A Comparative Study of G+5 Building With And Without Seismic Loads Using Staad. Pro

Satendra Rajak[1], Kamlesh Kumar Choudhary[2]
[1]Dept of Civil Engineering
[2]HOD & Assistant Professor, Dept of Civil Engineering
[1, 2] Saraswati Institute of Engineering & Technology, Jabalpur, India.

Abstract- *The majority of engineers are looking into how well multi-story residential apartment buildings can withstand earthquake forces using sophisticated non-linear techniques. In this study, a G+5-storey structure's ability to withstand earthquake forces is examined using the much easier equivalent static method and the Staad Pro software. The seismic analysis is further contrasted with the non-seismic analysis of an equivalent structure using a dead load and super load combination. It had been noted that the seismic results had significantly higher maximum moments and shear forces than the non-seismic analysis Previous earthquakes have shown that many structures were either entirely or partially destroyed as a result of earthquakes. Therefore, it is crucial to comprehend the unstable responses of these structures. The comparison of seismic and non-seismic structures is the main goal of the current research. In accordance with the specifications of IS codes 1893, 875, and 456:2000, the analysis was completed.*

Keywords- Stadd Pro., Earthquake, Loads, Non-seismic, Seismic, axial force, bending moment, shear force.

I. INTRODUCTION

This An earthquake is considered a natural disaster. Many people die every year as a result of failure of structure caused by earthquakes. For example, the magnitude of 7.8 earthquakes on the Richter scale struck on April 16, 2016. It killed more than 650 people with structures that collapsed hundreds of miles from the epicenter where the actual earthquake occurs. Damage to structures can be minimized by adopting earthquake-resistant design principles. This paper presents a comparative analysis of the G + 5-storey residential structure between a non-earthquake analysis (with dead and live loads) and an earthquake analysis (with dead, living loads and earthquakes). Earthquake response to a structure can be achieved by using direct, non-linear, vertical, dynamic analysis. The various methods of seismic analysis include

- Fixed Equilibrium Evaluation,
- Response to Analysis Issues,
- Linear Dynamic Analysis,
- Static Linear Analysis and
- Dynamic Nonlinear Analysis (Pushover Analysis)

II. OBJECTIVE OF STUDY

In order to determine the seismic response of a G+5-storey residential structure, equivalent static analysis is used in this research work.

1. To find out the effect of seismic and non-seismic loads on same structure.
2. A G+5 analysis is performed for a typical moment-resisting frame in zone II using professional software.
3. According to IS 1893-2002, seismic parameters like soil type, seismic zone, zone factor, importance factor, and response reduction factor are measured as criteria for earthquake-resistant structure design.
4. The structure is subjected to various load cases, including dead load, live load, and earthquake load.
5. The properties of the structure and its components are given below.

Table 1. The information about detailed plan details.

Plan Area(Structure)	106.50m2
Column Size	350x350mm
Beam Details	350x300mm
Slab Thickness	125mm
Utility of structure	Residential Structure
Height of structure	18m
Type of construction	RCC Frame structure
Grades of concrete	M25
Grades of steel	Fe415
Seismic Zone	II
Zone Factor	0.1
Importance factor	1
Response Reduction factor	3

III. SOFTWARE DISCUSSION

Brief Description software used

- Auto CAD
- STAAD.PRO

3.1 Auto CAD

A popular commercial drafting and computer-aided design (CAD) programmeis AutoCAD. Autodesk created and sold them In December 1982, AutoCAD made its debut as a desktop application for microcomputers with built-in graphics processors. Prior to the release of AutoCAD, the majority of commercial CAD programmes were run on mainframe or minicomputers, with each CAD operator (user) utilising a different graphics terminal. Additionally, there are web and mobile apps for AutoCAD .

Architects, project managers, engineers, graphic designers, city planners, and other professionals use AutoCAD in the workplace. In 1994, 750 training facilities around the world supported it.

At the 1982 Comdex, Autodesk displayed its initial version, which was then made available in December. CP/M-80 computers could be used with AutoCAD . By March 1986, AutoCAD —the company's flagship product—had overtaken all other CAD applications as the most widely used one globally. AutoCAD for Windows saw its 36th major release in 2022, and AutoCAD for Mac saw its 12th consecutive year of releases. AutoCAD 's default files format is.dwg. This and its interchange file format DXF, to a lesser extent, have emerged as de facto, if proprietary, standards for CAD data interoperability, particularly for the exchange of 2D drawings. The Autodesk-created and -supported format for publishing CAD data is now supported by Auto CAD .

3.2 Staad Pro

STAAD Pro is a structural design and analysis software developed by Research Engineers in 1997.STAAD. Pro is one of the most widely used structural analysis and design software products worldwide. It supports over 90 international steel, concrete, timber & aluminum design codes. It can make use of different forms of analysis from the conventional static analysis to more recent analysis methods like geometric non-linear analysis and Pushover analysis (Static-Non Linear Analysis). It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response variety analysis feature is supported for both user defined spectra.

Go to Plan view and see the Plan in STAAD Pro.

All members are seen as one unit and there is no joint in between members.

IV. METHODOLOGY

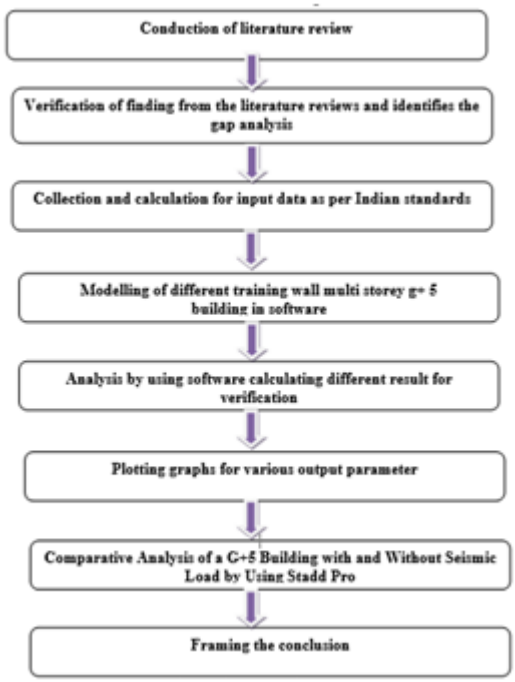


Fig -1: Flow chart of methodology

V. RESULTS AND OBSERVATION

5.1 Structure Data

The investigation of G+5 is accepted out using STAAD.pro software for ordinary moment resisting frame situated in zone II. Table 1 contains of the plan range, beam dimension, column dimension, slab wideness, the tallness of the structure. Seismic parameters such as Seismic Zone, Zone factor, Importance factor, Response Reduction factor, Soil type is measured as criteria for earthquake resistant design of structures as per IS 1893-2002. The properties of the structure and its components are given below. The prototype was generated in commercial software STAAD.pro. Different load cases is taken like dead load, live load, and earthquake load are applied to the structure. Table 2 gives the information about detailed plan details.

Table.1 shows the Details of components Used for construction of Structure.	
Plan Area(Structure)	106.50m2
Column Size	350x350mm
Beam Details	350x300mm
Slab Thickness Utility of structure Residential Structure Height of structure	18m
Type of construction RCC Frame structure[2] Grades(concrete, steel)	M25,Fe415
Seismic Zone	II
Zone Factor	0.1
Importance factor	1
Response Reduction factor	3

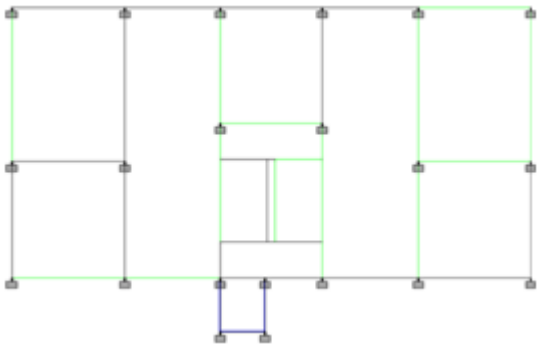


Fig -2: Plan of G+5 Building

Fig 3Shows Plan is framed in AutoCAD and STAAD.PRO software in order to analyse the respective structure. Fig.3 shows Elevated view of structure.

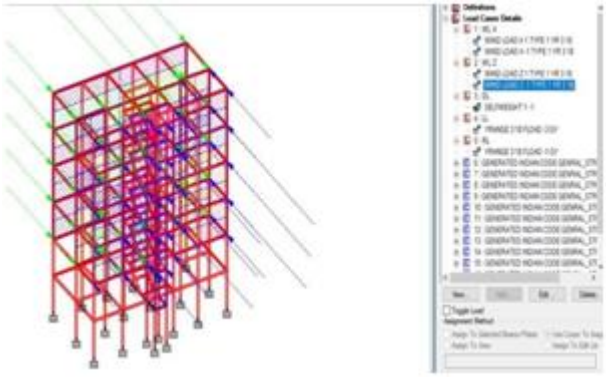


Fig 3.Loads actingonstructure.

figure 7.3.andfigure 7.4shows the various load applied to the structure such as dead load, live load, wind load, earth quake load**.**

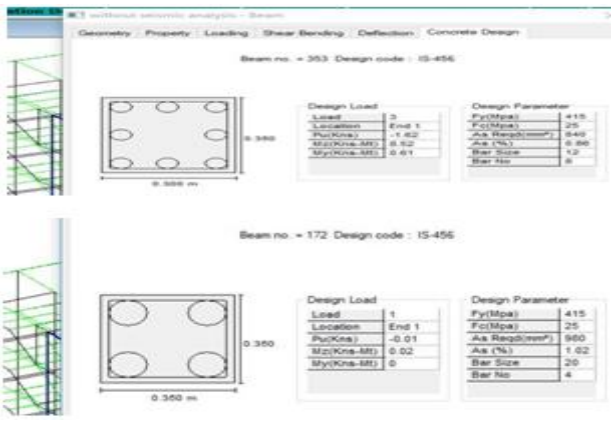


Fig 4. DetailofColumn**.**

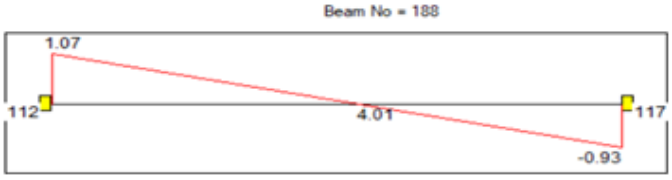


Fig 5 . Bending Moment Diagram with Seismic Load**.**

In figure 5, a point load of 4.01kn is appliedwhich causes a continuous bending moment in abeamit is of1.07to-0.93.

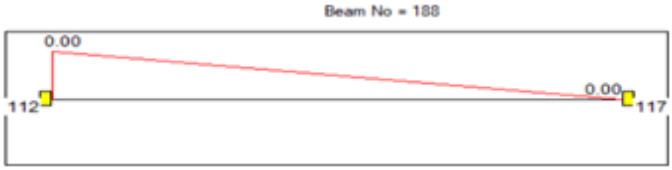


Fig 6. Bending Moment Diagram without Seismic Load.

In figure 6 a point load of 0 kn is applied which causes a continuous bending moment in a beam. There is no bending moment occurs in the beam of non seismic building.

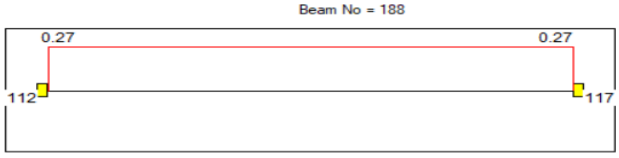


Fig7.. Shear Force Diagram With Seismic Load**.**

Figure 7. shows shear force diagram of beam188inwhichtheshearforceof0.27mm.

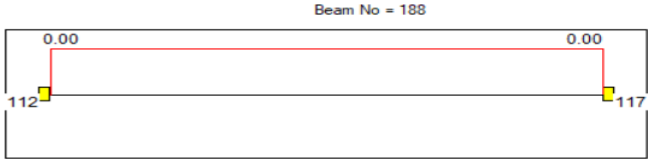
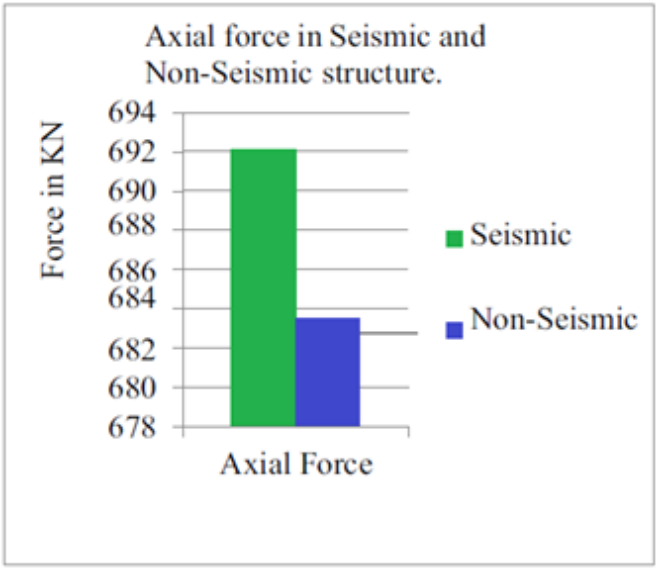
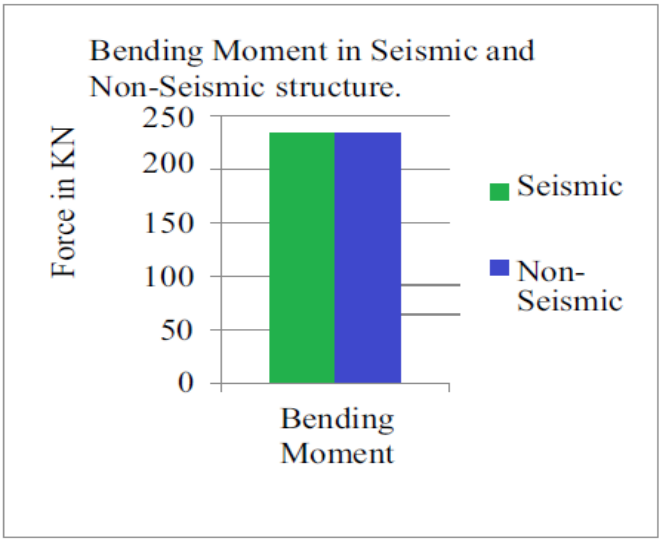


Fig 8. Shear Force Diagram Without Seismic Load**.**

Figure8showsshearforcediagramofbeam188inwhichtheshearforceof0 mm.



GraphNo.1showsmaximumAxialForceinSeismicstructure



GraphNo.7.2showsmaximumBendingMomentinSeismicstructure

Table. 7.2 Comparing of Maximum Displacement.

Displacement	X-axis	Y-axis	Z-axis
Seismic	5.445 mm	0.707 mm	2.719 mm
Non-Seismic	2.284 mm	0.141 mm	0.991 mm

VI. CONCLUSION

The goal of this research project was to evaluate the seismic load placed on G+5 buildings. STAAD.PRO software is used for the analysis in order to produce better results. Any structure that is subject to dynamic loading is evaluated by the STAAD.PRO software, and the results are precise. According to the analysis above, the axial force and displacement of seismic and non-seismic structures differ, but the bending moment and shear force are identical.

REFERENCES

.

[1] Author- Neelam Sharma, ISBN: "Earthquake Resistant Building Construction".
[2] Author- Sanjib Das, "STAAD.PRO CE - Seismic Analysis Using IS 1893 (PART-1)-2016".
[3] Dr H. J. Shah, Dr Sudhir K Jain Document no.: IITK-GSDMA-EQ26-V3.0 "Design Example of a Six Storey Building".
[4] Dr. JC Awkar, Dr. EM Lui, "Seismic Analysis and Response of Multistorey Semi-Rigid Frames", Elsevier Science Ltd., Volume 21, Issue.5, May 1999.
[5] "Seismic Analysis of tall buildings for different earthquake zones", IJETER (International Journal of Emerging Technologies in Engineering Research), Volume 5, Issue.4, April 2017.
[6] Andrea Polastri, Matteo Izzi, Luca Pozza, Cristiano Loss, Ian Smith, "Seismic Analysis of multi-storey timber buildings braced with a CLT core and perimeter shear-walls", Springer Nature, 6th September 2018.
[7] "Seismic performance evaluation of a tall building: Practical modelling of surrounding basement structures", Journal of Building Engineering, Volume 31, September 2020.
[8] Anurag Wahane, Vedprakash Sahu "Seismic Analysis on RCC Frame Building Resting on Sloping Ground Using STAAD Pro. Software" Volume 5, Issue 2 ,2020 IJRTI.
[9] Adhiraj A. Wadekar and Ajay G. Dahake "Analysis And Design Of A Multi-Storey Building By Using Staad Pro" 10.21474/IJAR01/10746 : April 2020.
[10] Prof. Komal S. Meshram, Samiksha Kumbhare, Sagar Thakur, Diksha Mate, Amit Moundekar, Raksha Waghmare "Seismic Analysis of Building Using Staad-Pro" International Journal of Innovations in Engineering and Science, Vol. 4, No. 5, 2019.
[11] Shubham Pandey "Seismic Behavior of Symmetric and Asymmetric Building for Static and Dynamic Analysis using STAAD.Pro" International Research Journal of Engineering and Technology (IRJET) Volume: 07 Issue: 07 | July 2020.