

# Design of Multi-Storeyed Residential Building using STAAD.Pro

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## ABSTRACT

Structural planning and analysis is an art and science of designing with economy, elegance and sturdiness. Structural designing requires an in-depth structural analysis on which the planning is predicted, to compete within the ever competitive market, The use of software can save many-man hours and efforts in structural analysis and an effort was made in the present study to achieve this objective. The part 1 study deals with the planning and analysis of G+5 multi-storey building using AutoCAD and Staad-Pro software. The building consists of a parking space on the ground floor and the other three units i.e. one unit of 2BHK and two units of 1BHK on the first second and third floor. The drafting and detailing work was completed using AutoCAD software and thereafter the entire design work was completed using “Staad-Pro v8i ss6. Manual analysis of seismic load is compared preferably with the results of software and thus it's concluded that Staad-Pro is suitable tool that may save considerable time and gives sufficiently accurate results.

**KEYWORDS:** *building, Staad-Pro, considerable, compared, preferably, sufficiently*

## INTRODUCTION

Structural analysis is the process of determining the effects of loads on physical structures and its constituent parts. All structures that must endure loads, such as buildings, bridges, aircraft, and ships, are subject to this type of examination. To compute a structure's deformations, internal forces, stresses, support responses, accelerations, and stability, structural analysis uses applied mechanics, materials science, and applied mathematics. The analysis' findings are used to validate a structure's suitability for usage. Structural analysis is thus an important aspect of structural engineering design. In order to do a thorough analysis, a structural engineer needs gather information such as structural loads, geometrical parameters, support conditions, and material properties from many sources. As a result of such an examination, support reactions, stresses, and displacements are often identified. It is then possible to compare this information to failure criteria. Structural engineers study, design, plan, and research structural components and structural systems to accomplish design goals and assure the safety and comfort of occupants, the beauty of structural engineer is that he makes life better for humanity; it is the business of saving lives.

## Need of the Study:

Due to the huge growing population and the absence of land, people have shifted from rural to urban areas and are currently building large-scale houses in small areas. In spite of this, due to the fast growth in land costs and the shortage of land, multi-story structures are becoming increasingly popular. A multi-story building has several levels above ground which generally features ramps, stairways, and elevators enabling vertical circulation. But, from a structural engineer's point of view the multi-storied building can be defined as one that, by virtue of its height, is affected by lateral forces due to wind or earthquake or both to an extent that they play an important role in the structural design. It's not just about building structures; it's about building structures that are efficient so that they can serve their desired purpose. As a result, it is critical to construct the structure using adequate load analysis so that it can withstand the elements for the duration of its life.

## Literature Review

**Varalakshmi (2014):** A multistory G+5 building in Kukatpally, Hyderabad, India, was designed and analysed. Using the well-known civil engineering software STAAD.PRO, the study comprises the

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design and analysis of columns, beams, footings, and slabs. A test of the soil's safe bearing capability was performed.

**Kumar et al. (2014)** presented the seismic investigation, they used a residential building with a G+ 15-story construction that is located in zone II. STAAD.PRO software was used to assess the entire structure on the computer. In static and dynamic analysis, they observed the response reduction of cases ordinary moment resisting frame and special moment resisting frame values using deflection diagrams. The resisting frame structure's unique moment is effective in resisting seismic loads.

**Mounika et al. (2016)** has designed and studied a residential building with STAAD Pro. The manual calculations were compared to STAAD Pro results during their design and analysis. Both the manual and automated results were accurate and matched.

**Aman et al. (2016)** developed and analyzed a current project for Unity Builders that was completed in Gulbarga. The project's name is Bharat Pride. They came to the conclusion that the results of the Staad-pro and Kanis methods are identical. The member's short-term deflection is less than 20 mm.

**Khan et al. (2016)** discussed the seismic analysis of RCC buildings with mass irregularity at various floor levels is carried out in this research. The influence of mass irregularity on different floors in RCC buildings is highlighted in this research. The lateral displacement of the building is reduced as the percentage of irregularity increases, according to a response spectrum analysis done on regular and varied irregular buildings using Staad-Pro. The tale drift decreases as the amount of vertical irregularity grows, and it continues within the acceptable range.

**Sudheer (2017)** developed and analyzed a building with a footprint of 17.52 x 26.36 meters and monolithic columns that create a network. There are 15 columns in all. He came to the conclusion that the multistory building analysis was substantially faster than manual calculations. When comparing manual calculation to software design, the reinforced percentage in the section is higher.

**Giresh et al. (2017)** STAAD Pro was used to demonstrate seismic analysis and design of a G + 7 residential building. To calculate the response of a structure subjected to seismic stimulation, earthquake, or Seismic analysis is used. He gathered all of the essential seismic data for the structure's seismic study. The seismic response of the structures was evaluated in terms of member forces, joint displacement, support reaction, and narrative drift in this study.

**Adapa (2017)** has presented the static analysis of G+4 multistoried building. He deals with the static forces and displacement at member joints. He summarized that calibrated loadings are carried out using Staad-pro software, and the results are compared to manual analysis, which he found adequate. He also stated that, in addition to static analysis, dynamic analysis, which is calibrated with reference to the Response spectrum, Time History Analysis, should be used to obtain a comprehensive response of a structure under various loads.

**Patil et al. (2017)** has presented the design and analysis of G+10 multistory residential building. To build an economical design, the bending moment, shear force, deflection, and reinforcement were all analyzed. In terms of bending and shear force, he concluded that wind load combinations are greater than earthquake load combinations. It is also necessary to change the reinforcement details in structural members for practical reasons.

**Das et al. (2017)** presents the paper of typical G+7-story skyscraper. The static and dynamic analyses were performed using STAAD - Pro software, and the post processing results were summarized, utilizing the design parameters stated in IS-1893-2002-Part-1 for Zone V. Because the deflection values for Dynamic analysis are higher, it is inferred that the result of Static analysis is roughly uneconomical

**Rani, et al. (2018):** They used STAAD Pro to design and assess the G + 4 Building. It was a three-dimensional framed design that included load calculations and STAAD Pro analysis of the entire structure. Limit State Design was utilized in the STAAD-Pro analysis, which followed the Indian Standard Code of Practice. The outcomes were extremely accurate.

**Tandon et al. (2018)** the research looks at how a building responds to a seismic load as measured by storey drift and foundation shear. The (G+8) building, which is located in zones 2 and 4, was seismically analyzed using STAAD Pro software. They discovered that seismic zone 2 and 4 increase base shear, lateral force, storey shear, maximum storey displacement, and overturning moment in both directions.

## METHODOLOGY

The development of thesis contains the analysis and thesis G+5 multistory building by using the software. In Civil Engineering, there is a broad range of software available. The amount of software available to support Civil Engineering and design demands is rapidly expanding as a result of technology advancements. The softwares used in civil engineering are described below.

### Civil Engineer Software for Drafting or Drawing:

- Auto Cad
- Sketch Up

#### Autocad:

AutoCAD is a computer-aided design (CAD) and drafting software program used in the commercial sector. Architects, engineers, project managers, and a variety of other professionals use it across a wide range of sectors. When it comes to 3D and 2D CAD design, AutoCAD is a well-known name. AutoCAD software is a program that helps to develop and communicate the final product with others. The mass of structures developed today rely on computer-aided design (CAD) drawings. AutoCAD is used by the vast majority of them.

AutoCAD was developed by Autodesk Inc. more than thirty years ago. AutoCAD is available for both Windows and Macintosh computers. AutoCAD 2D contains a lot of features and functions. It can clearly draw and change structures with precision. Text and

precise dimensions are simple to add. The project may be organized by layers, colours, and styles, and the geometry can be examined at various scales. Another useful feature is the ability to create a number of layouts for printing.

Another advantage is that collaborating with other AutoCAD users via the internet is simple. One can choose from a range of AutoCAD versions available on the internet, but the most recent version is always suggested. The fact that AutoCAD is a procedural program makes it easy to use. This means that the command window invites you to input commands in a logical, step-by-step way.

Most architectural software has adequate capability for high-quality visualization, and even walk-through movies can be created in these software. However, this work is frequently outsourced, and with a little effort, this work can be done in-house, saving business profits and allowing one to improve his quality.

### Plan of residential Building GROUND FLOOR PLAN

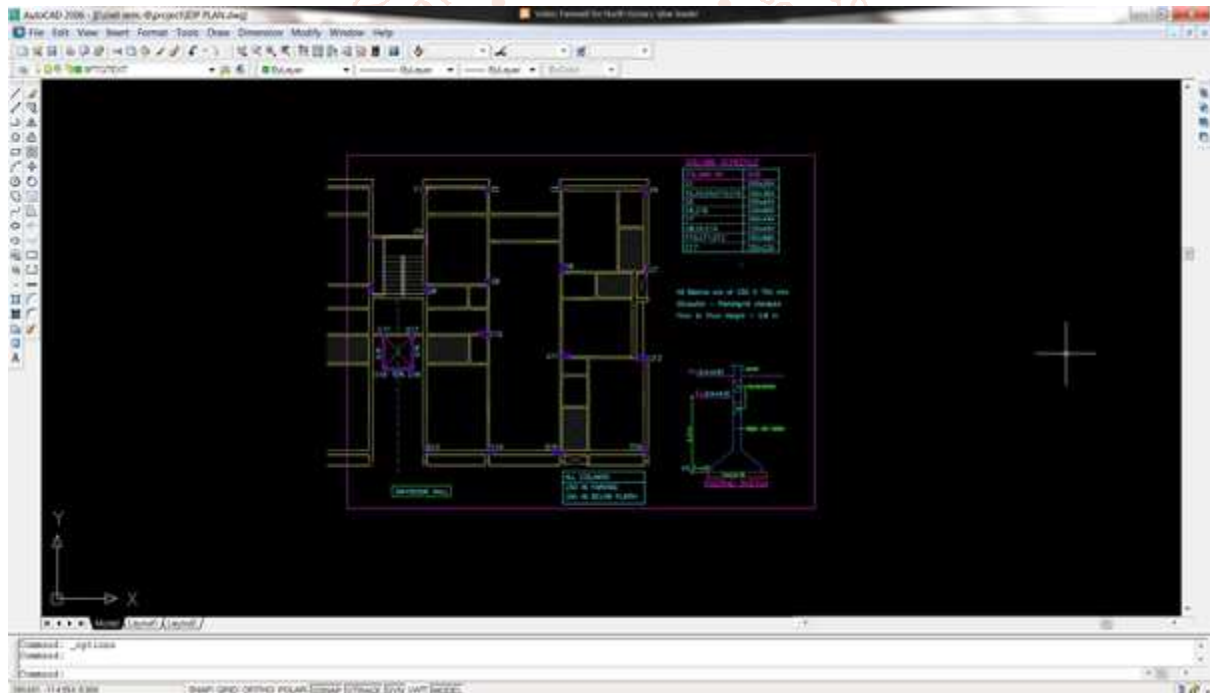


Figure 1: Ground Floor Plan

### FIRST FLOOR PLAN

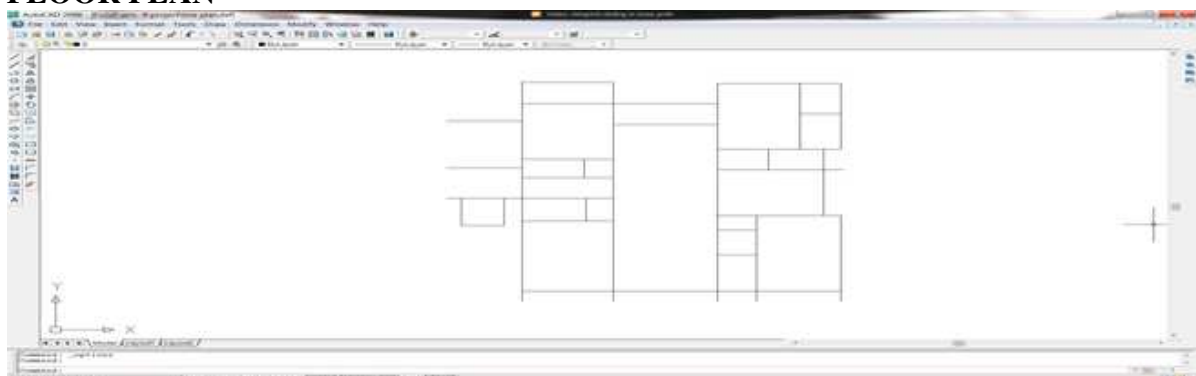


Figure 2: Auto Cad Plan of building



**CONCLUSIONS**

1. The study conclude that, analyzing multi-storey buildings with Staad pro reduces manual computations and consequently provides correct results in less time.
2. The comparison between base shear results of manual to software calculation gives maximum increment of 2.39 % at top most height of building i.e. at 12 meter, with minimum increment of 0.4 % at the height of 3 meter.
3. The average increment is nearly 18%. As a result, when compared to manual results, Staad pro results are almost as accurate. In addition Staad pro provides reinforcement details of all its members, as well as takeoff quantities of concrete and steel.
4. When analyzing the seismic parameters in various parts of India, the base shear levels vary considerably. Zone II has a value of 226.85 KN, zone III has a value of 362.96 KN, zone IV has a value of 544.44 KN, and zone V has a value of 816.66 KN.

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