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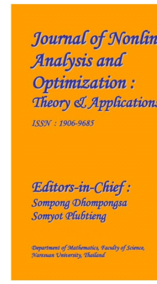

BEHAVIOUR OF RCC G+6 RESIDENTIAL BUILDINGS CONSIDERING SEISMIC ZONE IV AS PER IS 1893-2002

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ABSTRACT - The Indian Standard, which categorizes seismic zones, is a critical concern in regions with high seismic activity. This study investigates the behavior of Reinforced Concrete (RCC) G+6 residential buildings across these zones, focusing on G+6 buildings due to their prevalence in urban landscapes. The research aims to assess the response of RCC buildings to seismic forces, providing insights into the efficacy of design provisions specified in IS 1893-2002[1]. The study considers factors such as soil type, building configuration, and structural detailing, identifying vulnerabilities and strengths inherent in RCC constructions. The findings contribute to understanding seismic design principles and optimizing structural performance against seismic hazards[2]. The research serves as a valuable resource for architects, engineers, and policymakers in designing and constructing residential buildings in seismic-prone regions, facilitating informed decision-making processes to mitigate seismic risks and enhance structural safety standards.

KEYWORDS - seismic zones, Indian standard, RCC structures, STAAD.Pro software

1. INTRODUCTION

Earthquakes are natural phenomena caused by vibrations in the earth's crust, with volcanic eruptions being the main cause. Seismology studies reveal that 9 0 % of earthquakes occur due to tectonics[3]. Earthquakes can cause changes in geologic features, damage to man-made structures, and impact on human and animal life. To minimize the impact of earthquakes, structures should be designed according to safety criteria[4].

In India, there are four seismic zones: zone II, zone III, zone IV, and zone V. [5]Zone II is low-risk, while zone V is high-risk. IS 1893:2002 provides information on seismic design. [6]High-risk zones include North-eastern India, parts of Jammu and Kashmir, Himachal Pradesh, Uttaranchal, Rann of Kutch in Gujarat, North Bihar, and Andaman& Nicobar Islands.

1.1 Introduction to STAAD.Pro software

STAAD.Pro is a structural analysis and design software developed by Bentley Systems, known for its versatility in handling various types of structures. It offers a suite of tools for static, dynamic, and finite element analyses of structures, supporting a wide range of design codes and standards[7]. STAAD.Pro can model complex geometries, apply various loading conditions, and analyze structural behavior under different scenarios. [8]Its analytical capabilities include linear and nonlinear static analysis, dynamic analysis, buckling analysis, and finite element analysis (FEA). [9]It can accurately predict structural responses, enabling engineers to assess the performance and safety of their designs. STAAD.Pro also provides robust design capabilities for structural elements like beams, columns, slabs, and foundations, enabling engineers to generate design reports detailing reinforcement requirements and member sizes[6]. [10] Its user-friendly interface, advanced analytical capabilities, and comprehensive design features make it a preferred choice for structural engineers worldwide.

1.2 Aim and objective of the present project

The project investigates RCC G+6 residential buildings' seismic behavior across various zones, aiming to improve structural responses to seismic forces and inform design and construction practices.

1. To study the various outputs by STAAD.Pro analysis and to see results like ultimate load, ultimate bending moment,Shear force, Bending moments and others.
2. To introduce the principle of good earthquake resistant building practices.
3. To study the effect of shape of the structure on the overall seismic performance.

1.3 Scope ofwork

This project aims to investigate and evaluate the structural behavior of RCC G + 6 residential buildings in different seismic zones. [11]This includes reviewing literature, developing detailed structural models, simulating seismic loading conditions, analyzing key structural parameters, comparing responses across zones, and assessing the efficacy of seismic design provisions[12]. The project also aims to provide practical insights for optimizing design and construction practices to enhance seismic resilience.

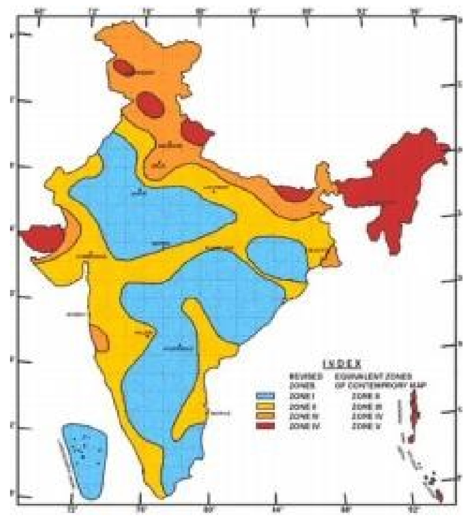


Fig 1:- Seismic zones of India Map

2.LITERATURE REVIEW

IS 1893 (Part 3): 2002 is a standard that assesses earthquake forces and designs new bridges on various structures.[13] It covers earthquake effects on retaining walls, bridge abutments, hydrodynamic effects, and soil liquefaction potential. The standard focuses on earthquakeresistant design of regular bridges, but requires detailed dynamic studies for special and major bridges.

Mr. Pathan Irfan Khan and Dr. Mrs. N.R.Dhamgein **2016** said that fast urbanization has led to the construction of multi-storied buildings in seismic zones, making them vulnerable to earthquakes. During the Bhuj earthquake, two buildings in Ahmadabad were damaged due to mass irregularity.[14] This study focuses on seismic analysis of RCC buildings with mass irregularity at different floor levels, highlighting the impact of mass irregularity on different floors and Response Spectrum analysis using STAAD.Pro.

Mr. Akash Panchal and **Mr. Ravi Dwivedi** in 2017 analyzes a G+6 existing RCC framed structure using STAAD.Pro V8i, comparing variations in steel percentage, maximum shear force, maximum bending moment, and maximum deflection in different seismic zones. Results show higher variations from zone II to zone V, [15]making the structure uneconomical due to potential earthquakes.

G. **Guruprasad et al. (2017)** conducted a dynamic analysis of G+15 storied RC frame buildings using ETABS software. They compared parameters like story drift, story shear, support reactions, building mode, and section cut force. [16,17]They found that L-shape buildings had the highest story shear value, and irregular plan structures could resist more base shear when earthquake loads were applied in the Y direction. Regular and L-shape buildings performed better than C-shaped ones.

S.K. Ahirwar, S.K. Jain, and M.M. Panda (2008) analyzed earthquake loads on multi-story R.C. Framed buildings, considering three, five, seven, and nine storey buildings. [18,19,20]They used the Seismic Coefficient method, Response Spectrum method, and Modal Analysis method to determine seismic responses, including storey shear and base shear.

3.METHODOLOGY

As we discussed in the previous chapters,a structure must be analyzed and designed to resist lateral earthquake forces.[21,22]In this chapter,the analysis and design procedure of the G+6 storey building is discussed with the help of STAAD.Pro software.[23]The structural details are inputted, and seismic loading conditions are applied to the models. [24]STAAD.Pro performs seismic analysis, including response spectrum, time history, and pushover analysis, to calculate the structural response to seismic forces. [25]Engineers can review and interpret the analysis results to assess the behavior of RCC G+6 residential buildings under different seismic conditions. STAAD.Pro also offers options for optimizing the design of RCC G+6 residential buildings to enhance their seismic performance.[26,27] Adherence to IS 1893-2002 and other design codes ensures that the seismic analysis aligns with established engineering practices and regulatory requirements.

3.1 Preliminary data

A G+6 storey building has been designed as an RCC framed structure with reinforced concrete slab. [28,29,30]The building is analyzed by using STAAD.Pro software and the analysis part is done in different zones of india.

3.2 Building configuration

The building model has six storeys with a constant storey of height 3m.

S.No	GENERAL DATA	VALUES
1.	Grade of concrete	M40
2.	Grade of steel	Fe-500
3.	The density of reinforced concrete	25 KN/m^3
4.	Slab thickness	125mm

Table 1: Other relevant data

Seismic zone	Seismic intensity	Zone factor
II	Low	0.10
III	Medium	0.16
IV	Severe	0.24
V	Very severe	0.36

Table 2: Zone factor

S.No	PARAMETER	VALUE
1.	Seismic zone	IV
2.	Response reduction factor	1
3.	Importance factor	1
4.	Soil type	Hard soil

5.	Damping ratio	5%
6.	Frame type	SMRF
7.	Seismic factor	0.24

Table 3: Input parameters for seismic analysis

3.3 Plan

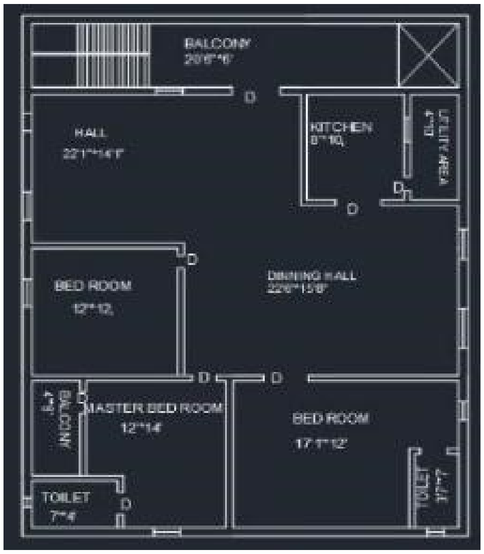


Fig 2: Plan of the building

4.ANALYSIS AND DESIGN WITH STAAD.PRO SOFTWARE.

It defines seismic loading conditions, applying seismic loads, performing response spectrum analysis, and time history analysis. [31]The results are then analyzed to assess the behavior of the buildings under seismic loading conditions. [32,33]Sensitivity analysis is conducted to evaluate the influence of factors like structural configurations or material properties on the seismic response. STAAD.Pro's optimization features are used to explore design alternatives and optimize the structural design for enhanced seismic performance. Compliance checks are conducted to ensure the results comply with IS 1893-2002 requirements.[34] Comprehensive reports are generated to document the seismic analysis process.

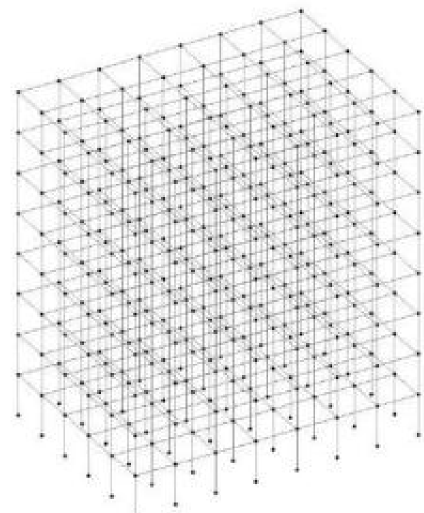
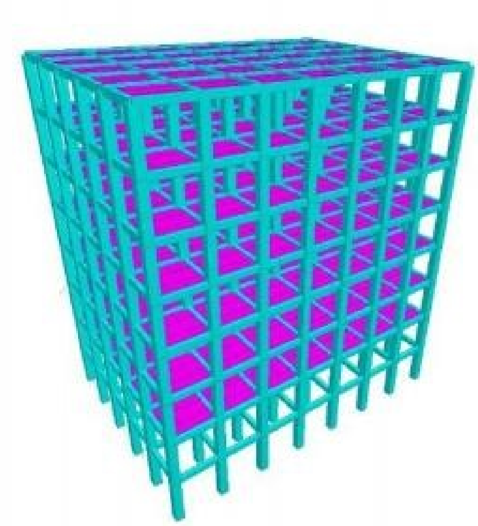


Fig 3: Skeleton view of the structure

Fig 4: Rendored view of structure



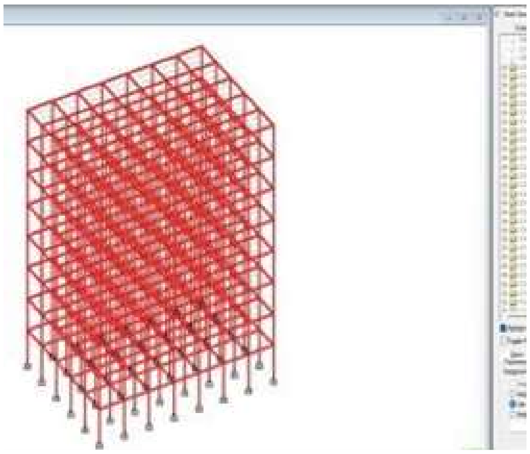


Fig 5: Loaded diagram

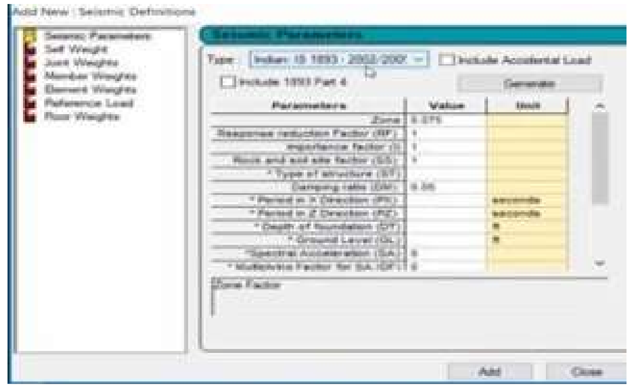
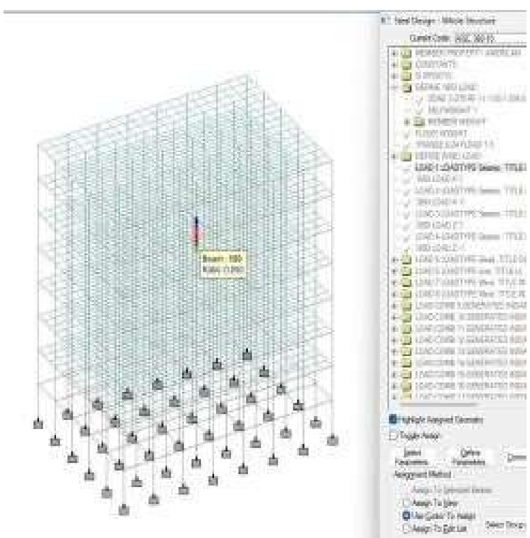


Fig 7: Seismic parameters

5.CONCLUSION

1. Evaluation of key parameters like inter-story drift, base shear, and structural integrity.



2. Findings emphasize the importance of considering seismic design provisions for RCC structures in seismic-prone regions.
3. Comparison of responses across various seismic zones identified vulnerabilities and strengths in RCC constructions.
4. Optimization capabilities of STAAD.Pro enabled exploration of design alternatives and refinement of structural designs.

5. Compliance with design codes and standards ensured adequate structural safety and stability.

Fig 6: Assigning of seismic loads

6. Documentation and reporting capabilities of STAAD.Pro facilitated effective communication of analysis and design results.

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