# PLANNING, ANALYSIS AND CONSTRUCTION SCHEDULING OF APPARTMENT BUILDING (G+13) BY USING PRIMAVERA P6

**Mrs. K.Priya[1], Mr. M.Kathiresan[2], D.Vengateshwari[3], M.Suriyakumari[4]**

[1,2]Assistant professor, [3,4]UG Scholar,
Department of Civil Engineering,
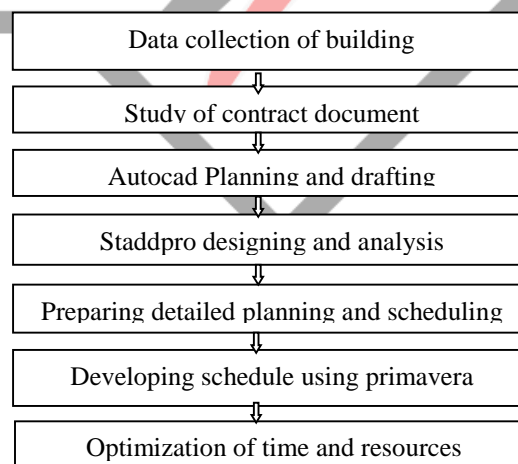Sri Ramakrishna Engineering College, Perambalur-621113, India.

*Abstract*: **Now days, the people from village are coming to towns for employment and educational facilities hence with the limited land available so as to proposed the apartment building and individual houses are feasible with each other. The main objective of this project is to analyse and to construction scheduling of an appartment building (G+13) using STAAD.Pro and Primavera P6 software. First of all, the planning is done using AutoCAD and code refers for this project is IS 456-2000. The first and foremost thing which we can get by effectively planning in primavera is start date on 11 March 2019 and finishing date of 16 June 2022 project. Primavera P6 helps in effectively scheduling the project by assigning two relationships at a time to each activity and considerably reduces the float. All the important steps like creating an EPS, creating a WBS, linking of activities according to their interdependence and availability of resources and determination of critical path are clearly exhibited in this report. Budgeted cost, time, and materials of the project are obtained by resource allocation.**

*Keywords*: **STADDPro, Primavera p6, AutocCAD, Code, planning, scheduling.**

## 1. INTRODUCTION:

Due to growing population and less availability of land. Multi-stored buildings are constructed which can serve many people live in limited area. One of the major problem facing by INDIAN country is rapid growth of population which restricted the availability of the land. More over even the available houses are let out at normal rent charges and consists of 52 houses in 13 floors with all basic amenities. The apartment building plan was drafting by AutoCAD software which is useful to easily draw a column layout and followed as per limit state method. STAAD-Pro is the most popular structural engineering software product for 3D model generation, analysis and multi-material design. The apartment building was studied by STAAD-Pro software which is used for the design and analysis carried out of shear force, bending moments, reinforcement and deflection and its software is very user friendly and effective. Construction activities are not limited only to the physical activity of allocating men, materials and machines, it involves as effective management of man power, machinery as well as materials by proper planning using project management Primavera p6 which can reduce the efforts and also helps to maintain the accuracy and quality of the project.

## 2. METHODOLOGY:

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│     Study of contract document      │
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│     Autocad Planning and drafting   │
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┌─────────────────────────────────────┐
│    Staddpro designing and analysis  │
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┌─────────────────────────────────────┐
│ Preparing detailed planning and scheduling │
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│   Developing schedule using primavera │
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│    Optimization of time and resources │
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## 3. LITERATURE REVIEW:

**F.Lazzali, S.Bedaoui:-** performance of masonry building in Algeria. The authors have categorized data of numbers and types of house construction to draw the plan for AUTOCAD software. To drafting the high rise building for (g+6). Light weight construction materials, standard workmanship, interior quality of mortar used to construct the building.

**Madhurivassavai et al., (2016)** he says that the one of the major problem country facing is the growing population. Because of the less availability of land, multi-storey building can be constructed to serve many people in limited area. Efficient modelling is performed using STAAD.Pro and AutoCAD. Manual calculations for high rise buildings are tedious and time consuming. STAAD.Pro provides us a quick, efficient and correct platform for analysing and coming up with structures.

**Y.Umesh(2015)-** Proper planning and scheduling is very essential in projects for sinking and scheming delays of the project. Extensive amounts of time, money, resources are wasted each year in a construction industry due to improper planning and scheduling.  With globalization the construction projects have become infinite and complex.  Planning of such projects requires huge amount of documentation work, which can be reduced with the help of project planning software. These studies are to plan, schedule and track a residential project with help of primavera software, study the results generated, it is possible to propose which method is suitable for the chosen residential project.

**Sreeshna K.S (2016)** this paper deals with structural analysis and design of B+G+4 storied apartment building. The work was completed in three stages. The first stage was modelling and analysis of building and the second stage was to design the structural elements and the final was to detail the structural elements. In this project STAAD.Pro software is used for analysing the building. The IS:875 (Part 1) and (Part 2) were referred for dead load and live load. Design of structural elements like beam, column, slab, staircase, shear wall, retaining wall, pile foundation is done according to IS Codes.

**V.dhanalakshmi (2016) -** Study deals with the project monitoring process of the economical method of transporting a pipeline construction was completed in Ennore -Trichy-Madurai.  Construction work and actual progress is a comparison between the planned progress of performed in this study using project management software Primavera P6.

**Y.Umesh(2015)-** Proper planning and scheduling is very essential in projects for sinking and scheming delays of the project. Extensive amounts of time, money, resources are wasted each year in a construction industry due to improper planning and scheduling.  With globalization the construction projects have become infinite and complex.  Planning of such projects requires huge amount of documentation work, which can be reduced with the help of project planning software. These studies are to plan, schedule and track a residential project with help of primavera software, study the results generated, it is possible to propose which method is suitable for the chosen residential project.

**B.S.K.Reddy (2015) -** They did resource optimization exercises on two on -going projects in Dubai, UAE. They individually leveled and then combined option with aggregated and then leveled clearly indicates reduction in demand of resources by 5.65% in later option, which could be best considered for economy. They concluded Resource leveling at project job site and forwarding demand leads a possible sharing of resources among projects.

**E.Suresh kumar  (2015)-** Scheduling using Primavera Software is a development which involves estimation, sequencing the activities, resources allocation and timing.  The construction scheduling is to complete the project in time and equal the resources with the allocated time. Scheduling using primavera. Software gives good controlling.

**Haughan (2002)** - Assume that planning and scheduling are time-cost oriented process in which becoming a challenge to project managers and planners when managing their project (Oglietti 2005). Scheduling represent a significant task within construction project management. Scheduling must take into account the trade-offs between time cost based on the consumption of the resources and also minimizing project duration (Yang 2007).  Planning for resources must ensure the development of reliable schedule.

**Unmesh Polekar et. al (2015)** author portray about construction Planning and testing activities in management work amid the execution. The Scheduling is accomplished for time management of every occasion or activities in the Project. The following is accomplished for real Project performing esteem. In any case, it's a little private building having less activates. The significance of the Planning, scheduling and following of the private Project utilizing primavera is to know the correlation amongst plan and genuine executed calendar. The essential issue experienced while executing a Project is an ascent in cost and augmentation in the finish time.

## 4. DESCRIPTION OF SOFTWARE:

    i. AutoCAD
    ii. STADDPro
    iii. Primavera P6

### i. ROLE OF AUTOCAD:

AUTOCAD is a computer aided design (CAD) program used for 2D and 3D design and drafting for the high rise apartment building(G+13) design and drafting for various fields in engineering like civil, mechanical, electrical, automation, architecture etc. It was first launched in 1982 by Autodesk, Inc.

AutoCAD Architecture allows designers to draw 3D objects such as walls, doors and windows, with more intelligent data associated with them rather than simple objects. Use of AutoCAD has drastically reduced the drafting time when done manually thus saving time which can be used in other productive work.

AutoCAD or Computer Aided Design is a very helpful tool in drafting and designing any structure. AutoCAD uses a Graphical User Interface for the purpose of drafting and designing any structure. The software has various inbuilt tools for complex drafting. Also AutoCAD can be used for 2D and 3D design and also for perspective design. Below is a screenshot of the GUI of AutoCAD. With the help of AutoCAD all the drafting for the project has been done.

It has made the life of a drafter quite easy than the conventional drafter using paper and pencil. It has made possible to make easy changes in the drawing as and when required. Also various commands such as COPY, OFFSET, ROTATE, MOVE have made the tedious process of redundant work quite easy and faster. Also one of the important features of AutoCAD is the import and export feature which allows users to move their plans drawn using autocad to other design softwares such as STAAD Pro with the help of

DXF file format which has in turn reduced load on the designer. Also structural designs made on STAAD and ETABS are also exportable to AutoCAD for minute detailing required.
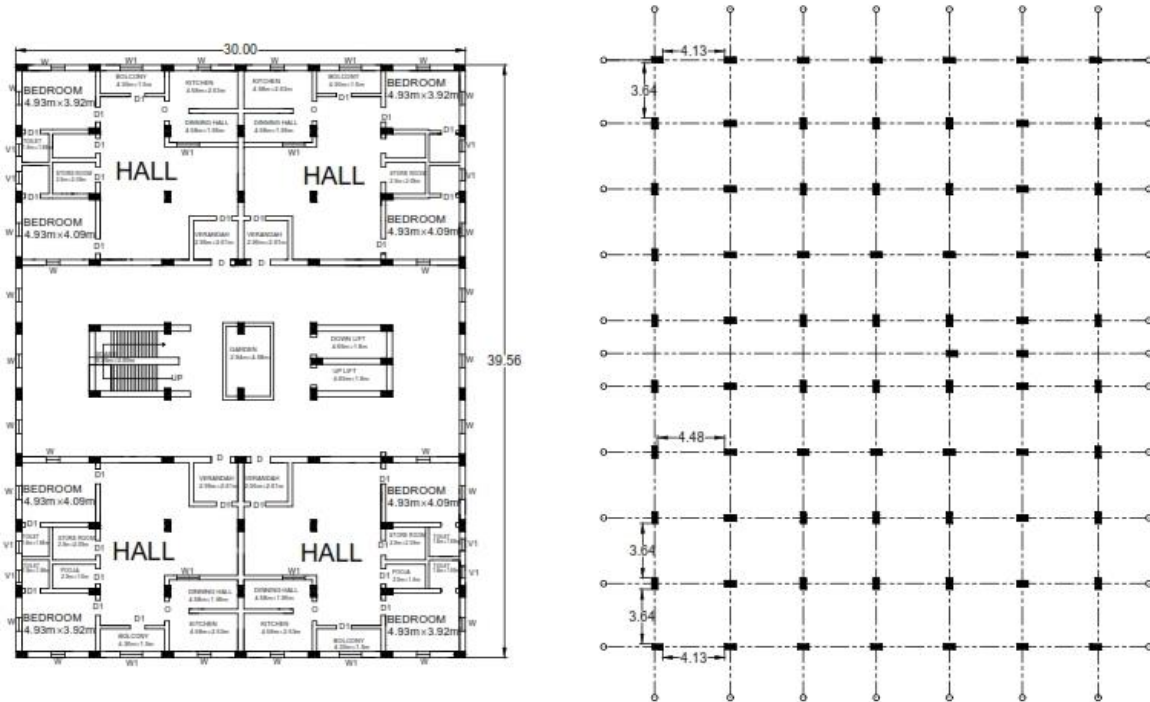


**Fig no 1: Appartment building plan with column layout**

In the above column layout picture the black lines signify the beam centre line while the white rectangular boxes signify the Columns .The beams have a cross section of 0.4x0.75 m. The columns have a cross section of 0.4x 0.75 m.  Slabs have a uniform thickness of 300mm while the staircase slab has a thickness of 200mm. The floor to floor to height is kept at 3.5 m.

All the work has been done in layers in AutoCAD, for easy editing and viewing. Layers make it easy to manipulate each individual layer making it visible and invisible for clarity as well as locking the layer to prevent editing in them. The proposed project has apartment building in each floor having a 2BHK layout along with a study and a family lounge. Each apartment has two master bedrooms with attached bath n toilet. The third bedroom shares a common bath and toilet with the rest of the apartment. There are a total of in 52 houses in 13 floors. The ground floor of the building will be used as parking.

**ii. ROLE OF STAADPro:**

STADD or STADDPro is a structural analysis and design computer software was developed by Research Engineers International CA. It was acquired by Bentley Systems in 2005. It is one of the most widely used design and structural analysis software's for concrete, steel and timber design codes. STAAD pro allows designers and structural engineers to design and analyse virtually any type of structure through its very flexible modelling environment, fluent data collection and advanced features.

It was one of the earliest structural analysis and design software with a user friendly and support for building codes of countries. It is nothing but to analysis the framed structure and it gives the detailing of the particular structure. We can design a structure for any types of loads and load combination with codal provisions. It is easier way of redesign a structure. STAAD.Pro software is used for static or dynamic analysis for structures such as bridges, low rise or high-rise buildings, stadiums, steel structures, etc. First step in STAAD.Pro is to specify the geometry of the structure and then the properties of the members are mentioned. Then the supports are generated and loadings are specified on the structure. Finally, the structure is analysed.
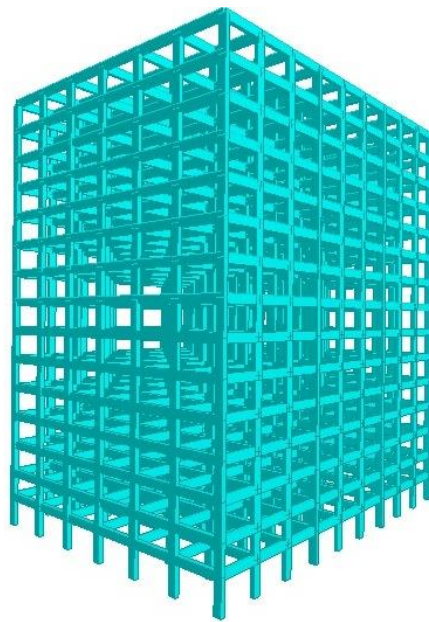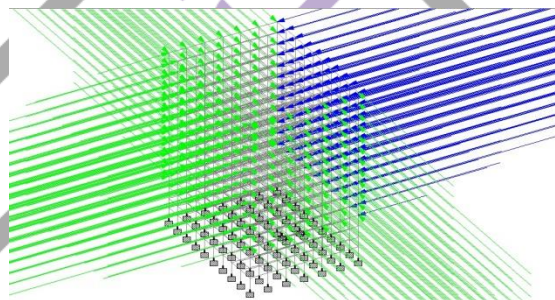
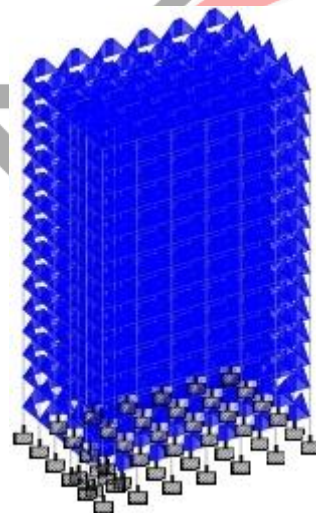**Fig no 2-D Rendered view of model**



**Fig no 3: Wind load diagram**
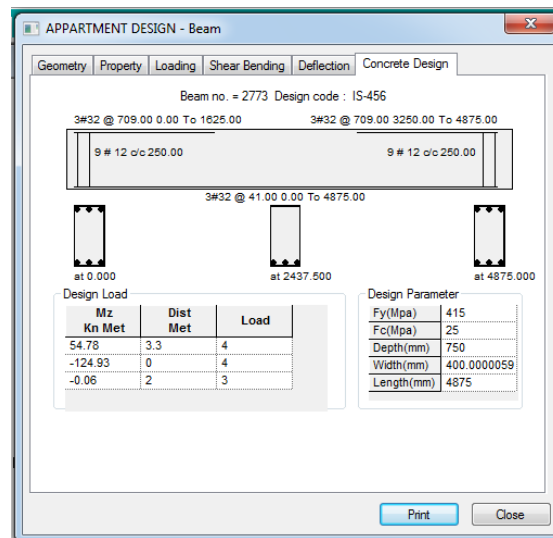


**Fig no 4: Live load diagram**

**Fig no 5: Reinforcement design diagram**

**Wind load:** These loads rely on the rate of the wind at the situation of the structure, permeableness of the structure, height of the structure etc. They will be horizontal or inclined forces. Wind loads are specified in IS 875 (Part 3).

**Live load:** Imposed load is created by the meant use or occupancy of a building together with the load of movable partitions, distributed and concentrated loads, load due to impact and vibration and dust loads. Live loads are specified in IS 875 (Part 2).

**iii. ROLE OF PRIMAVERA P6:**
Oracle primavera p6 is also known as EPPM which is abbreviated as enterprise project portfolio management. It is also the most powerful strong and easy handling software and used solution for worldwide, Organizing, planning, managing, and execute project, programs and portfolios. Primavera P6 software helps to achieve the maximum return on investments in project and progress. Primavera P6 gives a single solution for multi projects of any size. Primavera can handle the projects of large size according the persons need.

**History of primavera:** - In 1983, primavera came into System Corporation, whereas in 2008 primavera was undertaken by oracle and is now known as oracle primavera.

Primavera P6 version provides us a sophisticated integrated project portfolio management (PPM) solution which consists of role-specific tools that has to satisfy each team member's needs, their responsibilities, and skills. This solution uses a standard Windows interfaces, client/server architecture, Web-enabled technology, and stand-alone (SQL Server Express) or networked-based (Oracle and Microsoft SQL-Server) databases.

Primavera offers us the following software component and various better options for us to choose from: Primavera P6 Professional was built to get us running, planning and scheduling as early as Possible. With a very easy and an intuitive navigation, we can begin planning, scheduling and controlling our project faster than anyone can ever think possible. Required by many of the owners in their project specifications, this product is the gold-standard when it comes to its planning and managing projects. Whether the project is a sophisticated complex multi-billiondollar infrastructure project or an easy and simple residential or commercial building, P6 Professional is what we need.

**A. Pre data collection**:
This stage consists of literature review, setting of objectives and problem statement and based on that selection of research area has been done. For the research purpose, Hostel building is taken for study.
**B. Data collection:**
Frequent site visits were carried out to identify the construction sequence. Of the building and also practical time durations for executing activities were worked out. The data required for conducting analysis in the software is collected.
**C. Post data collection:**
The analysis will carried out in Primavera software, for tracking of the project schedule and all the reports and results generated from the software will be studied.
**D. Contract Document:**
The following project Data are furnished from the contract agreement, project report and tender documents.
**Steps Involved in Monitoring and Control:**
**1. Creating EPS**
To create an ideal schedule for any project, first step is to collect data available for the project. The following steps can be followed in Primavera P6 software. Create the complete structure of the company with its

branches, which is executing the project using primavera P6. This is known as Enterprise project structure (EPS).

## 2. Creating new project

The project contains a set of different activities and associated information that constitutes a plan for creating a product or service. The project is created under respective divisions in EPS. The project can be given planned start and finish dates. The project is assigned a calendar which can be global, resource or project calendar.
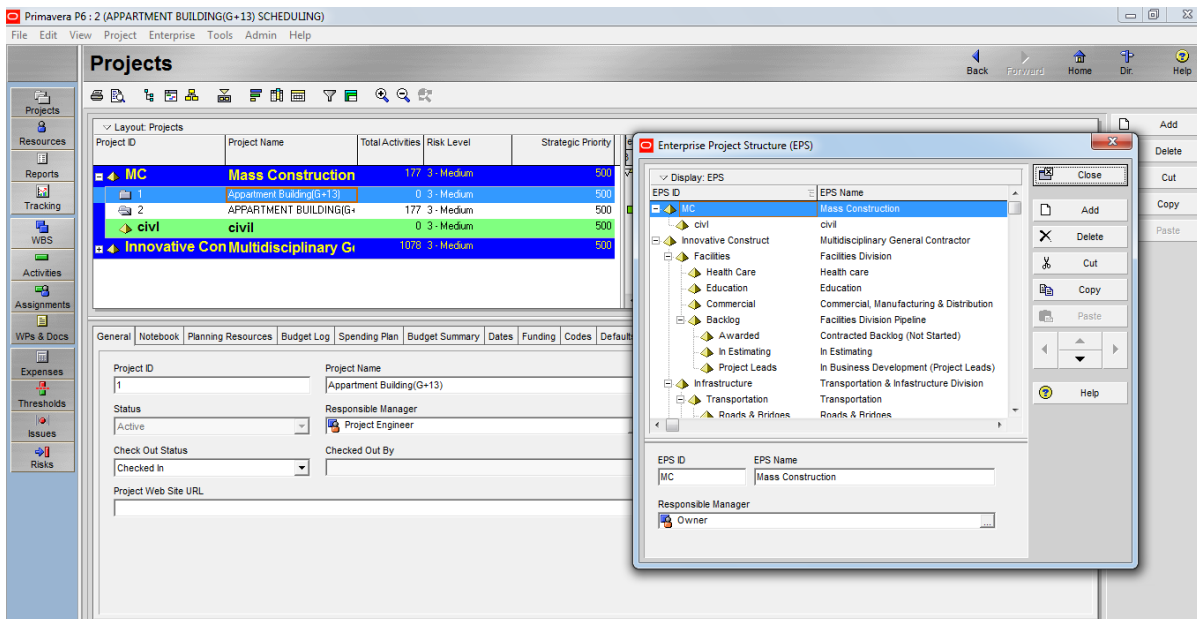


Fig no 6: Figure showing Creating new project

## 3. Creating a calendar

The calendar can create and assign it to each activity. These calendars define the available work hours in each calendar days. Also specify national holidays, organizations, and project- specific work/non a workdays and resource vocation days.
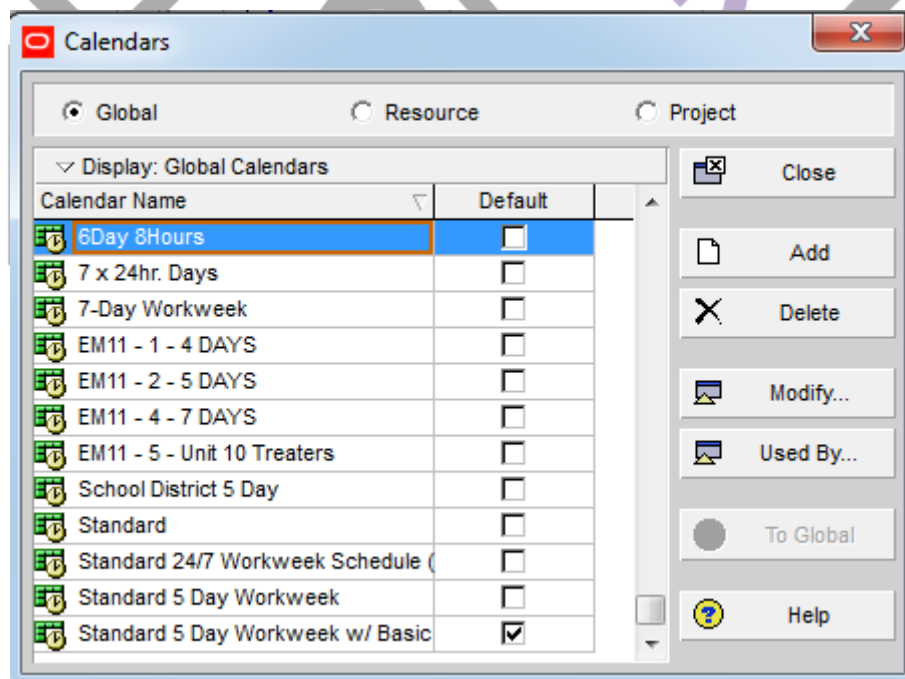


Fig no 7: Figure showing Creating calendar

## 4. Work breakdown structure

WBS elements have defined and organize the project elements. It helps to clearly identify the eliverables, report and summarize project schedule and estimated cost data at different levels of detail. WBS is a hierarchy of any project work that must be accomplished to complete a construction project. Each project has its own project WBS hierarchy structure with top level WBS element being equal to that of each EPS node of the project. Each WBS element contains more detailed in WBS levels, activities, or both resources constrains.

**Defining activity :**

Activities are the fundamental and key work elements of a project and form the top to lowest level of a WBS and, are the smallest subdivision of a project. A project activity has the following characteristics like activity ID, activity name, start and finish dates, activity calendar, activity codes, activity type, constraints, expenses, predecessor and successor relationships, resources, roles etc.
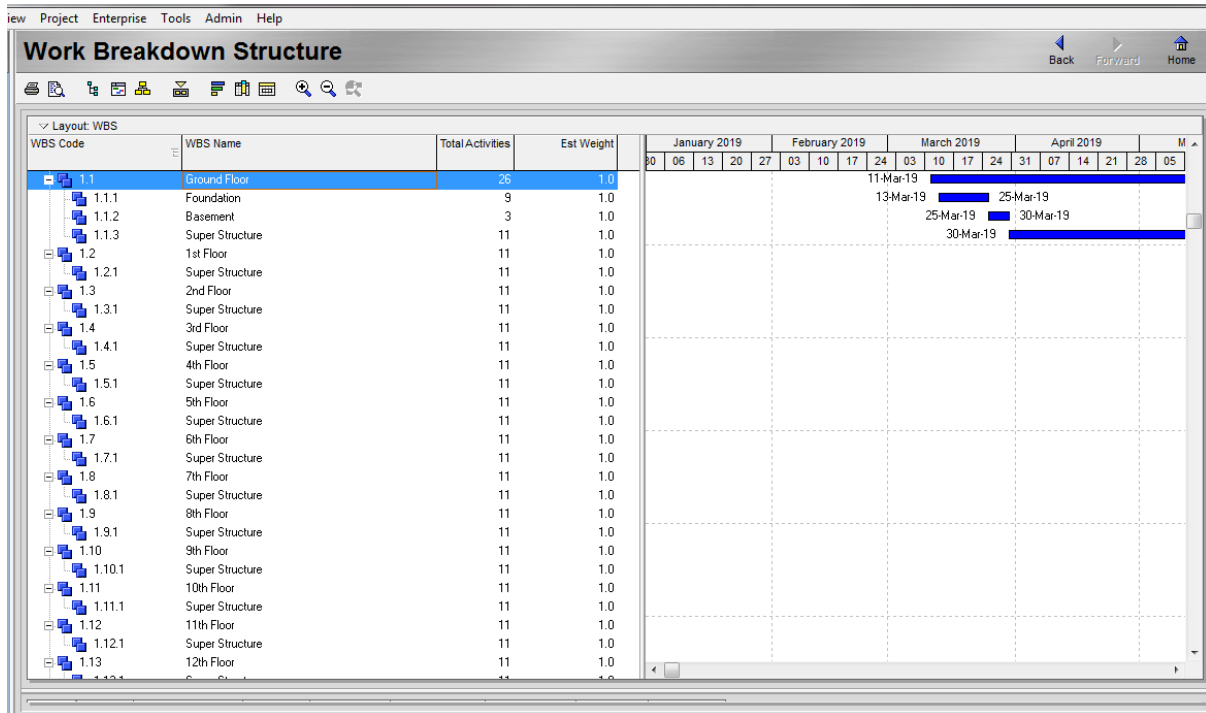


Fig no 8: Figure showing Creating WBS

**Constraints:**

Applying date constraints to the activities based on the type of work. Constraints are used to impose restrictions on activities that cannot be realistically scheduled with logical links. Sometimes activities must be accomplished according to specific dates rather than the dates determined by other activities in the

project. The need to use a constraint to delay an activity to start as late as possible without affecting any activities after it.
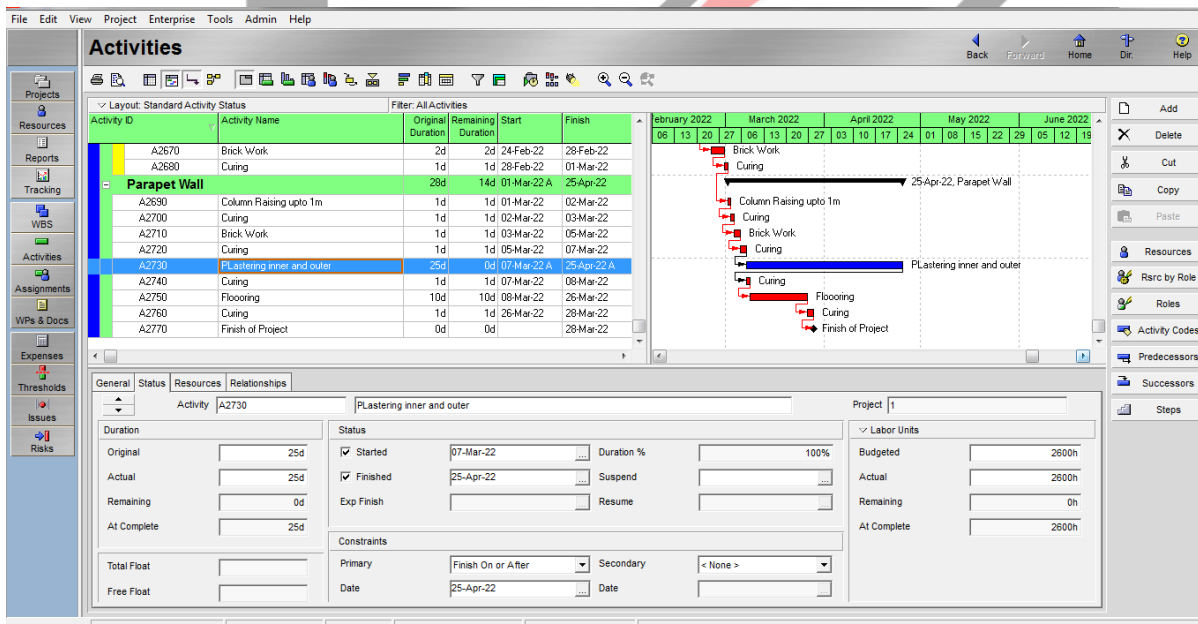


Fig no 9: Figure showing Creating constraints

**Level of Effort:** Level of effort activities gets their dates and durations from their predecessors and successors. It's most common to assign a predecessor with an SS relationship and a successor with an FF relationship. Then when resource is allocated to the activity his/her effort will be spread over the activity duration. The level of effort in primavera optimizes the duration.
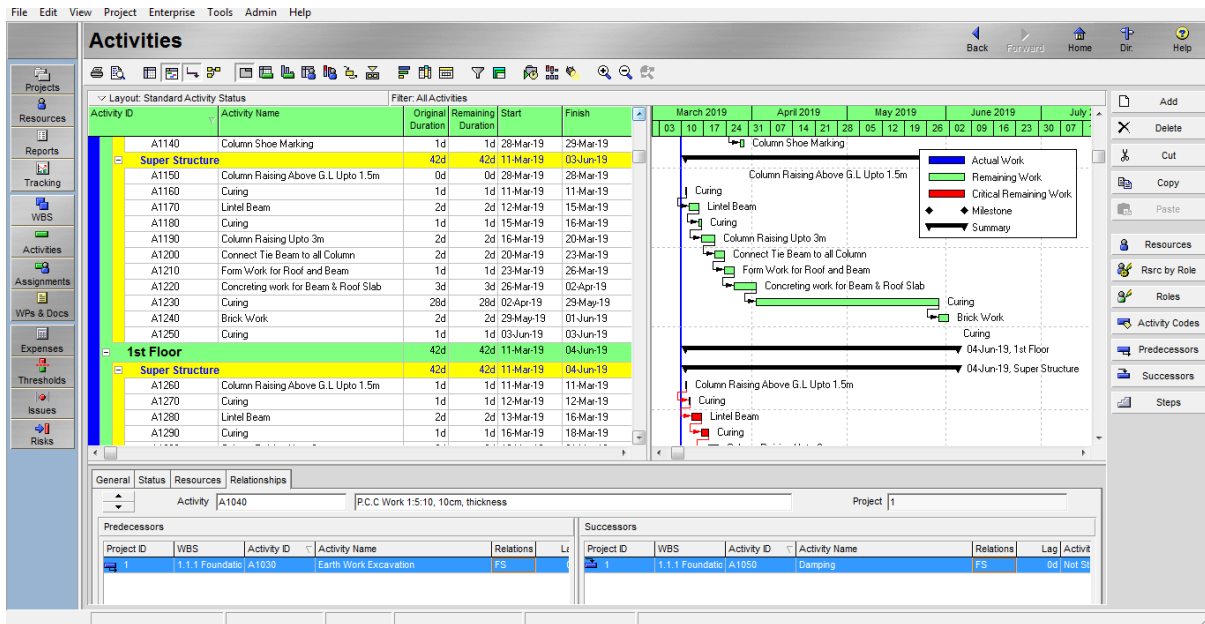
Fig no 10: Figure showing Creating LOF

## 6. Relationship between activities:

To form a network, scheduling the activities should be connected to each other, which is done by assigning succeeding, preceding activities with significant relationship to the overall project activities.
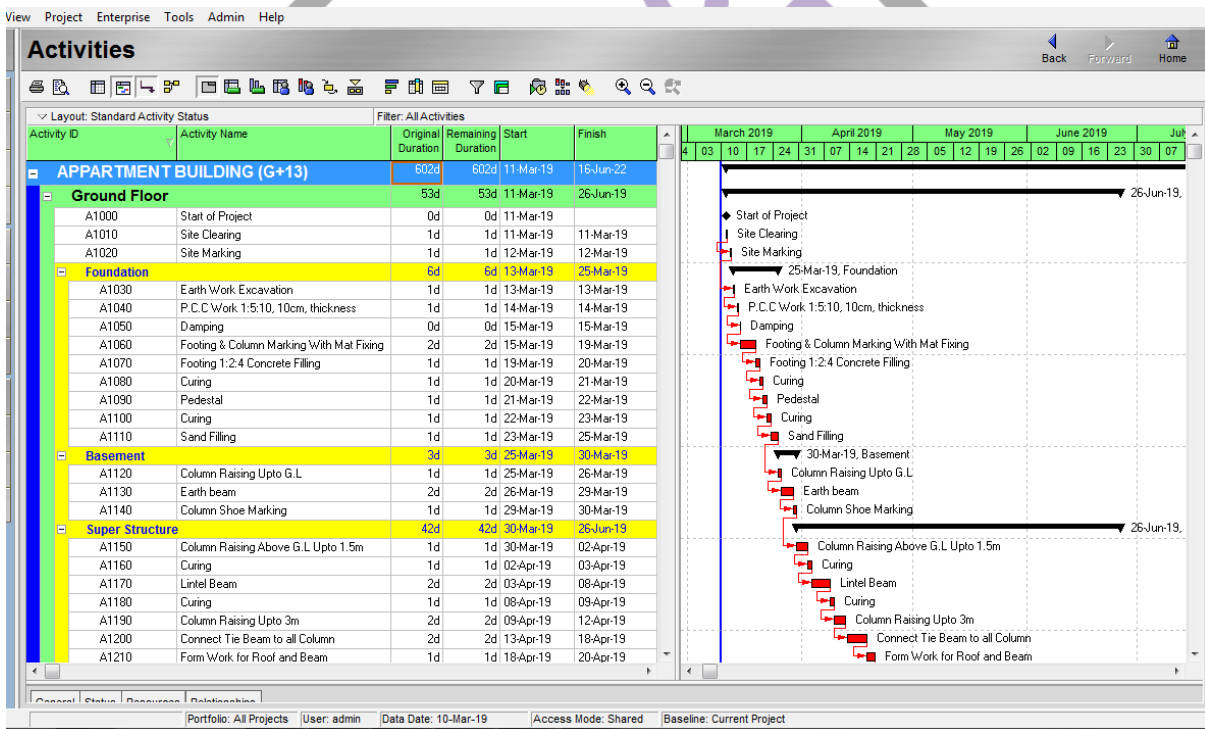Art (FS) relationship.



Fig no 11: Figure showing Creating activity

## 7. Activity Duration

When planning the work, the project duration is entered in the original duration field. The actual duration can only be entered for the project activities, which are completed.

## 8. Activity Dates

The following types of project activity dates available in the primavera; actual start, planned start, actual finish, planned finish.

## 9. Creating baseline

A simple baseline plan is a complete copy of the original schedule which provides a target against which a project's performance is tracked. Choose project. Maintain baseline. Then add and save a copy of current project as a new baseline B1. Then choose project baseline as B1 and assign primary baseline as B1. Daily updates to be made.

### 10. Resource assingning:

The resource allocation window shows all the resources grouped by labor and non labor. An approximate rate analysis was done for rates of individual resource groups, considering the various component resources. Most of the resources are taken as material. Machines are taken as non–labor and human worker is listed as labor.
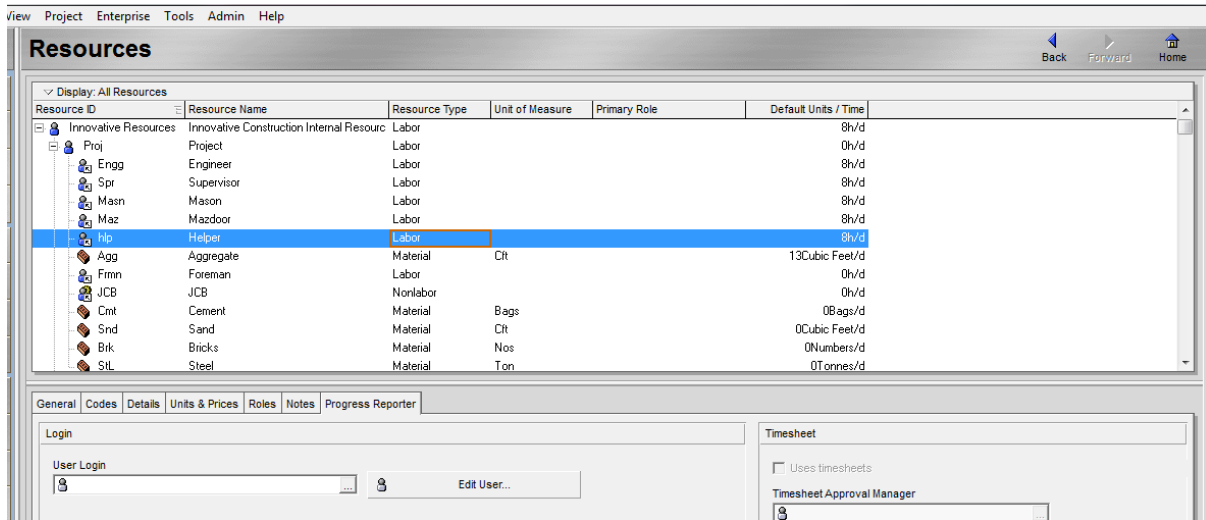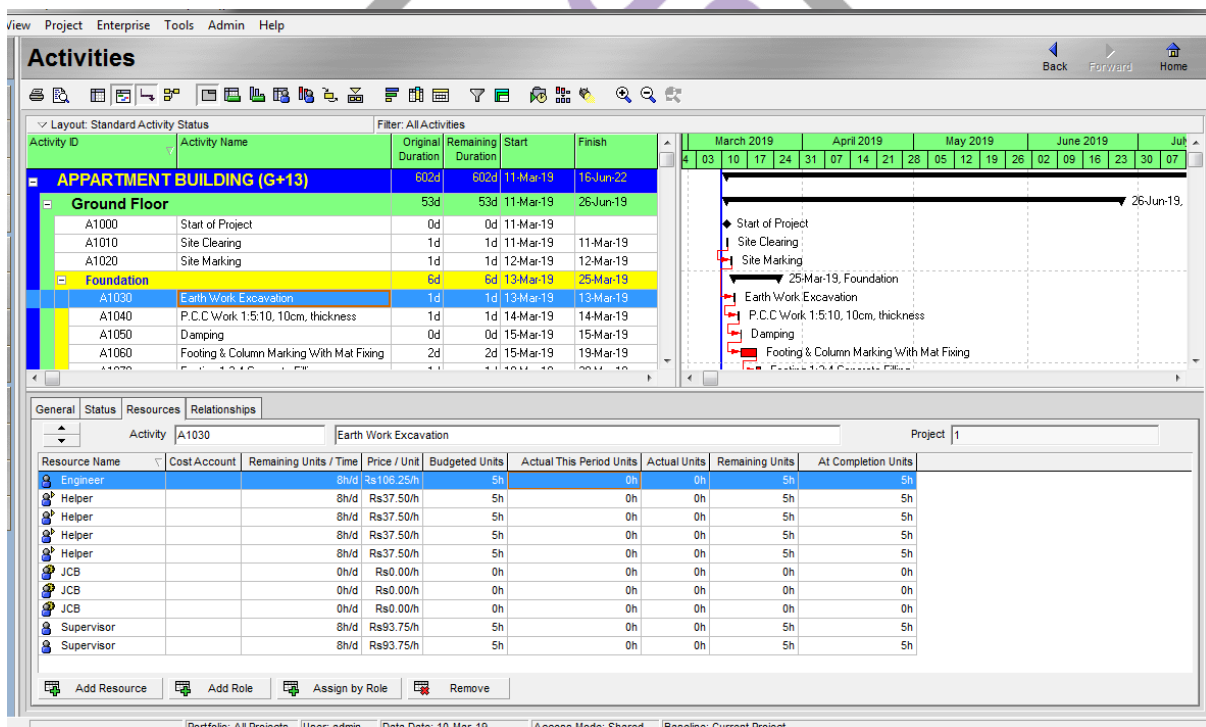


Fig no 12: Figure showing Creating Resource picture



Fig no 13: Figure showing Resource Allocation by activities

## 5. CONCLUSION:

Based on study carried out on the best features of primavera in schedule control techniques, it is concluded that primavera can be used to schedule project and reduce project duration in the construction projects by the following reasons:

1. Planning, analysis and design of G+13 multi-storey residential building was done. It's a G+13 storied building with parking in the basement and the rest of the floors are occupied with apartments.  All the structural components were designed manually and detailed using AutoCAD.

2. The analysis and design of the entire structure has been completed using STAAD pro. The better results include the various forces acting on various members as well various schedules for various members.

3. The first and foremost thing which we can get by effective planning in primavera is Start date of the project and Finish date of the project i.e Start date is 11 March 2019, And Finish date is 16 June 2022.

4. Primavera P6 helps in effectively scheduling the project by assigning two relationships at a time to each activity and considerably reduces the float.

5. Resources allocated to activities can be visually assessed for each activity & can be managed and reassigned at point of time.

6. The multiple resources required for the each activity can be allocated in effectively may it be in the form at Manpower, Machinery or Material.

7. Finally the project compares all the schedule techniques and let us knows the actual performance of the project, so as to take quick decision by the planning engineer/project manager in case of schedule parameters.

8. The project review was carried out to have a complete view of the case study of project and found out the difference in scheduled control against planned schedule.

9. For scheduling control study on constraints and activity types is done using primavera P6 software. The project schedule control decreases the duration due to apply of constraints, level of effort, resource dependent it has an effect on the project duration.

10. In this case study decrease in duration is 13.03% which will increase in project cost also. In a real time project, solving schedule control using primavera P6 software gives the best result can be realized.

11. In this project without touching any resources to optimizing, the total duration using level of efforts, resource dependent and constraint have been reduced.

12. A real time project solved using this optimization software shows that best converging result can be obtained.

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