,724.81	42.30	24,84,059.46
56	Applying two coats of distemper primer of approved brand of manufacture on wall surfaces after thoroughly brushing the surface free from mortar dropping dust loose materials and other foreign matter sand papered smooth to give final finish to the surface complete. including carriage of material in all lead and lifts	Sqm	58,724.81	30.00	17,61,744.30
57	Distempering two coats with oil bound washable distemper of approved brand and manufacture and of required shade on undecrated wall surface to give an even shade over and including a priming coat with distemper primer of approved brand and manufacture after throughly brushing the surface free from mortar droppings and other foreign matter and also including preparing the surface even and sand papered smooth priming coat with distemper primer including carriage of material upto all leads and lifts and as per direction of Enginner in charge.	Sqm	58,724.81	63.00	36,99,663.03
58	Wall paintinjg with two coats with plastic emultion paint of approved brand and manufacture and of required shade on undecrated wall surface to give an even shade over and including a priming coat with distemper primer of approved brand and manufacture after throughly brushing the surface free from mortar droppings and other foreign matter and also including preparing the surface even and sand papered smooth priming coat with distemper primer including carriage of material upto all leads and lifts and as per direction of Enginner in charge.	Sqm	3,063.27	69.11	2,11,702.59
59	Providing and applying wall finishing with weather proof exterior grade emulsion of approved design (Apex ultima) or its equarlied on undecorated walls surfaces (two coats) on plain, grooved, curved rough cast, mouildings / cornices etc. to give an even shade and final finish after	Sqm	6,878.04	70.70	4,86,277.43

	throughlycleaning the surface to remove all dirt, dust and other forreign matter etc. including sand paper smooth complete.				
60	Providing plinth protection 50mm thick in cement concrete 1:3:6 (1 cement : 3 sand : 6 graded stone aggregate 20mm nominal size) including carriage of material in all lead and lifts	Sqm	219.60	226.00	49,629.60
61	Providing under layer for plinth protection of 75 mm thick (unconsolidated) bed dry brick/stone aggregate 40mm nominal size well rammed and consolidated and grouted with fine sand including preparation of ground. including carriage of material in all lead and lifts	Sqm	219.60	197.00	43,261.20
62	C/o v shaped drain in cement concret 1:3:6 (1 Cement 3 sand: 6 graded stone aggregate 20mm nominal size) and curing completeincluding carriage of material in all leads and lifts.	Rmt	250.00	567.00	1,41,750.00
63	C/o coursed rubble hammer dressed U shaped open surface drain with side wall 15 x 22 cm in CM 1:6 (1 cement : 6sand) and inside plastering with cement plaster 1:3 (1 cement : 3 sand) including earth work and laying 10 cm CC in 1:5:10 (1 cement : 5 sand : 10 courced aggregate) of 40 mm nominal size and 7.5 cm cement concrete 1:2:4 (1 cement : 2 sand : 4 stone aggregate) on 20mm normal size and finished with a floating coat of net cement slurry complete as per standard design .	Rmt	250.00	809.80	2,02,450.00
64	Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with three wheel 80-100 kN static roller in stages to proper grade and camber, applying and brooming, stone screening/binding materials to fill-up the interstices of coarse aggregate, watering and compacting to the required density Grading 1 as per Technical Specification Clause 405.including carriage of material in all leads and lifts and as per direciton of Engineer				

i)	WBM G1 Base course 90-40mm	Cum	153.00	1,461.54	2,23,615.92
65	Providing and laying spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing rolling with three Wheel 80-100 KN static roller in stages to proper grade and camber, applying and brooking stone screening/binding materials to fill up the interstices of course aggregate, watering and compacting to the required density Grading- II as per Technical specification Clause 405				
	G2 Base course 63 to 45	Cum	121.50	1,544.38	1,87,642.17
66	Providing and laying spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing rolling with three Wheel 80-100 KN static roller in stages to proper grade and camber, applying and brooking stone screening/binding materials to fill up the interstices of course aggregate, watering and compacting to the required density Grading- III as per Technical specification Clause 405	Sqm	1,020.00	1,551.91	15,82,949.86
67	Preparation of sub-Grade by dressing to camber, earth work for cutting involved for sub grade to be paid separately depending upon the classification of soil completed as per HPPWD specifications.	Sqm	1,020.00	0.69	703.80
68	Consolidation of sub grade with road roller including making good the undulation with earth or quarry soil etc. and re-rolling the sub-grade etc. complete as per HPPWD specifications.	Sqm	1,020.00	0.83	846.60
69	Painting lines, Dashes, Arrows, etc. on Road in Two Coats on New Work with ready mixed road marking paint conforming to IS:164 on bituminous/concrete surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control as per drawing and Technical Specification Clause 1702including carriage of material up to all leads and lifts and as per direction of Engineer incharge.	Sqm	400.00	64.10	25,640.00

70	Providing and fixing of retroreflectorised cautionary, mandatory and informatory sign as per IRC:67 made of 1.5 mm thick M S sheet duly stobed white colour in frount and gray colour on back with red reflective border of 65mm width and required letters and figure with reflective tape engineering grade as per clause 1701.3.9 of MORD for Rural Road of required shade and colour supported and welded on 47mm x47mm x12SWG sheet tube firmly fixed to the ground by mean of properly disigned foundations with M-15 grade cement concrete 450x450x600, 600mm below ground level as per approved drawing Clause 1701.2.2 size 800 x 600mm rectangular including carriage of material up to all leads and lifts and as per direction of Engineer incharge.	Each	30.00	1,800.00	54,000.00
71	Providing and laying paraphet size 2.00x 0.45x 0.60 mtr in CC 1:3:6 (1 Cement 3 sand: 6 graded stone aggregate 40mm nominal size) including shuttring, centring and struting and proping etc. as per drawing and design, curing complete including carriage of material in all leads and lifts as per the direction of Engineer- In charge.	Cum	10.80	4,681.00	50,554.80
72	Providing and applying Lustre paint to walls of approved colour & shade of Asian Paints or equivalent, cleaning the surface and make it free from dust by scrapping, cleaning etc., including application of primer coat over the same; application of minimum two or more coats of lustre paint upto the desired finish of the EIC and protecting till the handing over of site including required scaffolding, cleaning, filling up cracks with approved crack filler etc. all complete at all levels and leads to entire satisfaction of the EIC	Sqm	500.00	121.00	60,500.00
73	Providing and supplying and fixing security cabin with flooring as per drawings and design, Code C1, Size 4'X4', Height 7' from AFG Group or equivelent including carriage of material upto all leads and lifts and as per direction of Engineer incharge as per drawing and design.	Each	2.00	44,131.56	88,263.12
	Total Amount (A) - Civil Works				**48,64,26,037.75**

5.6 FINANCIAL ANALYSIS

Table 5.2

Name	Cost
Total Cost of the Project	628600000
Total Number of Blocks	4
Total Estimated Cost of Civil work	486426037.75
Cost of each Block	121606509.34
Cost Percent of 1 Block	19.61%
Difference between the cost	142173962.3
Percentage	77.38%
Billing up to Date	195631392
Cost Incurred to Date	170114253.9
Percentage of Completion of Project	33.87%
Revenue on Project	21271824

Total estimated cost of civil work is 77.38% of the total cost of the project.

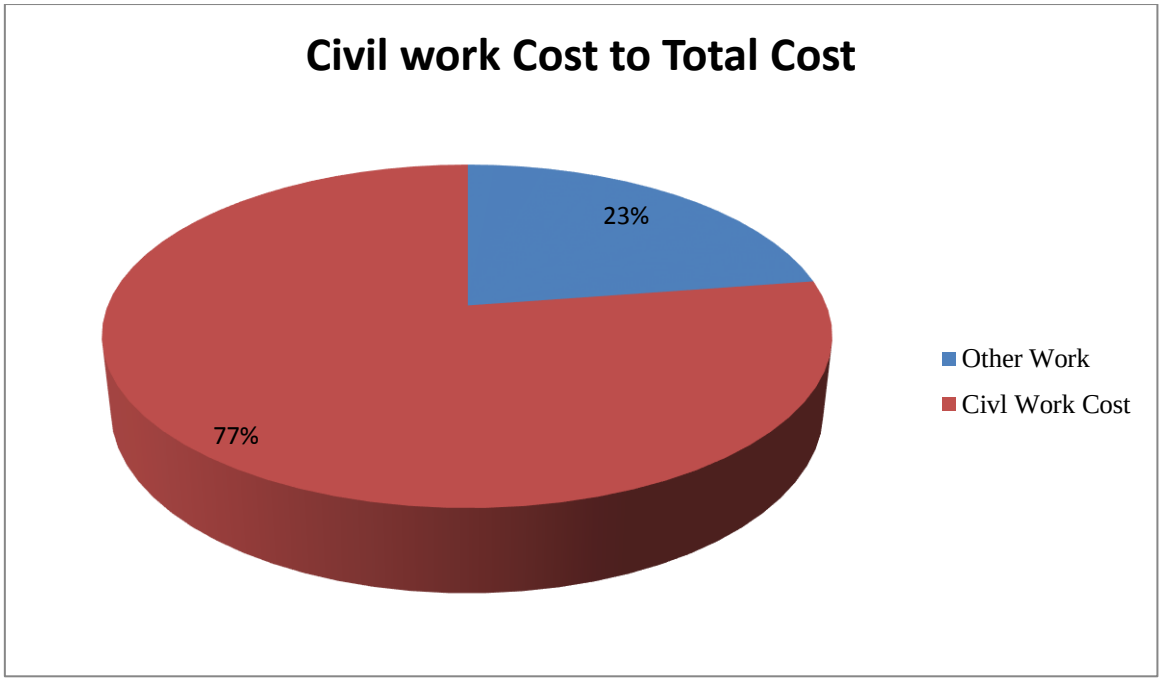


Figure.5.11. Percentage of Civil Work Cost

Percentage of completion of work is 33.87%.

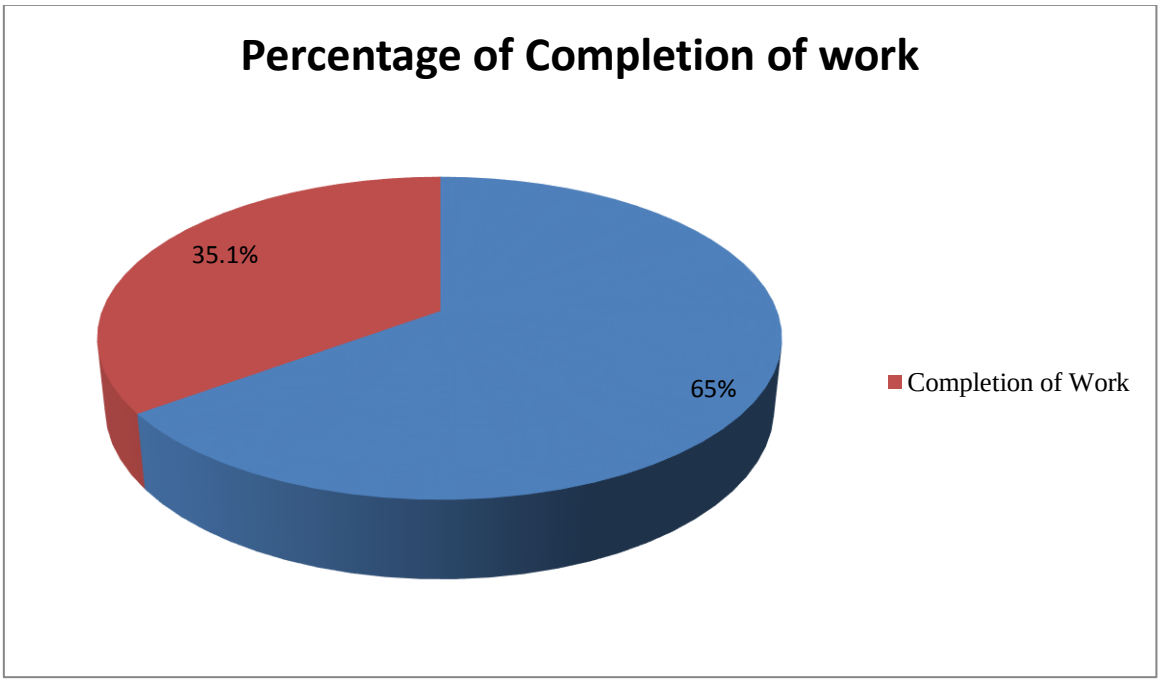


Figure.5.11. Percentage of completion of Work

5.7 EARNED VALUE CALCULATIONS

To perform EVM, three values need to be determined

- **Planned Value (PV or BCWS)** - budgeted costs of the work scheduled
- **Actual Costs (AC or ACWP)** - actual costs of the work performed
- **Earned Value (EV or BCWP)** - budgeted costs of the work performed

5.7.1 Planned Value (PV)

- It is the budget cost for the work schedule to be completed on an activity
- Only changes when baseline is changed
- Also referred as “BCWS”

5.7.2 Earned Value (EV)

- It is the budget amount for the work actually completed on the scheduled activity
- Baseline value of the reported work
- Also referred as “BCWP”

5.7.3 Actual Costs (AC)

- It is the total cost incurred in accomplishing work on the schedule activity
- Actual costs for reported work
- Also referred as "ACWP"

5.7.4Analysis

- Cost Variance (CV) : CV = EV – AC
- Cost Performance Index (CPI) : CPI = EV / AC
- Schedule Variance (SV) : SV = EV - PV
- Schedule Performance Index (SPI) : SPI = EV / PV
- Estimate at Completion : EAC = AC + ETC
- Estimate to Complete : (BAC - EV) / CPI

Table 5.3 EVM ANALYSIS

EVM ANALYSIS	
Planned Value (BCWS or PV)	₹ 62,86,00,000.00
Earned value (BCWP or EV)	₹ 21,29,06,820.00
Actual Cost of Work performed (ACWP or AC)	₹ 19,56,31,392.00
Variance	
Schedule Variance (SV)= BCWP-BCWS	₹ -41,56,93,180.00
Cost variance (CV) = BCWP-ACWP	₹ 1,72,75,428.00
Schedule Performance Index (SPI)	33.87%
Cost Performance Index (CPI)	1.08831
Estimate to Completion (EAC)	₹ 38,19,63,506.14
Estimate at Completion (ETC)	₹ 57,75,94,898.14

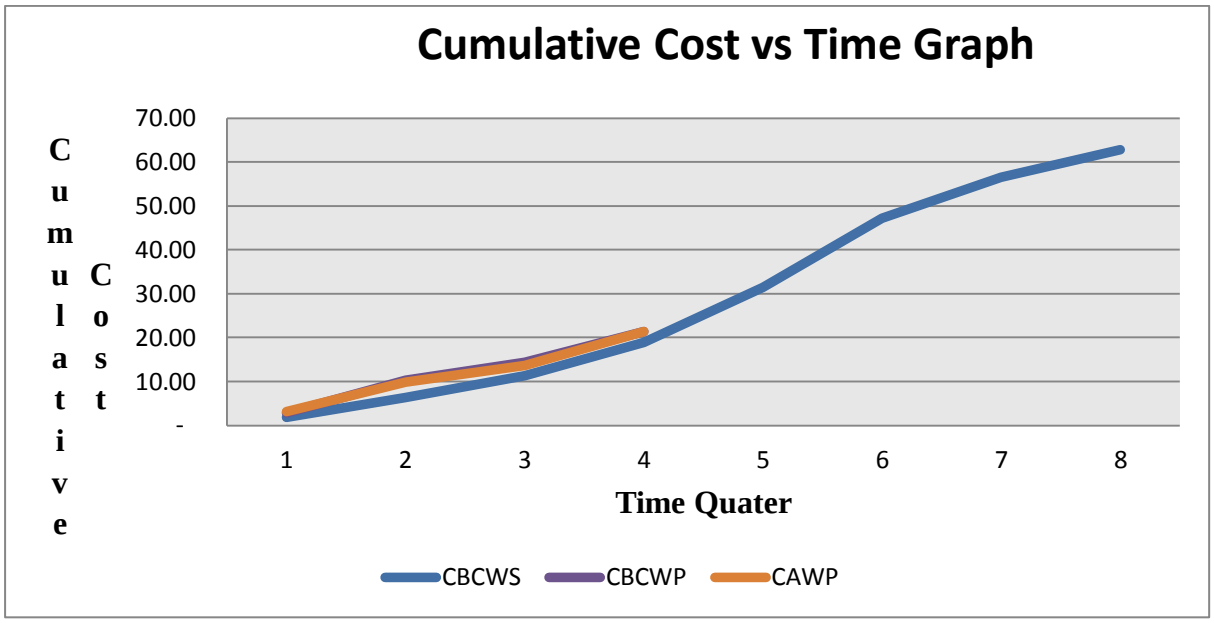
From the above calculations we came to know that:

- SPI i.e., Schedule Performance Index is less than 1 that means the project is behind the schedule.
- CPI i.e., Cost Performance Index is greater than 1 that means the project is under budget.

- Schedule Variance is a negative value that also tells us that the project is behind the schedule.

	Quarter Number							
	1	2	3	4	5	6	7	8
CBCWS	1.89	6.29	11.31	18.86	31.43	47.15	56.57	62.86
BCWS	1.89	4.40	5.03	7.54	12.57	15.72	9.43	6.29
BCWP	2.82	7.43	4.07	7.02	-	-	-	-
CBCWP	2.82	10.25	14.32	21.34	-	-	-	-
ACWP	3.13	6.76	3.70	7.80	-	-	-	-
CAWP	3.13	9.89	13.59	21.39	-	-	-	-

These values are in terms of Crores.



The graph between Cumulative Cost vs Time Graph above shows the progress of the project.

CONCLUSION AND FUTURE SCOPE

CONCLUSION

Application of the methodology which are proposed in the above study shows that when the scheduling is done for the project total estimated days can be known before the construction phase starts, which is 130 days for single storey building and 458 days for multi-storey car parking of 11 floors which are very helpful to the construction manager during the construction phase.

After that the quantities of each floor are being calculated with the help of long wall short wall method in excel sheet and with the help of this excel sheet cost analysis of single storey building and repetitive floors of multi-storey building is determined which is 5.9 lakhs and 48 crore.

Then Earned Value Analysis is done for repetitive floor project from which it was concluded that, SPI i.e., Schedule Performance Index is less than 1 that means the project is behind the schedule, CPI i.e., Cost Performance Index is greater than 1 that means the project is under budget, Schedule Variance (SV) is a negative value that also tells us that the project is behind the schedule and lastly cost variance comes out to be a negative value which means that after 24 months i.e., the completion of project time the project cost will be increased.

SCOPE OF THE STUDY

This study deals with the scheduling and determining of total estimated cost of Repetitive and Non-Repetitive building for which Microsoft project is used for scheduling and total estimated days can be determined for which excel sheet of Float determination is made. Microsoft project can be very helpful in determining the total estimated days of the project for large construction projects which can be run without any hindrance. Because of MSP we know the critical path so during construction phase we have to complete those critical activities without any delay which can create some problem afterwards during the construction. Furthermore resources can be allocated which can be helpful for the contractors to control the project without any problems and can be regularly checked which resources are being used in those specific activities for large construction projects. And cost plays an important part in the construction industry so to complete the project within the budget. Hence MSP can make our work easy and should be used for large construction projects and during construction phase work can be regularly checked.

ANNEXTURE

LATEST PREVAILING MARKET RATE

Name of the Work:-TutikandiMultistorey Parking and Civil Amenities Centre, Shimla, H.P. (Contract Package No. HPTDB/10.2)

S. NO.	PARTICULARS	FROM THE PLACE	DISTANCE	MARKET RATE	UNIT
(A)	**CIVIL WORKS**				
1	SAND	Nalagarh	100	1100.00	Cum
2	STONE AGGREGATE 40 MM	JolKhad (Arki)	60	800.00	Cum
3	STONE AGGREGATE 20 MM	JolKhad (Arki)	60	900.00	Cum
4	STONE AGGREGATE 10 MM	JolKhad (Arki)	60	900.00	Cum
5	CEMENT ACC/AMBUJA/WHITE CEMENT	Local FOR at Shimla	5	7000.00	Tonne
6	MS. PLATES /STRUCTURE STEEL	Local at Shimla	5	5400.00	Qtl.
7	TOR STEEL	Local at Shimla	5	5200.00	Qtl.
8	BOULDER	JolKhad (Arki)	60	700.00	Cum
9	SAND STONE (HARD ROCK)	Local at Shimla	5	2800.00	Cum
10	BOND STONE	Local at Shimla	5	1800.00	Each
11	b) SECOND CLASS BRICKS	Local at Shimla	5	8000.00	Per1000
12	b) SECOND CLASS KAIL BALLIES	Local at Shimla	5	130.00	Each
13	SCREWS a) 40 mm	Local at Shimla	5	70.00	Per100 Nos.
	b) 32 mm	Local at Shimla	5	50	
	c) 25 mm	Local at Shimla	5	40	
14	GLASSES PANS 4 MM (SAINT GOBIN / EQIL)	Local at Shimla	5	450.00	Sqm.
15	GLASSES PANS 5.5MM (SAINT GOBIN / EQIL)	Local at Shimla	5	600.00	Sqm.
16	M.S. FLAT 40 X 3 MM (TATA OR EQIL)	Local at Shimla	5	5400.00	Qtl.
17	POWDER COATED ALUMINIUM SLIDING DOOR BOLT 300X16 MM	Local at Shimla	5	200.00	Each
18	POWDER COATED ALUMINIUM SLIDING DOOR BOLT 250X16 MM	Local at Shimla	5	180.00	Each
19	POWDER COATED ALUMINIUM TOWER BOLTS(BARREL TYPE) 200 X10 MM	Local at Shimla	5	80.00	Each
20	POWDER COATED ALUMINIUM TOWER BOLTS(BARREL TYPE) 150 X 10MM	Local at Shimla	5	60.00	Each
21	POWDER COATED ALUMINIUM HANDLES 125 MM	Local at Shimla	5	65.00	Each
22	POWDER COATED ALUMINIUM HANDLES 100 MM	Local at Shimla	5	55.00	Each
23	10MM ANTISKID VITRIFIED TILES 600MM X 600 X 10 MM	Local at Shimla	5	850.00	Sqm
24	ANTISKID VITRIFIED TILES 300MM X 300 X 7.3 MM	Local at Shimla	5	400.00	Sqm
25	CERAMIC GLAZED TILES 7.3 MM	Local at Shimla	5	500.00	Sqm
26	BIRLA WHITE WALL CARE PUTTY	Local at Shimla	5	30.00	Kg
27	DISTEMPER PRIMER (NEROLAC / ASIAN)	Local at Shimla	5	75.00	Liter
28	DISTEMPER OIL BOUND OBD (NEROLAC	Local at Shimla	5	60.00	Kg

	/ ASIAN)				
29	WEATHER PROOF EMULSION APEX ULTIMA / BERGER WEATHERCOAT (NEROLAC / ASIAN)	Local at Shimla	5	280.00	Liter
30	READY MIXED WHITE LEAD PRIMER (NEROLAC / ASIAN)	Local at Shimla	5	180.00	Liter
31	WHITE ENAMEL PAINT (NEROLAC / ASIAN)	Local at Shimla	5	260.00	Liter
32	INTERLOCK PAVER BLOCKS 80 MM THICK NTC	Chandigarh	170	650.00	Sqm
33	INTERLOCK PAVER BLOCKS 60 MM THICK NTC	Chandigarh	170	550.00	Sqm
34	FLOOR TRAPS 110 x 75 MM	Local at Shimla	5	450.00	Sqm
35	20 MM THICK KOTA STONE	Local at Shimla	5	440.00	Sqm
36	ALUMINIUM (JINDAL / EQIL.)	Local at Shimla	5	250.00	Kg
37	GRANITE STONE	Local at Shimla	5	2000.00	Sqm
38	GRANITE STONE/FLAMED GRANITE	Local at Shimla	5	3000.00	Sqm
39	PRE-PAINTED SHEET 0.60MM TH. (TATA OR EQUI)	Local at Shimla	5	550.00	Sqm
40	RIDGE OR HIPS / VALLEYES 0.60MM TH. (TATA OR EQUI)	Local at Shimla	5	320.00	Rmt
41	BP SHEET FACIA 1.6-2MM TH. (TATA OR EQUI)	Local at Shimla	5	65.00	Kg
42	1ST. CLASS KAIL WOOD (FOR FRAM OF FALSE CEILING)	Local at Shimla	5	98000.00	Cum
43	READYMADE WOODEN PLANKS (SEASONED KAILWOOD 12MM TH.	Local at Shimla	5	1200.00	Sqm
44	12MM TH. FIBER BOARD FOR EXPENSION JOINT	Local at Shimla	5	35.00	Rmt
45	ALUMINIUM CREDEL 6 MM TH. FOR EXPENSION JOINT	Local at Shimla	5	250.00	Rmt
46	MS WIRE MESH GUAGE 0.6MM	Local at Shimla	5	30.00	Sqm
47	12MM PHENOL BONDED PRE LAM BOARD (GREEN / EQUIL)	Local at Shimla	5	800.00	Sqm
48	READYMADE WOODEN PLANKS (SEASONED KAILWOOD 12MM TH.	Local at Shimla	5	1200.00	Kg
49	ALUMINIUM DOOR STOPPERS	Local at Shimla	5	70.00	Each
50	BRASS DOOR LOCKS (HARRISON / PLAZA)	Local at Shimla	5	800.00	Each
51	STRUCTURAL STEEL (ISA / ISMC)	Local at Shimla	5	55.00	Kg
52	SS POWDER COATING RAILING	Local at Shimla	5	2000.00	Rmt
53	ROLLING SHUTTERS (BELOW 3.50M WIDTH)	Local at Shimla	5	1400.00	Sqm
54	WIRE SPRING 27.50 CM LONG FOR ROLLING SHUTTER	Local at Shimla	5	700.00	Each
55	TOP COVER FOR ROLLING SHUTTER	Local at Shimla	5	500.00	Each
56	WALL BEARING FOR ROLLING SHUTTER	Local at Shimla	5	800.00	Each
57	KOTA STONE 20MM TH.	Local at Shimla	5	500.00	Sqm
58	KOTA STONE 25 MM TH.	Local at Shimla	5	550.00	Sqm
59	PVC PIPE (D-PLAST OR EQIL)	Local at Shimla	5		
A	75 mm	Local at Shimla	5	110.00	Rmt
B	110 mm	Local at Shimla	5	140.00	Rmt
C	160 mm	Local at Shimla	5	190.00	Rmt
60	PVC ACCESSORIES & FITTINGS (D-PLAST OR EQIL)	Local at Shimla	5		
A	PLAIN BEND	Local at Shimla	5		

	75MM	Local at Shimla	5	70.00	Each
	110MM	Local at Shimla	5	90.00	Each
	160MM	Local at Shimla	5	120.00	Each
B	DOOR BEND	Local at Shimla			
	75MM	Local at Shimla	5	110.00	Each
	110MM	Local at Shimla	5	150.00	Each
	160MM	Local at Shimla	5	190.00	Each
C	DOOR TEE	Local at Shimla			
	75MM	Local at Shimla	5	110.00	Each
	110MM	Local at Shimla	5	150.00	Each
	160MM	Local at Shimla	5	190.00	Each
D	COLLAR	Local at Shimla			
	75MM	Local at Shimla	5	60.00	Each
	110MM	Local at Shimla	5	80.00	Each
	160MM	Local at Shimla	5	100.00	Each
F	CLAMPS	Local at Shimla			
	75MM	Local at Shimla	5	25.00	Each
	110MM	Local at Shimla	5	40.00	Each
	160MM	Local at Shimla	5	60.00	Each
F	FLOOR TRAPS 110 x 75 MM	Local at Shimla	5	300.00	Each
		Local at Shimla	5		Each
61	SEMI REFLECTIVE INFORMATERY SIGN BOARD (SIZE 800 x 600 MM)	Local at Shimla	5	3000.00	Each
62	READYMADE CUPBOARD (GODREJ / EQUIL)	Local at Shimla	5	20000.00	Each
63	LUSTER PAINT	Local at Shimla	5	600.00	Liter
64	ALUMINIUM GRILL	Local at Shimla	5	1250.00	Sqm
65	READYMADE SECURITY CABIN (4'0"X4'0"X7'0") (AFG OR EQIL)	Local at Shimla	5	35000.00	Each
		Local at Shimla			
66	BELL JET FOUNTAIN COMPLETE IN RESPECTS	Local at Shimla	5	850000.00	Each
67	Polyester synthetic fibers	Local at Shimla	5	370.00	Kg

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