iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 14 **Issue:** VII **Month of publication:** July 2026

DOI: https://doi.org/10.22214/ijraset.2026.84224

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue VII July 2026- Available at www.ijraset.com

Analysis and Design of Shearwalls for Earthquake Resistant Buildings Using Etabs

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Abstract: ***The rising frequency of seismic occurrences and the expansion of multi-story structure development have made earthquake-resistant design a crucial component of structural engineeringIf buildings are not built with sufficient lateral load-resisting systems, lateral forces produced during earthquakes can result in excessive displacement, structural instability, and major damage. Because they offer more stiffness, strength, and stability, reinforced concrete shear walls are widely acknowledged as one of the best structural elements for enhancing a building's seismic performance.***

The analysis and design of shear walls for earthquake-resistant structures using ETABS is the main emphasis of this work. A multi-story structure made of reinforced concrete is modeled and examined under seismic and gravity loading scenarios. Material qualities, geometric configurations, loading conditions, and design parameters are established in compliance with the applicable Indian Standards when the structural model is created using ETABS. By changing the shear walls' placement within the structure, various structural configurations are taken into consideration in order to assess the efficacy of shear walls. Structural response characteristics including storey displacement, storey drift, base shear, storey stiffness, natural time period, and mode shapes are used to evaluate each model's earthquake behavior.

The analytical findings show that adding shear walls to reinforced concrete structures greatly enhances their seismic performance by lowering lateral displacement and interstory drift while boosting overall stability and structural stiffness. Compared to traditional moment-resisting frame systems, buildings with appropriately positioned shear walls show better resistance to forces caused by earthquakes. The study also emphasizes how crucial shear wall placement and configuration are to obtaining effective structural performance and reducing seismic damage.

For structural engineers and designers involved in the planning and construction of earthquake-resistant structures, the project's results offer useful information. The results validate the efficient application of shear walls as a cost-effective and dependable lateral load-resisting technology for reinforced concrete buildings situated in seismically active areas. The study also shows how effective ETABS is as a structural analysis and design tool for assessing and improving multi-story structures' seismic behavior.

Keywords: Shear walls, earthquake resistance, ETABS, seismic analysis, reinforced concrete, multi-story buildings, storey displacement, storey drift, base shear, and structural design are some of the keywords.

I. INTRODUCTION

A. Introduction

One of the most damaging natural catastrophes that damage infrastructure and buildings globally is an earthquake. Lateral loads caused by seismic forces during an earthquake can cause excessive displacement, structural damage, or even collapse if the building is not properly planned. The requirement for earthquake-resistant structural solutions has grown as the number of multi-story structures rises as a result of rapid urbanization and population expansion.

The strength, longevity, and affordability of reinforced concrete (RC) structures make them popular. However, during powerful earthquakes, traditional moment-resisting frame constructions may undergo considerable lateral displacement. Structural engineers use lateral load-resisting systems like shear walls, braced frames, and core walls to get around this restriction. Among these technologies, reinforced concrete shear walls are acknowledged as one of the best ways to enhance a building's seismic performance.

Shear walls are vertical structural components made to withstand horizontal stresses brought on by wind and earthquakes. They increase the building's overall rigidity and stability while securely transferring these lateral stresses to the base. In order to improve human safety during seismic events, properly built shear walls minimize storey displacement, storey drift, torsional impacts, and structural damage.

B. Aim of the Study

To use ETABS to analyze and design reinforced concrete shear walls for multi-story, earthquake-resistant structures and assess how well they improve seismic performance..

C. Objectives

- To use ETABS to create a three-dimensional model of a multi-story reinforced concrete structure.
- To examine the structure both with and without shear walls.
- To investigate how various shear wall positions affect seismic behavior.
- To assess base shear, natural time period, storey displacement, and storey drift.
- To create shear walls in compliance with relevant Indian Standards.
- To identify the best shear wall arrangement for increased earthquake resistance.

D. Scope of the Study

This project's scope involves utilizing ETABS to model, analyze, and design a multi-story skyscraper made of reinforced concrete. According to applicable Indian Standards, seismic loading is taken into account in this analysis. Based on structural response metrics, several shear wall configurations are assessed and contrasted. The initiative does not involve building or experimental testing; instead, it concentrates on analytical assessment.

E. Need for the Study

- To strengthen multi-story structures' resistance to earthquakes.
- on lessen the harm that seismic forces do on structures.
- To determine the best location for shear walls.
- To increase structural stability and lateral stiffness.
- To encourage cost-effective and safe construction design.
- To accurately analyze and design structures using ETABS.

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H. Expected Outcomes

- The building's improved seismic performance.
- A decrease in storey drift and displacement.
- A greater degree of lateral rigidity.
- Determining the best configuration for shear walls.
- Suggestions for earthquake-resistant building design that is both affordable and safe.

I. Chapter Summary

In addition to introducing the idea of earthquake-resistant structures, this chapter emphasized the significance of shear walls in withstanding lateral stresses. The study's context, problem description, objectives, scope, methodology, and anticipated results were

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 14 Issue VII July 2026- Available at www.ijraset.com

all given. Previous studies on shear walls, the seismic behavior of reinforced concrete structures, and the use of ETABS in structural analysis will be reviewed in the next chapte

II. INTRODUCTION

Dynamic lateral forces created by earthquakes can have a substantial impact on a building's stability and safety. Strength, stiffness, ductility, and overall structural layout all affect a structure's seismic performance. Reinforced concrete shear walls are frequently used in multi-story buildings to increase resistance against stresses caused by earthquakes. By acting as the main lateral load-resisting components, these walls lessen excessive movement and improve the structure's overall stability.

ETABS is now one of the most used tools for modeling, evaluating, and designing multi-story structures due to the development of structural analysis software. It allows engineers to assess structural reactions such base shear, storey displacement, storey drift, and natural time period while conducting linear static, response spectrum, and time-history assessments.

This chapter examines earlier studies on shear wall behavior, earthquake-resistant construction, and the use of ETABS in seismic analysis. The evaluation identifies gaps that this project seeks to fill and aids in identifying current research trends.

A. ETABS Software

A sophisticated structural engineering program called ETABS is utilized for building analysis and design. It enables engineers to apply different loading conditions, simulate intricate buildings, and assess seismic performance in accordance with design guidelines.

Important characteristics consist of:

• Structural modeling in three dimensions.

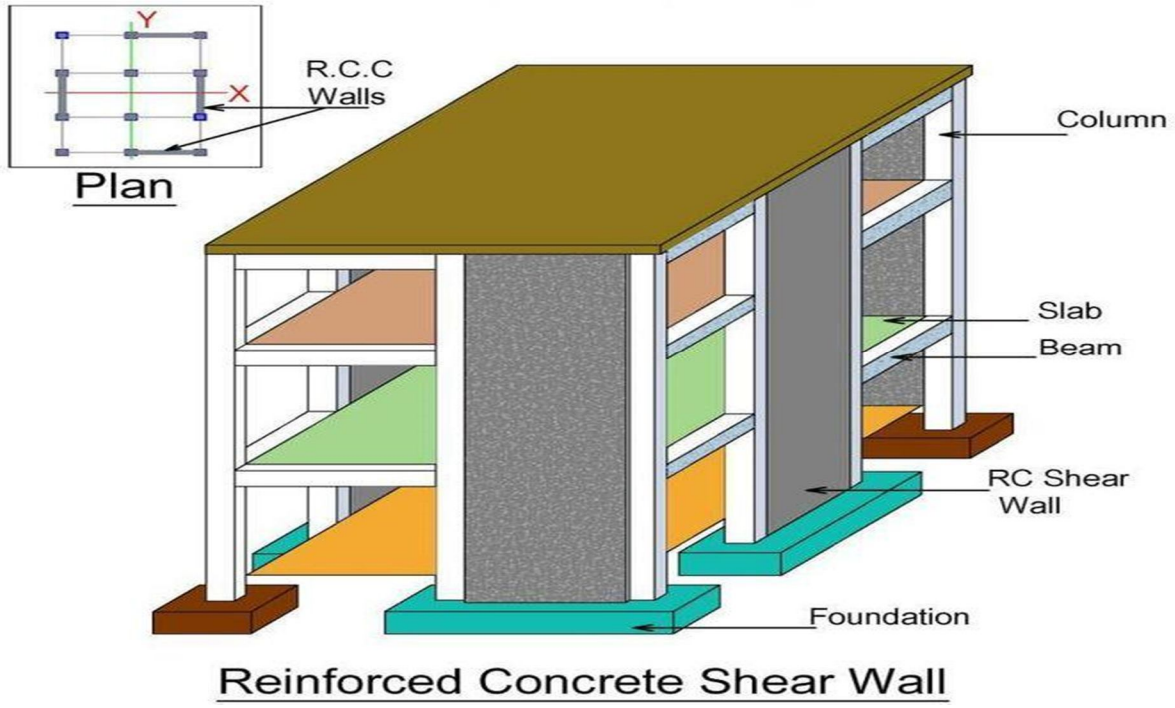
Analysis of Response Spectrum.

Equivalent Static Analysis.

• The design of reinforced concrete.

• Evaluation of storey reaction.

• Create reports.



Reinforced Concrete Shear Wall

SHEAR WALL TYPES & EFFICIENCY

Shear walls can be classified as load-bearing or non-load-bearing, depending on whether they carry gravity loads also in addition to lateral load. They can be classified based on the type of masonry and construction used, for example, brick or concrete, reinforced and unreinforced, single or multiple wythe, single story or multi-storey, solid or perforated, rectangular or flanged, cantilever or coupled, etc. Most commonly used shear walls have rectangular or flanged configuration. Several types of shear walls are shown in Fig. 1.

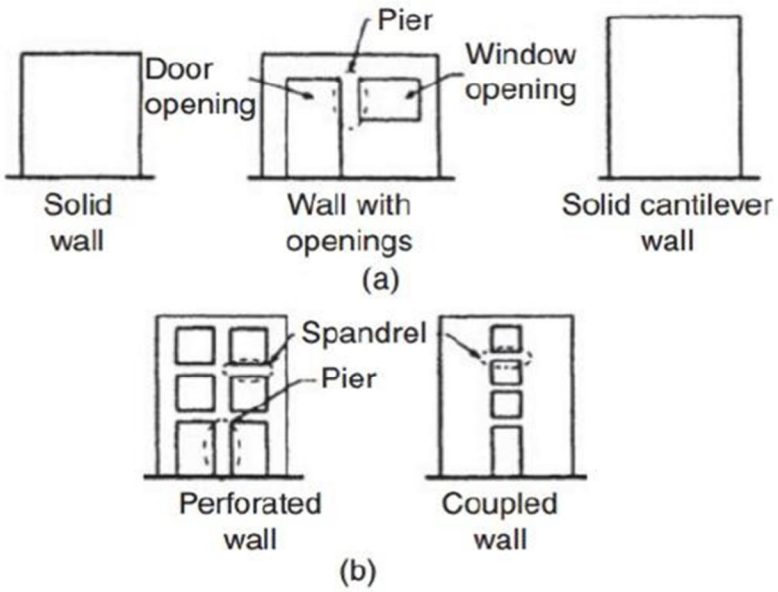
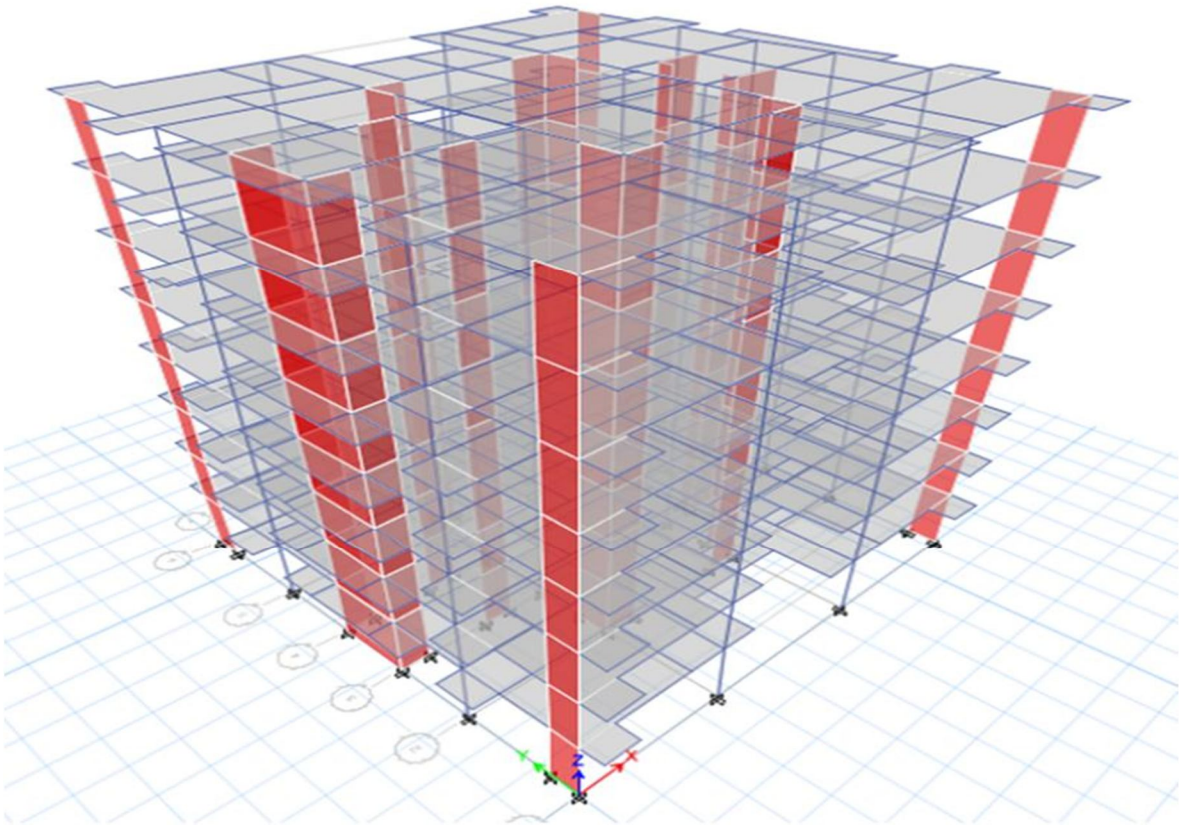


Fig. 1: Types of shear wall, (a) single storey, (b) Multi-storey

Efficiency of shear walls is described in terms of rigidity (or stiffness). Solid shear walls are most efficient so it is highly desirable. Often openings are required in shear walls for functional necessity (e.g., doors and windows);

III. INTRODUCTION

This chapter explains the approach used to analyze and design shear walls in a multi-story reinforced concrete structure using ETABS. Building geometry, material characteristics, structural elements, loading circumstances, seismic analysis techniques, and design approach are all included. In accordance with the relevant Indian Standards, the building is modeled as a three-dimensional reinforced concrete structure and examined under gravity and seismic stresses. This methodology's goal is to assess how various shear wall layouts affect the building's seismic performance.



A. Building Description

For seismic investigation, a residential structure made of reinforced concrete is chosen. A typical multi-story structure situated in an earthquake-prone area is represented by the structural arrangement.

Building Specifications

Parameter	Value
Building Type	Reinforced Concrete Residential Building
Number of Floors	G + 15
Total Height	48 m
Storey Height	3.0 m
Bay Spacing	5 m
Bays	5 × 5
Structural System	RC Moment Resisting Frame with Shear Walls
Concrete Grade	M30
Steel Grade	Fe500

B. Shear Wall Configuration

The impact of various shear wall configurations on the structural response is assessed.
Model 1: A structure without a shear wall.
Model 2 Shear walls are positioned at the corners of the structure.
Model 3: The lift core is surrounded by shear walls.
Corner and core shear walls combined in Model 4.
The best configuration for enhancing earthquake resistance may be found by comparing these models.

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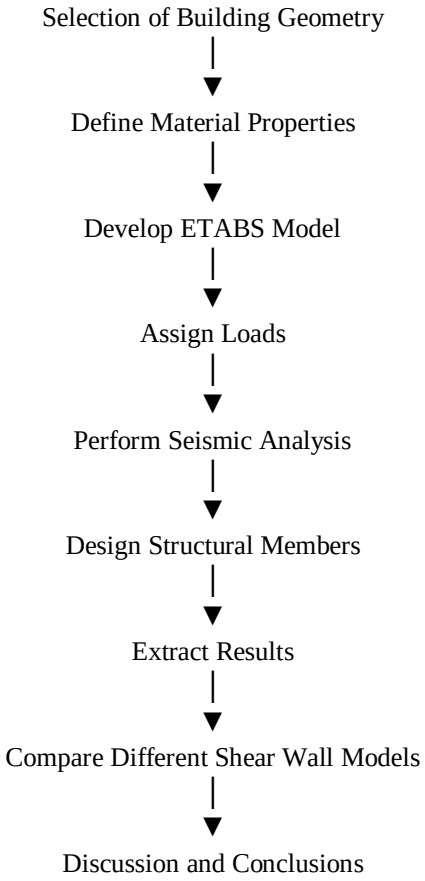
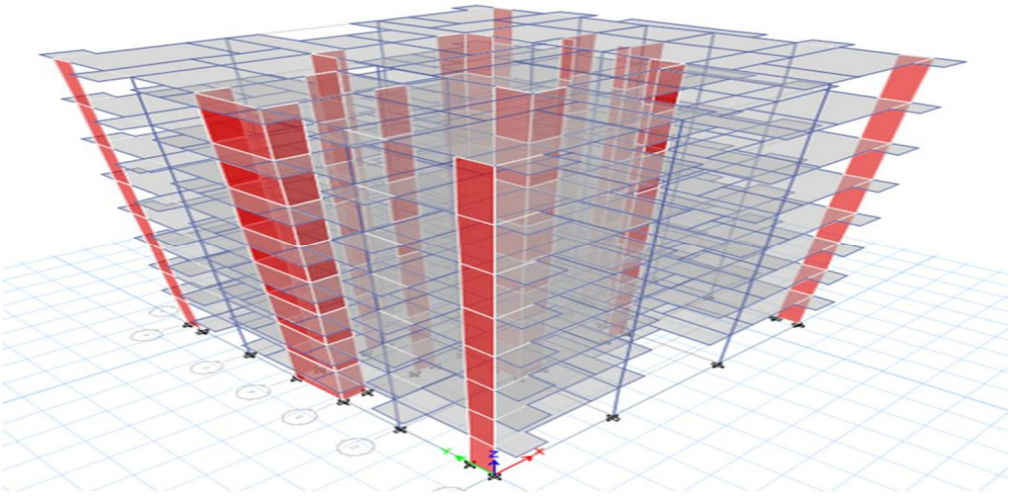
C. Flow Chart of Methodology

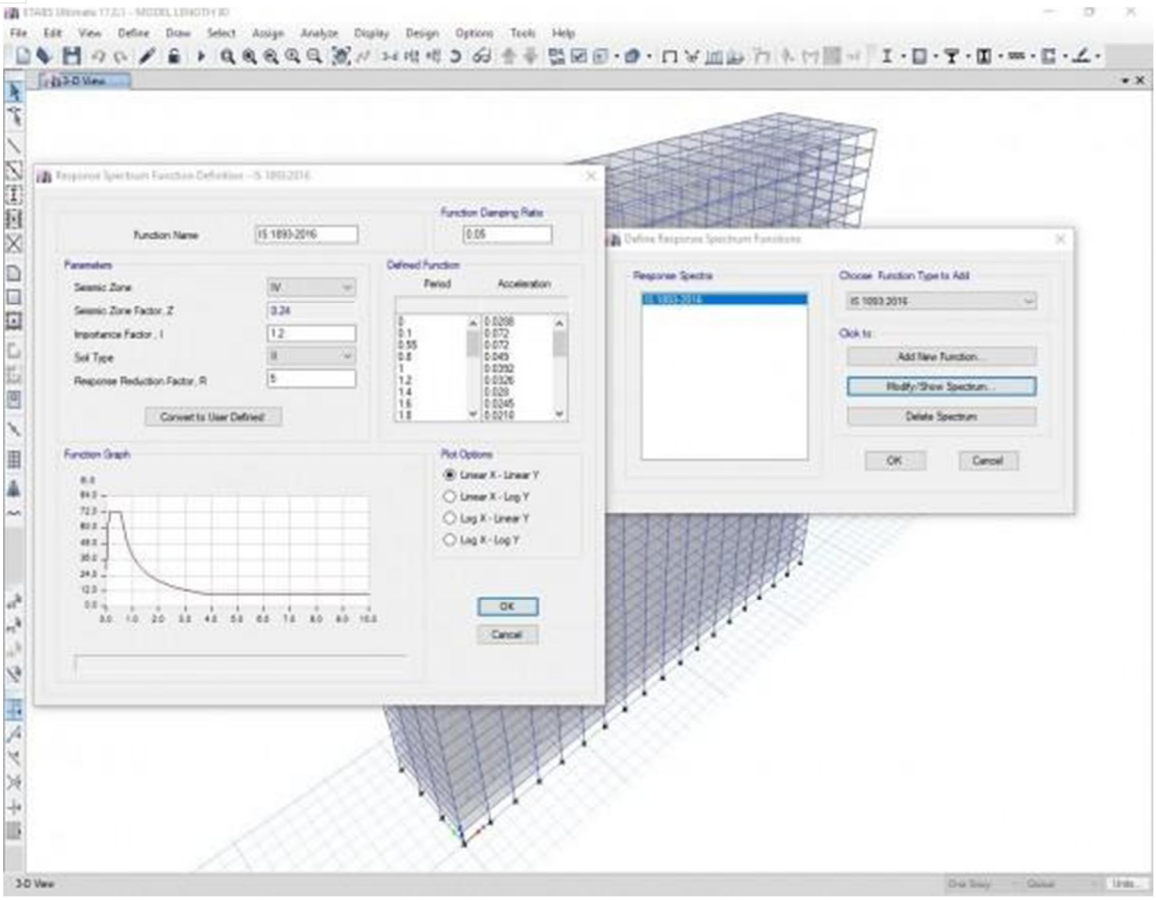


IV. INTRODUCTION

This chapter describes the modeling, analysis, and design process used to assess a multi-story reinforced concrete building's seismic performance using ETABS. By specifying the building geometry, material characteristics, member sections, and loading conditions, a three-dimensional structural model is produced. The usefulness of shear walls in enhancing structural performance is examined by analyzing the structure under earthquake and gravity loads.

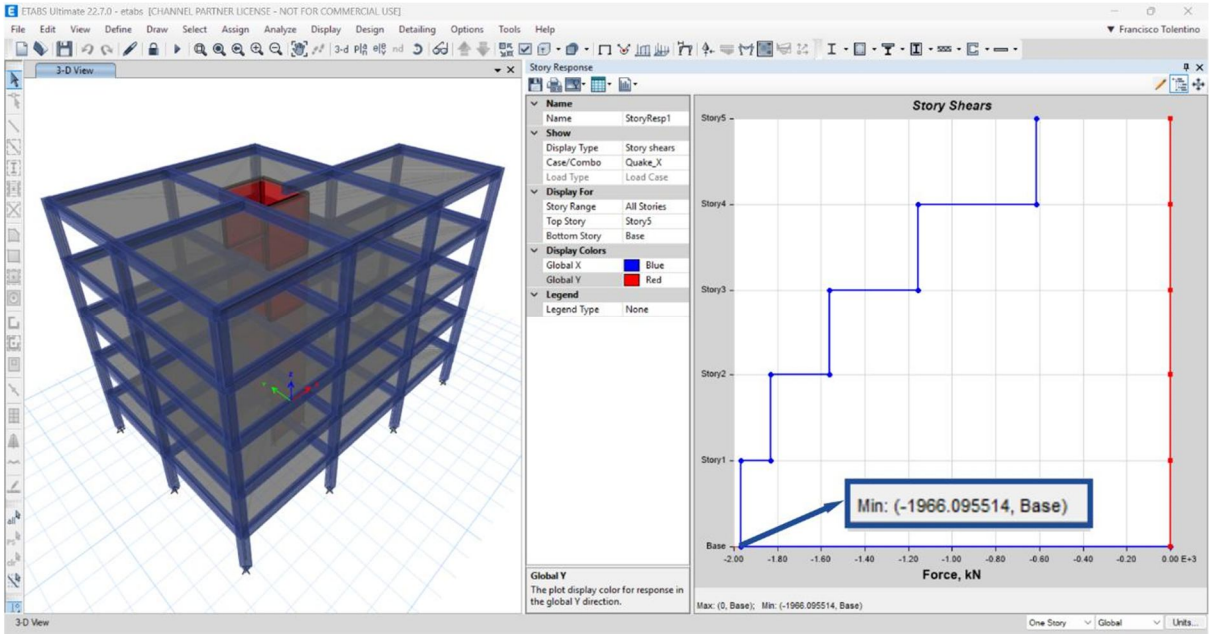
The impact of various shear wall configurations on key seismic response characteristics, including base shear, storey stiffness, storey displacement, storey drift, and natural time period, is examined. The most effective shear wall arrangement is determined by comparing the structural behavior of each model using the ETABS data.





V. INTRODUCTION

The findings of the seismic analysis of the multi-story reinforced concrete structure constructed in ETABS are presented in this chapter. To ascertain how well various shear wall layouts withstand seismic stresses, their structural reactions are assessed and contrasted. The comparison is based on factors including base shear, storey stiffness, storey drift, storey displacement, and natural time period. The findings make it evident how shear walls affect the building's seismic performance.



VI. CONCLUSIONS AND FUTURE SCOPE

A. Introduction

The results of the study on the analysis and design of reinforced concrete shear walls for earthquake-resistant buildings using ETABS are summarized in this chapter. The impact of shear walls on the seismic response of a multi-story building has been assessed based on the analytical results, and the conclusions offer helpful guidance for choosing appropriate shear wall arrangements to enhance structural safety and performance in seismic regions.

B. Summary of the Study

The study examined the seismic behavior of a multi-story reinforced concrete structure with various shear wall layouts. By specifying the building's shape, material characteristics, structural components, and loading circumstances, a three-dimensional model was created in ETABS. The relevant Indian Standards were followed for applying dead loads, live loads, and earthquake loads.

ETABS seismic analysis techniques were used to evaluate the building's structural reaction. Storey displacement, storey drift, base shear, storey stiffness, and natural time period were among the important response characteristics that were assessed and contrasted. The investigation showed how crucial shear walls are to enhancing reinforced concrete buildings' ability to withstand lateral loads.

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The references listed below are appropriate for an M.Tech project titled "Analysis and Design of Shear Walls for Earthquake-Resistant Buildings Using ETABS." Use the citation style (APA, IEEE, or another defined format) that your university requires.

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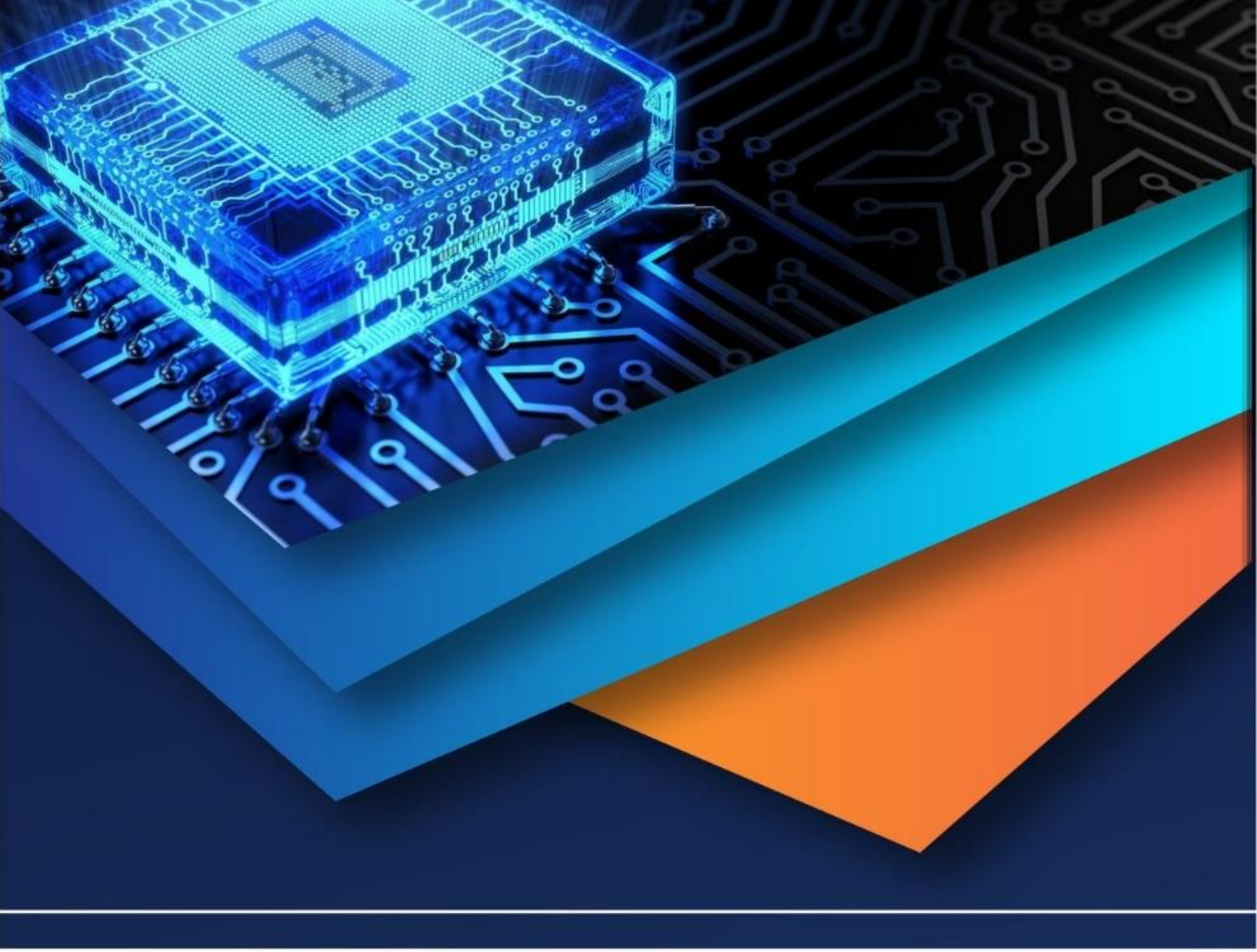

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