# Design, Planning and Cost Estimation of A G+5 Residential Building

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**Abstract-** *Any construction project to begin with starts with the Layout of the building or structure followed by Design and Analysis of the structure which is succeeded by cost estimation and planning for the said project. This project involves the layout, design, analysis, planning and cost estimation of a G+5 residential building located in RAIPUR.*

*The layout of the proposed G+5 residential building is based on a plot of size 150' x 90 '. Previously the plot was being used as a commercial complex, but according to the new plan it will be used as a multi-store residential building. The ground floor of the building will be used as parking while the remaning 5 floors will be divided into 8 apartments each having an area of 246sq m. Each apartment is of 3BHK configuration. All the drafting was done using AutoCAD. Also these drawings made on AutoCAD also served as a base for transfer of the structure for analysis and design into STAAD Pro.*

*Keywords*- Staad Pro, Cost estimation, Design, Planning, Autocad.

## I. INTRODUCTION

Any Construction Project To Begin With Starts With The Layout Of The Building Or Structure Followed By Design And Analysis Of The Structure Which Is Succeeded By Cost Estimation And Planning For The Said Project. This Project Involves The Layout, Design, Analysis, Planning And Cost Estimation Of A G+5 Residential Building Located In Jangpura, Delhi.

For Completing The Project Very Popular Civil Engineering Software's Such As Autocad, STAAD Pro V8i, Primavera Project Planner And Microsoft Excel For Cost Estimation Have Been Used.

**Objectives Of The Project**

The Objectives Of The Project Are Mentioned Below:

1.  Draft The Layout Of The Proposed Building Using Autocad
2.  Analyses And Design The Building On STAAD Pro V8i
3.  Plan The Project Schedule Using Primavera P6.

Calculate The Approximate Cost Of The Building

### Role of AutoCAD

AutoCAD is a commercial software application for 2D and 3D computer aided 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. The data can be programmed to represent products sold in the building industry, or it can be extracted into a file for pricing material estimation etc.

In this project AutoCAD has been used extensively for drafting and modelling for the structure. Also the various detailing for the foundation has also been completed using AutoCAD. Use of AutoCAD has drastically reduced the drafting time when done manually thus saving time which can be used in other productive work

### Role of STAAD Pro

STAAD Pro V8i has a very user friendly interface and very useful for designing complex structures and analysing them. STAAD Pro V8i is a design and structural analysis program 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.

STAAD pro supports over 70 international codes including IS456:2000 IS800:2007 and over 20 U.S codes in more than 7 languages.

STAAD pro is able to integrate with other Bently Products such as STAAD. foundation and Pro Steel and Open STAAD. It is also able to integrate with other third party applications thus giving a good flexibility to designers working on various software's.

Using STAAD Pro one can check all the structural parameters in a design such as bending moment analysis, shear force analysis, buckling in a column, loads, deflection thereby helping the structural engineer in designing the structure better.

STAAD pro V8i also has the DESIGN feature which enables engineers to calculate the various design data including the reinforcement in case of concrete design. This features also corrects the designers in case of any mistake and rectify it. It is also useful in cost estimation as it also gives the various quantities of steel, reinforcement and concrete take off thereby reducing the load of cost estimation from the engineer.

**Role of Primavera P6**

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-Billion Dollar Infrastructure Project Or An Easy And Simple Residential Or Commercial Building, P6 Professional Is What We Need. Primavera P6 Professional is an ideal for organizations that require managing and planning either a single project or multiple projects all together while supporting a multi-user access across a department or for the entire organization. Anyone can

install this software by either as a standalone installation or a network installation.

The Primavera P6 facilitates organizations to improve the process of project management by gaining knowledge of from their experiences and using that resulting insight to new and more sophisticated projects. By using Primavera P6 as the basis for project plans and helping our organization persistently refine the planning of project and management process throughout the project life cycle.

**Role of Microsoft Excel in Cost Estimation**

Excel is a typical spreadsheet which is nowadays widely used in cost estimation and also sometimes for planning purposes. Excel has various inbuilt calculation tools which can be used for complex calculation. Apart from that one can also input one's own formula for special calculations. The user interface is very friendly and easy to use. There are around Rows: 1,048,576 Columns: 16,384,which makes it easier for the user to enter a large amount of data into a single spreadsheet. Also there are features like the auto correct which make changes to the entire document if there is an error in inputting an entry. This makes the job the less redundant and easier for the Estimator.

The key objective of cost estimation is to arrive at an accurate cost and schedules so as to avoid schedule slips and cost overruns. Cost estimation goes beyond preparing approx. costs and helps in preparing schedules, manage human resource, support assessment and decision making. The wide range of topics in cost estimation represents the crossing of various fields such as project management, business management and engineering. Cost estimation recognises and pays attention to the relationship between cost and physical dimension of what is being built.

In a construction project there are several types of estimators such as building estimator, electrical estimator, quantity surveyor etc. The work of an estimator is very important because they help in planning, managing the project cost, investment appraisal, risk analysis etc. Estimators also help in budgeting, planning and monitoring a project.
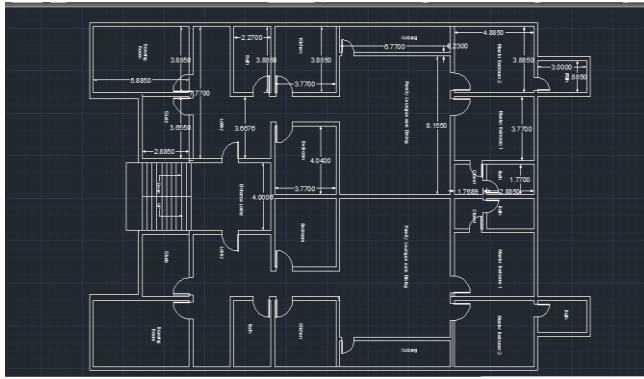
## II. LITERATURE REVIEW

**AutoCAD**

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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 and ETABS 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.

**STAAD Pro**

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The GUI or Graphical User Interface or user communicates with the STAAD Pro analysis engine through the standard input file. That input file, a text file consists of a series of commands which are sequentially executed. These commands contain either instructions or data pertaining to analysis and/or design. The STAAD Pro input file may be created through the text editor or the GUI facility. Generally, any text editor can be utilized to edit/create the STD input file. The GUI Modelling facility creates the input file through an interactive graphics oriented procedure.

STAAD allows users to create various types of structures and also analysis these structures which are listed below

- A SPACE structure, is a 3D-frame structure in which loads may be applied in any plane, it is the most general type.
- A PLANE structure is bound by any two axes with loads acting on the same plane.
- A TRUSS structure is a structure having various truss members with axial loading but no bending.
- A FLOOR structure is a 2D or 3D structure with no horizontal movement of the structure. Columns are also to be modelled with the floor in a FLOOR structure as long as the structure has no horizontal loading. In case there is a horizontal load, it should be analysed as a SPACE structure.

**Primavera P6**

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-billion dollar infrastructure project or an easy and simple residential or commercial building, P6 Professional is what we need.

Primavera P6 Professional is an ideal for organizations that require managing and planning either a single project or multiple projects all together while supporting a multi-user access across a department or for the entire organization. Anyone can install this software by either as a standalone installation or a network installation.

This software has a very user friendly interface which helps any project manager to keep tabs on the work that is going on and what work is to follow next. The project manager can show his client the progress of his work in real time which is quite necessary to please the client.

The various activities and there time schedules are shown using an animated Gantt chart. The chart also shows the relationships between various activities and these activities are linked to the various resources for easy monitoring.
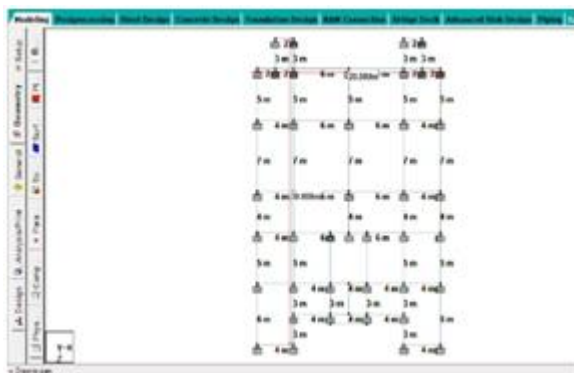


All the progress can be monitored in real time and appropriate actions can be taken if there is any problem in

following the schedule. Also Primavera allows the user to keep a tab on the cost, labour and the resources in real time. This helps the project manager to plan better and keep the costs.

Primavera is better than conventional planning in the way that the user knows the status of the work in real time which provides a lot of flexibility to the user to keep the project under control.

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**Case Studies**

**Bedabrata Bhattacharjee & A.S.V. Nagender 2007(NIT Rourkela):** They used STAAD pro for the analysis and design of a G+21 multi storeyed building. The dead loads acting on the slab were calculated manually while live load, seismic load and wind load have been entered by following respective IS Codes. The design was done using limit state of design according to IS 456:2000. They showed how efficiently and easily such a high rise building can be designed within a very short span of time.

**Ashis Debashis Behera 2012:** This report studied the comparison between two 30 storeyed buildings having the same layout and dimensions but with two different load combination

DL+LL+ Seismic Load
DL+LL+ Wind Load

The analysis and design for both the models were done using STAAD Pro. The results showed that the building with seismic load combination required more reinforcement than the building with the wind load combination.

**B. Suresh & P.M.B Raj Kiran Nanduri 2012:** This research paper focuses on the comparison between earthquake resistant analysis and design vs the non-earthquake resistant analysis and design using STAAD pro. This paper shows that the concrete and reinforcement requirement for both structures is

similar and that there is no higher cost involved in building a structure with seismic loading.

**Azidah Ziden, Fatariah Zakaria & Ahmad Nizam Othman (University Sains Malaysia, Penang, Malaysia) 2012:** This study shows how AutoCAD can be an effective tool in increasing the performance of students of various levels. It helps in proper visualisation of the project to be undertaken and thus help students in learning Engineering Design better. The study also shows how AutoCAD increases.

### III. CONCLUSION

This project includes the layout of G+5 residential building using AutoCAD, Analysis and Design using STAAD Pro, Planning using Primavera P6 and concludes with the cost estimate for the entire project.

The layout of the proposed G+5 residential building is based on a plot of size 150' x 90 'located at RAIPUR CG. Previously the plot was being used as a commercial complex, but according to the new plan it will be used as a multi-store residential building. The ground floor of the building will be used as parking while the remaning 5 floors will be divided into 8 apartments each having an area of 246sq m. Each apartment is of 3BHK configuration. All the drafting was done using AutoCAD. Also these drawings made on AutoCAD also served as a base for transfer of the structure for analysis and design into STAAD Pro.

The analysis and design of the entire structure has been completed using STAAD pro. The results include the various forces acting on various members as well various schedules for various members. Also using the software we got the concrete take-off as well as the weight of the various reinforcement bars thus easing the load of cost estimation. The foundation has been designed as an isolated footing using soil condition as medium. The foundation design values were calculated using STAAD Foundation.

Primavera P6 has been used for planning the various activities that surround the construction of a building. Using primavera we were able to formulate a working schedule and also a progress bar for constant monitoring of the project. Using primavera we were able to assign various resources as well as responsibilities on various people related to the various stages of the project there by increasing accountability. The duration of the project using primavera has been calculated to be around 374 days which also includes holidays. The progress and the relationship between various activities has also been shown in the form of an animated Gantt Chart. This

chart also helps the Project manager to explain to his clients the various aspects as well as progress of the project.

The cost estimate for the project has been calculated using Centre Line Method in Microsoft Excel. For the Abstract cost CPWD Schedule of rates has been followed and a total cost of Rs 11082364 has been calculated

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