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Design of Multi-storeyed Residential G+5 Building using STAAD.Pro and AutoCAD

Sinny Kumari[1], Deeksha Shrotriya[2]

[1]Research Scholar, [2]Assistant Professor,
[1,2]Department of Civil Engineering, LNCT, Bhopal, Madhya Pradesh, India

ABSTRACT

The study deals with the Seismic Analysis of G+5 multi-storey's building in different zones using Staad-Pro software. The same building frame is evaluated in several zones, and an analysis is performed to get findings for base shear and reinforcement details. Analysis has been performed according to IS 1893 -2002 part-1

KEYWORDS: *analysis, seismicload, baseshear, Staad-Pro, software*

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INTRODUCTION

Structural analysis is essential because it establishes a foundation for structural design and determines whether a particular structure can withstand external and internal loads and pressures. The structural analysis serves in the identification of the reason of structural failure. Many software exists now that creates a model and shakes it in an earthquake and blows wind on it, and the software tells an engineer which portion of the structure is likely to fail so that it may be saved even before it is completed.

Few researches have been performed in the area of design and analysis of low-rise buildings using software and compared the software results to manual results. There is also lessresearch in the domain of seismic analysis of low-rise buildings in India's various zones. Furthermore, a research was conducted utilizing Staad-pro to design and evaluate a building, with the findings compared to manual results.

Objective of the work:

The main aim is to calculate and analyze the seismic reaction of the building, then evaluate and design it using STAAD-Pro software.

The primary objective of the current research study is as follows:

1. To develop and analyze the G+5 model in Staad-pro model
2. Comparison of earthquake load obtained from Staad-pro software with themanual results.
3. To study the seismic loads in four zones of India.
4. Comparison of base shear results of same building in different seismic zones.
5. To compare the quantity of concrete and steel reinforcement in different seismiczones.

Literature Review

Malarande et al. (2019) presents the analysis and design of a multistory building using Staad Pro and manual calculation for two seismic zones. The study considers an attempt to assess and design a building utilizing Staad-pro G+9 building. The analysis and design are carried out in accordance with the

IS456:2000 regulation. The result of design of beam, column, seismic weight obtained from software is compared to manual results.

Dinesh et al. (2019) evaluated and developed a multistory (G+10) building using the Staad- pro software. Limit State Design, as defined by the Indian Standard Code of Practice, is employed in the STAAD-Pro analysis. Gravity Load, which includes both dead and live loads, and Lateral Load, which solely includes Wind Loads, are the loads that are taken intoaccount while designing a residential building. A residential structure has a total height of 30 meters and a total area of 9,048 square meters.

Satheesh et al. (2020) used Staad Pro to analyze a G+10 residential structure. They deal withestimating seismic and wind loads for residential buildings in accordance with IS:1893-2002 and IS:875-2015 part 3. They used Kani's method to manually analyze the structure and compared the results to Staad-Pro. They came to the conclusion that the findings of the staad-pro and kanis methods are nearly identical.

Tejaswini et al. (2021) the project report includes a seismic study and design for a G+9 RCC building. The beam, column, slab, and footing designs, as well as the applied dead and live loads, are derived. This software examined the entire structure using the STAADPRO software. The base shear values obtained from Staad-pro and manual calculations are compared.

METHODOLOGY

Table 1: Staad-Pro Input of Wind Specifications

PARAMETERS	VALUE
Building classification category	3
Basic wind speed	39m/sec
Exposure category	B
Structure type	Building Structure

Wind intensity outcome at different heights are describes in table 2

Table 2: Staad-Pro Output of Wind Specifications

Wind Intensity	Height
0.8191	0.00
0.8191	4.57
0.8327	5.14
0.8453	5.71
0.8571	6.28
0.8681	6.85
0.8784	7.42
0.8882	8.00
0.8975	8.57
0.9064	9.14
0.9149	9.71
0.9231	10.28
0.9309	10.85
0.9384	11.14
0.9457	12

Designs in Staad-pro:

Reinforcement details of sample beams and columns are describes in respectively.

Table 3: Reinforcement Details of Random Beams.

BeamNo.	Size in Meter	Main Reinforcement	Shear Reinforcement
107 (5 Floor)	0.2 X0.4	Top- 3-12mm diaBottom- 2 -12mm dia	2 legged 8mmdia @ 125mm c/c
107 (4 Floor)	0.2 X0.4	Top- 3-12mm diaBottom- 2 -12mm dia	2 legged 8mmdia @ 125mm c/c
107 (3 Floor)	0.2 X0.4	Top- 3-12mm diaBottom- 2 -12mm dia	2 legged 8mmdia @ 125mm c/c
13 (2 Floor)	0.2 X0.4	Top- 2- 10mmdia Bottom 2 -12mmDia	2 legged 8mm dia @ 125mmc/c
96 (1 Floor)	0.2 x0.4	Top- 4- 10mmdia Bottom 2 -10mmDia	2 legged 8mmdia @ 125mmc/c

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Table 4: Reinforcement Details of Random Columns

ColumnNo.	Size inMeter	Main Reinforcement	Tie Reinforcement
153	0.2 X 0.4	8 – 12 mm dia bar	8- mm dia @ 190mm C/C
69	0.2 X 0.4	8- 16mm dia bar	8- mm dia @ 200mm C/C

Comparison of manual & Staad-Pro Results:

The manual calculation and the analysis of seismic parameters i.e. seismic weight, base shear are as discussed in table. The seismic parameters are calculated with manual calculation and the same is then calculated with Staad-pro software. The results obtained in Staad-pro are slightly more as compared with manual calculation. The average increment of nearly 1.4% is identified in the results of Staad-pro.

Table 5 Manual & Staad-Pro Results:

Parameters	Manual	Staad-Pro	% Increment
SeismicWeight	13410.44 4 KN	13436.8 6 KN	0.196 %
Base Shear	335.261 KN	336.92 KN	0.49 %

Table 6: Comparison of Base Shear at Different Height:

Floor Height (meter)	Base shear (Manual)	Base shear (Staad-Pro)	% Increment
12	150.86	154.48	2.39 %
9	268.2	273.21	1.86 %
6	320.83	325.86	1.56 %
3	335.26	336.92	0.49 %

CONCLUSIONS

In addition, different steel quantities are acquired in different zones, comprising51383 N in zone II, 54104 N in zone III, 65835 N in zone IV, and 75484 N in zone V.

As a result we conclude that same building with same dead load, live load, and same seismic weight gives different base shear and steel values to resist it in different seismic zones.

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