

DESIGN OF SEISMIC RESISTANT RESIDENTIAL BUILDING USING STAAD.PRO.

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ABSTRACT: Earthquakes may produce casualty of different forms in different magnitudes which vary from the case force majeure, fatalities and physical damages of buildings (ranging from minor damage to leveled structures), and a long list of others such as liquefaction. The secondary effects including fire, blocking of water / electric power / transport services and communication cut are more devastating yet. Humanbuilt structures are nonetheless the primary cause of death in earthquakes. So they have to be well designed and made. It is therefore highly necessary to establish new technologies which prevent those losses. Hence, we began to investigate these new methods and enhance our knowledge and be informed about these recent techniques, and their application, in order to minimize earthquake effects on our structures during daily life. This study looks at the basic theories and methods adapted for reducing seismic vulnerability of buildings in order to preserve human lives. It focuses on the role of seismic risk assessment, design standards, structural systems and mitigation solutions in minimizing the risk of earthquake damage. We want to make a building in this seismic area (where our site is located) with material that are resistance from seismic earthquakes. Every area we are in has different intensities and we're going to gather all the data available relative to our site about soil type, seismic intensity, seismic history, and then make our decision. The ultimate objective is to design STAAD based Seismic resistant structure. Pro software. We are going to get there in stages. STAAD. Pro is one of the main applications in our project, in STAAD. Pro I am looking to design and analyze the structure, in respect of seismic loads and reaction. It is more useful for us to design our building against seismic resistant residential house.

Keywords: *Advanced Techniques, Earthquake, Effective Designs Process, Structure failure, STAAD.Pro, earthquake; structural systems; design codes; Seismic resistance.*

I. INTRODUCTION

1.1 Introduction The safety and stability issue of the building were more or less influenced by earthquakes, especially around the seismic area. Buildings should be designed to remain inhabitable and safe (or avoid collapse at all) when subjected to seismic forces in order to limit injury, harm, and imperial damage. With more and more urbanization and the demand for multi stories residential building, it is necessary to adopt earthquake resistant principles in the design of structure. This project deals with the structural design and analysis of G+3 gravity & seismic resistant residential building by STAAD. Pro software. Gravity load and seismic load has been modelled and analysed as per appropriate Indian Standard codes, mainly IS 1893 (Part 1): 2016 for earthquake loading and IS 456: 2000 for reinforced concrete design. STAAD. Pro is a powerful software for three-dimensional model generation, loading application, and nonlinear dynamic analyses comprising modelling of building structure, its seismic response assessment under earthquake ground motion since it is capable of taking all the geometric stiffness into account. The modelling of G+3 residential building in order to assess the behaviour of lateral force i.e. base shear, Storey drift and member forces and design various structural components such as beams, columns, slabs and footing etc., providing necessary strength, stiffness, ductility. By integrating software driven analysis methods, the project closes the gap between theoretical seismic design concepts and actual engineering practice and plays an important role in developing safe, economic-codecompliant residential dwellings

II. LITERATURE REVIEW

1. Shobhit Kumar et. al (2022) briefly about the fundamentals of the earthquake-resistant building along with materials & methodology of construction. They also discussed the case study of the earthquake of 26. Jan.2001 in Bhuj India.
2. Ruchi, Kusum Choudhary et. al. (2022) presented a review of a few earthquake-resistant structures of the seismic zone. They also presented various techniques to protect buildings from such disasters.
3. Gauri Kolhapur et. al. (2021) presented a study of the seismic analysis of medium rise structure for static and dynamic analysis in ordinary moment resisting frame (OMRF) and special moment resisting frame (SMRF). They presented a study of residential buildings & concluded the importance of resisting frame structure.
4. Sanjivan Mahadik et. al (2020) highlight the different techniques for increasing the resistance of seismic structures. Such techniques incorporate the usage of base isolation, shear walls, etc. In the end, they conclude that if we collaborate with these technologies the damage due to earthquakes can be reduced
5. Deepesh Panchal et. al. (2019) highlights the importance of earthquake-resistant building through a global-level review of test & findings done by researchers & suggest solutions to get rid of such disasters.
6. Katta Venkataramana et. al (2018) discussed the necessity of earthquake-resistant structures followed by building typologies and earthquake-resisting construction practices. At last future trends are discussed.
7. G.B. Ramesh Kumar et. (2018) al discussed the basics of earthquake-resistant

structures & intensity-wise analysis of earthquakes occur so far. Several load types are also discussed. At last importance of Indian design standards and software applications in such type of design is presented.

8. Aman Kumar et. al (2017) discussed a critical review of 2 techniques of retrofitting i.e., base isolation method, tuned damper mass method, etc. Through results, it is expressed that TMD structures are more efficient.
9. Akshay R Kohli et. al (2017) presented a STADD Pro software model for earthquake-resistant structures. Live Load, Dead load, and wind load analysis are presented. Both static & dynamic analysis is presented for concern structure. This software base model can be implemented in practical design consideration.

III. IMPLEMENTATION

MODEL PROJECT DETAILS

3.1 Project details

Table 1 Project Details

Purpose of building	RESIDENTIAL
Site dimension shape	Regular (rectangular)
Number of floors	G+3
Wall materials	Solid blocks, light weight blocks
Height of stories	3m

3.1.2. Site data

1. Area: 151.59sqm
2. Zone: 2
3. Soil Type: medium
4. Zone factor: 0.1
5. Response Reduction Factor: 5.0

3.2 Design Parameters

Properties of the building material

1. Characteristics of concrete and steel: M35 and Fy500
2. Live load=3kN/m² for office space and 2kN/m² for toilets
3. FF= 1.5kN/m²
4. Beam size = 300mmx300 mm
5. Column size = 300mmx450mm.

3.3 Software Components

STAD PRO

IV. METHODOLOGY

4.1 Data Collection: Gather architectural drawings, building dimensions, site details, and seismic zone information.

4.2 Modeling in STAAD.Pro: Create a 3D model of the residential building. Define member properties, material strengths, and support conditions.

4.3 Load Application: Apply dead load and live load as per IS 875. Assign seismic loads using IS 1893 (Part 1): 2016 guidelines. Generate load combinations for analysis.

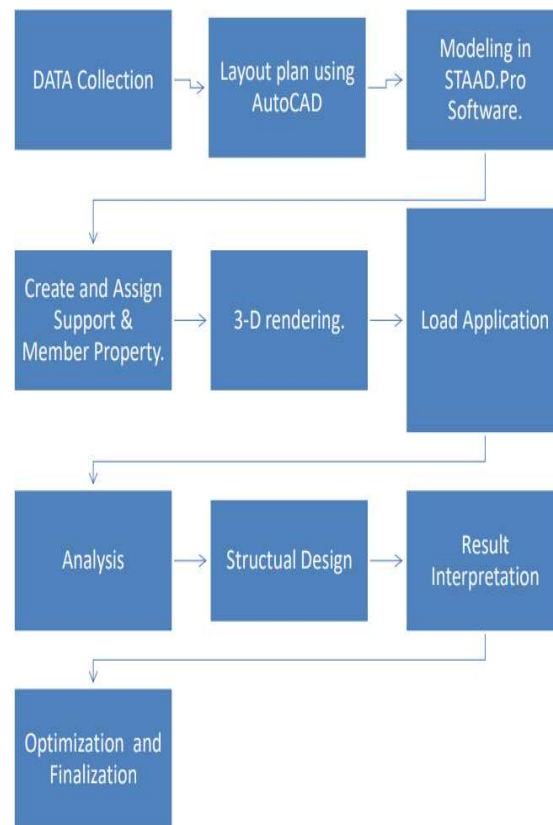
4.4 Analysis: Perform linear static analysis. Conduct response spectrum analysis to study dynamic behavior.

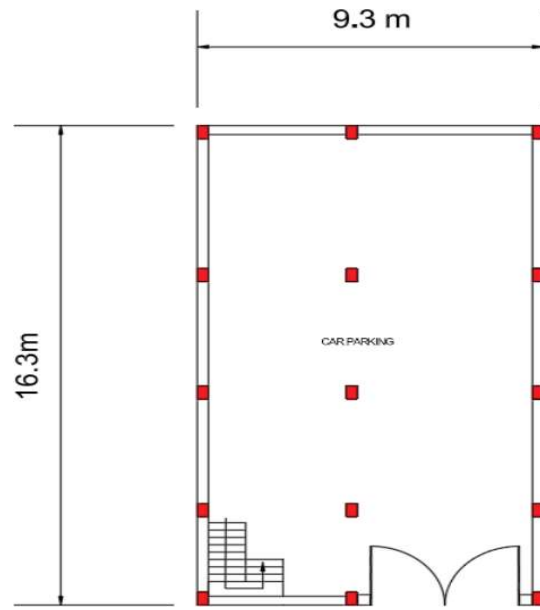
4.5 Design: Design RCC elements like beams, columns, and slabs as per IS 456:2000. Check drift limits, storey displacement, and torsion effects.

4.6 Result Interpretation: Study bending moments, shear forces, deflections, and base shear. Identify critical structural components and ensure they meet safety criteria.

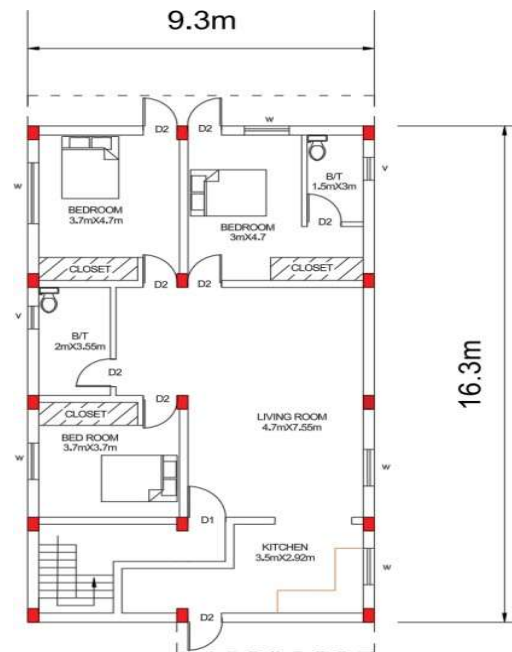
4.7 Optimization & Finalization: Improve member sizes or reinforcement where required. Make sure there are zero errors and warnings. If any errors and warnings are shown, try to correct them. Finalize the structural design ensuring both safety and economy. Post tensioned flat slab

Flow Chart Represents process involved in the G+3 in STAD PRO till to the detailed output.



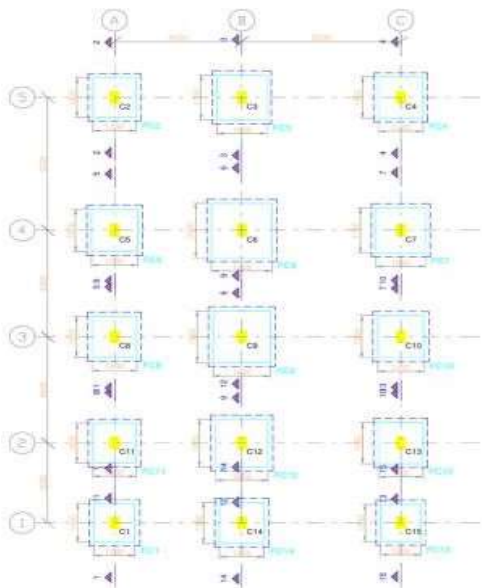


GROUND FLOOR



TYPICAL FLOOR

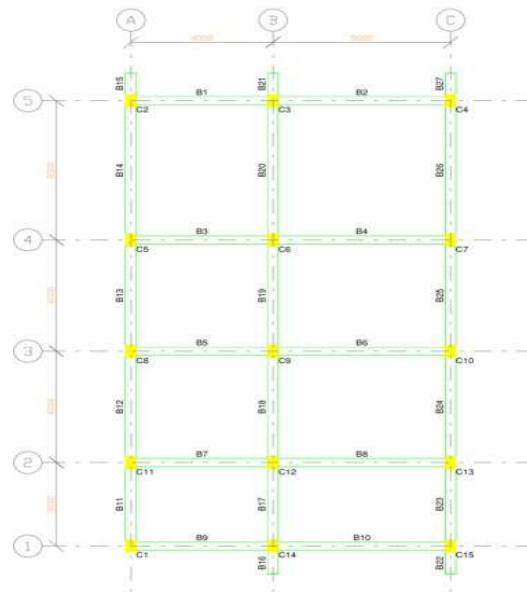
V. RESULT AND DISCUSSION:



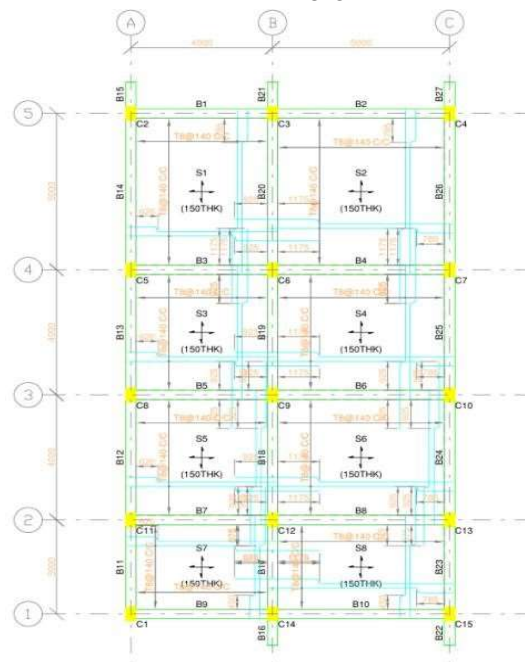
FOOTING DESIGN

1.5 M		MAX. HEIGHT: 1000MM = 1000MM COLUMN NO. 2040 = 2040MM			
750	3 M				
		25 1000MM LONG	25 1000MM LONG	25 1000MM LONG	
		25 1000MM LONG	25 1000MM LONG	25 1000MM LONG	
750	3 M			10 1000	
		MAX. HEIGHT: 1000MM = 1000MM COLUMN NO. 2040 = 2040MM			
		25 1000MM LONG	25 1000MM LONG	25 1000MM LONG	
750	3 M				
		25 1000MM LONG	25 1000MM LONG	25 1000MM LONG	
		25 1000MM LONG	25 1000MM LONG	25 1000MM LONG	
1.5 M					
COLUMN MARKED		C4			

COLUMN DESIGN



BEAM DESIGN



SLAB DESIGN

Future Directions

Optimization and finalization of a seismic-resistant structure in STAAD.Pro is a systematic and iterative process aimed at achieving structural safety, serviceability, and economy while satisfying seismic design code requirements. STAAD.Pro provides an integrated platform for modelling, analysis, design, and refinement of structural systems subjected to earthquake loads. The process begins after the preliminary structural configuration and initial member sizing have been established based on architectural requirements and basic design assumptions

VI. CONCLUSION

1. The design of seismic-resistant buildings is a critical area of study, given the increasing frequency and intensity of earthquakes worldwide. This project has explored the application of STAAD.Pro in analyzing and designing structures capable of withstanding seismic forces. STAAD.Pro, with its advanced computational capabilities and user-friendly interface, has proven to be an invaluable tool for engineers seeking to optimize building resilience while adhering to stringent safety standards.
2. We have designed a G+3 residential building that is resistant to seismic forces that the building will be exposed to. Our design is immune to all the lateral forces that an earthquake can cause. The result we obtained in STAAD.Pro software after all the simulation showed us zero errors and warnings. This signifies that our design is safe.
3. One of the key takeaways from this study is the importance of understanding seismic dynamics and their impact on structural integrity. STAAD.Pro allows engineers to perform detailed analyses, considering factors such as ground motion, building weight, material properties, and damping mechanisms. The software's ability to simulate real-world conditions enables the prediction of potential failure points, facilitating the development of designs that prioritize both safety and cost-effectiveness.

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