A
Project report on

# SEISMIC ANALYSIS OF MULTI STOREY RESIDENTIAL BUILDING (G+5) WITH AND WITHOUT FLOATING COLUMN USING ETABS

Submitted in partial fulfillment of the requirements
for the award of degree of

**BACHELOR OF TECHNOLOGY**
**IN**
**CIVIL ENGINEERING**

*Submitted by*


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(Approved by AICTE, New Delhi & Permanent Affiliation to JNTUA, Anantapuramu. Three B. Tech Programmes (CSE, ECE & CE) are accredited by NBA, New Delhi. Accredited by NAAC with 'A' Grade, Bangalore. Accredited by Institution of Engineers (India), KOLKATA. A-grade awarded by AP Knowledge Mission. Recognized under sections 2(f)& 12(B) of UGC Act 1956.)
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**2023-2024**

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# ***CERTIFICATE***

*This is to certify that the project work entitled,* **"SEISMIC ANALYSIS OF MULTI STOREY RESIDENTIAL BUILDING (G+5) WITH AND WITHOUT FLOATING COLUMN USING ETABS",** done by

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*is being submitted in partial fulfillment of the requirements for the award of the degree of* ***BACHELOR OF TECHNOLOGY*** *in* ***CIVIL ENGINEERING*** *to Annamacharya Institute of Technology and Sciences, Tirupati, is a record of bonafide work carried out by them under my guidance and supervision.*

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# ACKNOWLEDGEMENT

It is our insightful duty and pleasure to express our gratitude to all those who helped us in completion of this work successfully.

We would like to express our sincere gratitude to our supervisor **Ila Vamsikrishna,** Assistant professor, Civil Engineering, AITS, Tirupati, for his constant help, kind co-operation and encouragement in completing the work successfully. We are thankful for his careful verification of the manuscript in spite of his busy schedule.

It is our privilege to record our deep indebtedness to **Mr. A. Anil**, HOD, Department of Civil Engineering, AITS, Tirupati for his valuable guidance and constant cooperation throughout this work.

We are very much thankful to all the Internal Departmental Committee members for their valuable suggestions in all reviews and letting our work to go smoothly. We are thankful to all our B.Tech colleagues for their co-operation and faculty members, Lab Technicians for their support in completion of our work.

It is our pleasure to express sincere thanks to **Prof. C. Nadhamuni Reddy,** Principal, Annamacharya Institute of technology and Sciences, Tirupati and **Sri. C. Gangi Reddy,** Hon Secretary of Annamacharya Educational Trust for providing good infrastructure and facilities in our college.

Last but not least we feel more responsible to express our sincere thanks friends and family members for their moral support, time without which the successful completion of the work would not have been possible.

# ABSTRACT

This project investigates the seismic performance of multi-story buildings with and without floating columns. We employed analytical studies to assess their structural behavior. Our findings indicate that buildings with floating columns experience lower base shear but greater story displacement, particularly when placed at corners on the ground floor. Comparative analysis demonstrates that buildings with floating columns exhibit greater story drift, displacement, and base shear compared to those without. The most significant story drift occurs at the 3rd and 4th levels. Our research suggests that placing floating columns in the interior of the building reduces seismic vulnerability. Moreover, increasing column diameter effectively minimizes displacement.

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# CHAPTER 1

# INTRODUCTION

## 1.1 GENERAL

A "floating column" can refer to a structural element in architecture and engineering. In construction, a floating column is a vertical member (typically made of steel or reinforced concrete) that is not continuous from the ground level to the topmost floor of a building. Instead, it is designed to span only certain levels, leaving some floors without direct vertical support from the ground.

The term "floating" encapsulates the primary purpose of these columns, allowing for controlled displacements during seismic events. The rationale behind this innovative design lies in its ability to enhance a building's seismic performance. Additionally, floating columns offer architects and designers the opportunity for creative expression in structural design. By strategically placing these columns, often at corners, they not only enhance seismic performance but also contribute to the aesthetic and architectural uniqueness of the building. In essence, the introduction of floating columns in modern construction represents a holistic approach, addressing seismic resilience, economic efficiency, and architectural innovation, thereby exemplifying the evolving landscape of structural engineering in response to the dynamic challenges of the built environment.

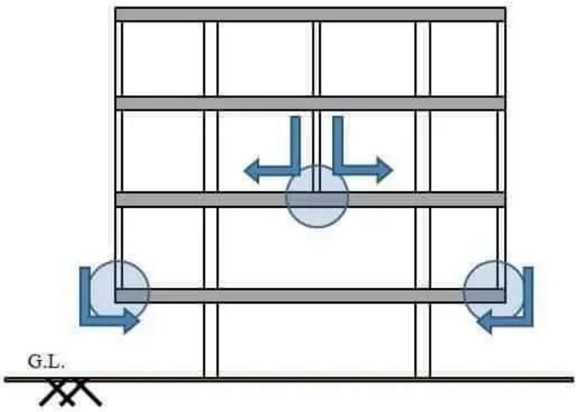



**Fig 1.1 Floating column**

The inclusion of floating columns, structural elements with limited support from the foundation, introduces an additional layer of complexity to the analysis. Floating columns can influence the building's response to seismic forces, impacting factors like lateral displacement and overall structural behaviour. By leveraging ETABS, a cutting-edge structural analysis tool, we aim to assess the dynamic interaction between the building and ground motion, considering the effects of floating columns on the structural response.

## 1.2 OBJECTIVES

- Conduct a detailed seismic analysis of a G+5 residential building using ETABS, assessing key parameters such as story drift, displacement, moment, and shear under seismic forces.
- Investigate and compare structural responses between configurations with and without floating columns, analysing the impact on story drift, displacement, moment, and shear distribution to identify variations in structural behaviour.
- Examine the role of floating columns in enhancing or mitigating seismic effects, evaluating their influence on overall stiffness, flexibility, and dynamic response of the building.
- Utilize analysis findings to optimize the structural design of the G+5 building for seismic resilience. Explore design modifications considering the benefits or challenges posed by floating columns, ensuring compliance with safety standards.

## 1.3 SCOPE OF PROJECT

This project aims to conduct a detailed seismic analysis of a G+5 residential building using ETABS, focusing on comparing structural responses with and without floating columns. Key parameters, including story drift, displacement, moment, and shear, will be examined. The study will optimize the structural design by leveraging findings to enhance seismic resilience and contribute data-driven recommendations to seismic design guidelines, emphasizing the impact of floating columns on multi-story residential buildings.

## 1.4 RESPONSE SPECTRUM METHOD

To ensure the effective analysis and design of structures for seismic activity at a particular site, having access to the actual time history record is essential. However, obtaining such records for every location is impractical. Moreover, relying solely on the peak ground acceleration value is inadequate because the structure's response is influenced by both the frequency content of ground motion and its own dynamic properties. To address these issues, the earthquake response spectrum has emerged as the predominant tool in seismic analysis. By calculating maximum values in each spectrum, the response spectrum method provides computational advantages in predicting displacements and member forces within structural systems.

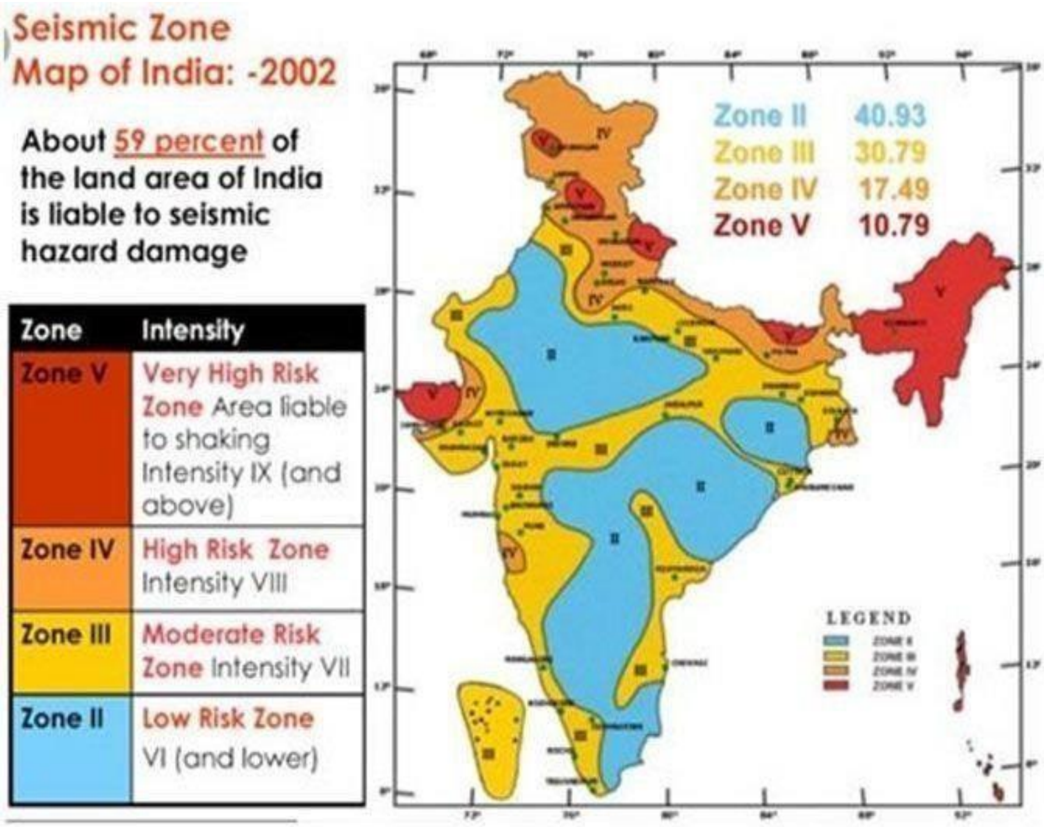



**Fig 1.2 Seismic zones in India**

## 1.5 BASIC DEFINITIONS

**a) Story:**

In the construction of multi-story or residential buildings, the term "story" refers to each level or floor of the building. It's characterized by the presence of a floor-to-floor gap, distinguishing one level from another. *

**b) Story shear:**

Story shear is a crucial concept in structural engineering, especially in seismic analysis. When a lateral load, such as wind or seismic force, acts upon a building, it generates forces that are distributed not only at the base but also along the height of the structure.

**c) Story Displacement:**

Story displacement is the deflection of a single story relative to the base or ground level of the structure. Intuitively, we can expect higher total displacement values as we move up the structure. So, a graph showing the story displacement vs. the height of the structure looks exactly like the deflected shape.

# CHAPTER 2

# LITERATURE REVIEW

Material studies explore compatibility with construction materials, considering factors like durability and cost-effectiveness. The multidisciplinary literature encompasses numerical modelling, case studies, code compliance, and environmental considerations, collectively offering valuable insights for future research and practical implementation in construction projects. Some of the research work conducted by earlier researchers on floating columns has been described below.

**Lallawmkimi; Pankaj Kumar (2023)** has examined the effect of floating column in high rise buildings. They concluded that "Buildings with floating columns pose higher seismic risks due to increased displacements, particularly in corner placements. Economically, floating column constructions are found to be less viable than regular buildings, with higher steel and concrete usage. Triangular plates and bracing are identified as effective strategies to minimize displacement and enhance structural stability in floating column structures."

**Teena Tara Tom; Meenu Madhu; V.P Akhil; and Richu Varghese Renji (2022)** has presented a paper on seismic analysis of a multi-storyed building with floating column using ETABS. They finalised that "Introduction of floating columns reduces base shear by 51.38% compared to buildings with infill walls, offering technical and functional advantages. Despite a 12.5% increase in story displacements, floating column buildings provide extra space for parking or entrance corridors. They are safe under gravity loads and designed exclusively for those loads."

**Neha Pawar; Dr. Kuldeep Dabhekar; Prof. Prakash Patil; Dr.IshaKhedikar; Dr. Santosh Jaju (2021)** has studied the effect of floating columns on buildings subjected to seismic forces. They found that "The structural behaviour of buildings with floating columns under various stiffness irregularities. Interior placement of floating columns reduces seismic hazard compared to outer periphery placement. Increasing column diameter reduces displacement, but taller upper stories increase overturning moments. Incorporating floating columns addresses both architectural and structural needs by providing more space with fewer obstructions."

**Mr. Bhavani Shankar; Mr. Dheekshith K; Mr. Sreedarshan P V(2021)** has investigated the study of floating column on high rise building. They concluded that "Shear force and bending moment escalate with building height in standard column constructions. G+3 and G+7 structures exhibit notable discrepancies in shear force and bending moment. Introduction of floating central columns amplifies shear force and bending moment as the building rises. Various column configurations yield distinct effects on shear force and bending moment across different building heights."

**Sreadha A R; C. Pany (2020)** has examined the seismic study of multistory building using floating column. They concluded that “Structures with floating columns exhibit maximum displacement compared to those without. Displacement increases with higher storys, especially when floating columns are shifted upwards. Buildings lacking floating columns demonstrate minimum story drift, while those with floating columns experience maximum drift. Base shear is minimal in structures without floating columns but reaches its peak in structures with floating columns.”

**Nagalakshmi D; Dr. R Balamurugan (2018)** has presented a paper onseismic analysis of a building with floating columns by ETABS. They finalized that “Lateral displacements are greater in floating column buildings, leading to reduced safety under lateral loads, while extreme story drift and increased story shear make them economically unfavorable compared to normal buildings, emphasizing the need for cautious consideration of floating column construction for specific functional needs.”

**Sasidhar T; P Sai Avinash; N Janardan (2017)** has studied the analysis of multi-storyed building with and without floating column using ETABS. They found that “The use of floating columns increases bending moment, shear, and steel requirements in buildings. However, they are not suitable for seismic zones where load paths can be disrupted by earthquakes, potentially leading to damage. Optimal placement of floating columns, ideally on the 2nd floor alternatively, minimizes the building's overall moment, shear, and steel requirements. While floating columns offer advantages in maximizing floor space index, they also pose risks and increase the vulnerability of the building.”

**BhukyaNagaraju, M Suneetha (2017)** has examined the design and analysis of G+12 with and without floating columns using ETABS. They concluded that “The dynamic behavior of multi-story buildings with and without floating columns is analyzed under different earthquake excitations using compatible time history and Electro earthquake data scaled to 0.2g PGA. Finite element models, validated through static and free vibration results, show that increasing ground floor column dimensions reduce maximum displacement and interstory drift values, affecting base shear and overturning moment. Comparison between ETABS and Perform-3D models reveals similar results, with effective period calculations closely aligned and slight differences in Non-Structural Performance (NSP) attributed to variations in rotational gage assignments.”

**IshaRohilla, S.M. Gupta, Babita Saini (2015)** has studied the seismic response of multi storied irregular building with floating column. They finalised that “Floating columns are discouraged in high-rise buildings in zone 5 due to their poor performance, as their presence leads to increased story displacement and drift, with displacement rising further under increased load on the floating columns. Despite a decrease in story shear, improving beam and column sizes can enhance building performance by reducing story displacement and drift, necessitating dimension increases in two consecutive floors for optimal results.”

**Sabari S, Mr. Praveen J.V (2015)** has examined the seismic analysis of multistory building with floating column. They concluded that “A study on multistory building behaviour under varying earthquake excitation was conducted, comparing structures with and without floating columns. Utilizing compatible time history and Bhuj earthquake data, static and free vibration results from a finite element code were validated. The dynamic analysis revealed that increasing column size dimensions effectively reduced maximum displacement and inter-story drift values, leading to the conclusion that larger columns enhance seismic performance in multistory buildings.”

# CHAPTER 3
# METHODOLOGY

## SOFTWARE USED

1. AutoCAD
2. ETABS

### 3.1 AutoCAD

AutoCAD, developed by Autodesk, stands as a cornerstone in the realm of Computer-Aided Design (CAD) software, empowering architects, engineers, and designers to create precise and detailed drawings. Its inception in 1982 marked a transformative moment in the way professionals approached drafting and design, transitioning from manual methods to a digital platform. AutoCAD has since evolved into a sophisticated and versatile software suite, offering a myriad of tools tailored to various industries.

#### 3.1.1 AutoCAD Preferences and Interface:

AutoCAD's interface is user-friendly, comprising a ribbon at the top, tool palettes on the sides, and a command line at the bottom. The software allows users to customize their workspace, adjusting the layout and tools to suit their preferences. This adaptability enhances efficiency, as professionals can streamline their workflow by organizing tools based on their frequency of use. Preferences also extend to drawing settings, where users can define units, precision, and other parameters to align with project requirements.

#### 3.1.2 Uses of AutoCAD in Architectural Design:

AutoCAD is integral in architectural design, particularly for creating 2D plans of various architectural elements. From ground floor layouts to intricate site plans and multistory structures, AutoCAD provides the tools needed to transform conceptual ideas into detailed, accurate drawings.

**Table 3.1 Building data**

| | |
|---|---|
| Building type | G+5 RC Building |
| Depth of foundation | 2.5 m |
| Height of each story | 3 m |
| Total height of the building | 17.5 m |
| Size of beam | 300 X 450 mm |
| | 300 X 500 mm |
| | 300 X 550 mm |
| Size of column | 300 X 450 mm |
| | 300 X 600 mm |
| | 450 X 450 mm |
| Slab | 150 mm |
| External wall thickness | 230 mm |
| Internal wall thickness | 150 mm |
| Height of parapet wall | 1.2 m |

**Table 3.2 Loads**

| **Type of load** | **Value** |
|---|---|
| External wall load | 12 kN/m |
| Internal wall load | 6 kN/m |
| Live load | 2 kN/m |
| Earthquake load | Based on IS 1893 - 2002 |
| Load combination | 1.2 (DL + LL + EQX) |

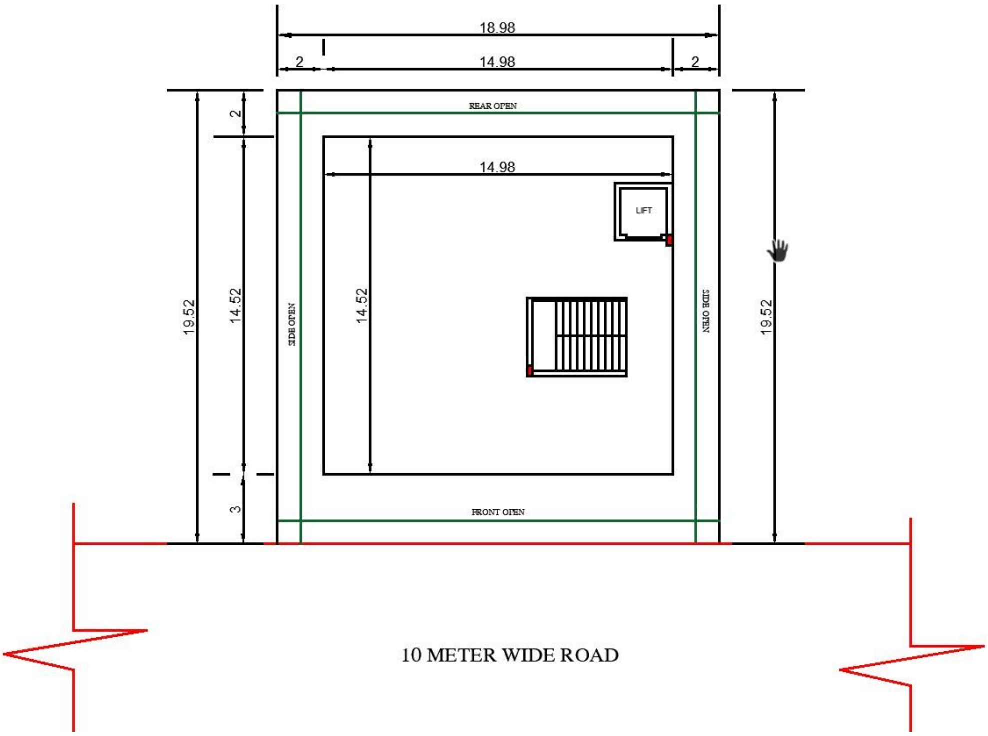



**Fig 3.1 Site plan**

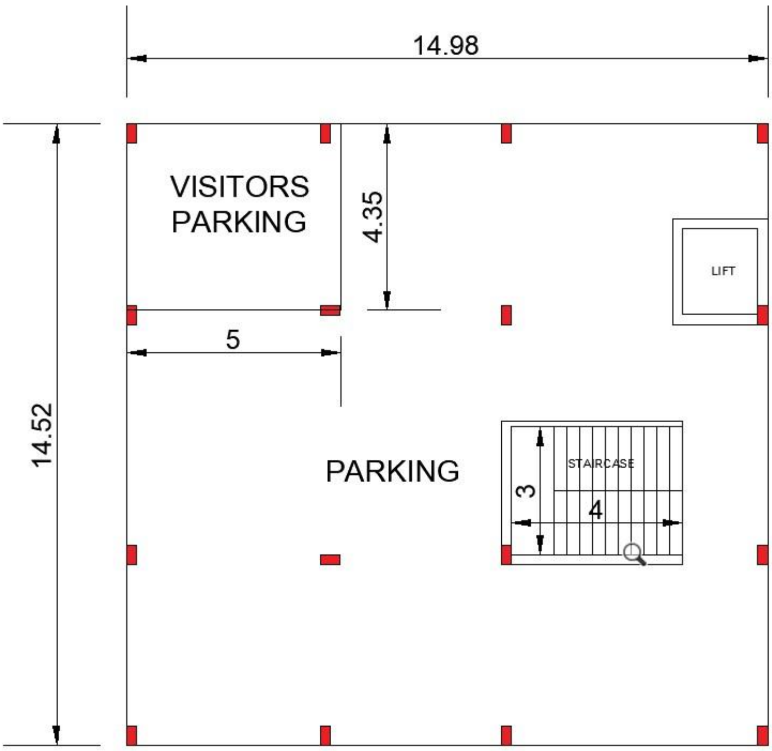



**Fig 3.2 Parking area plan**

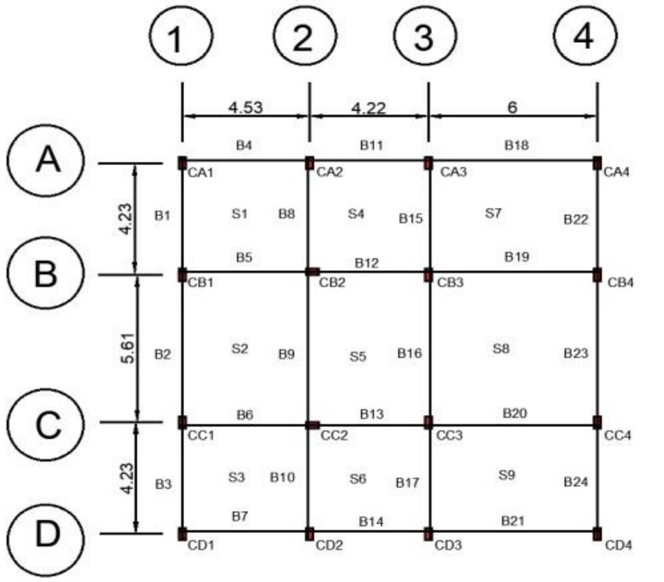



**Fig 3.3 Beam and Column layout**

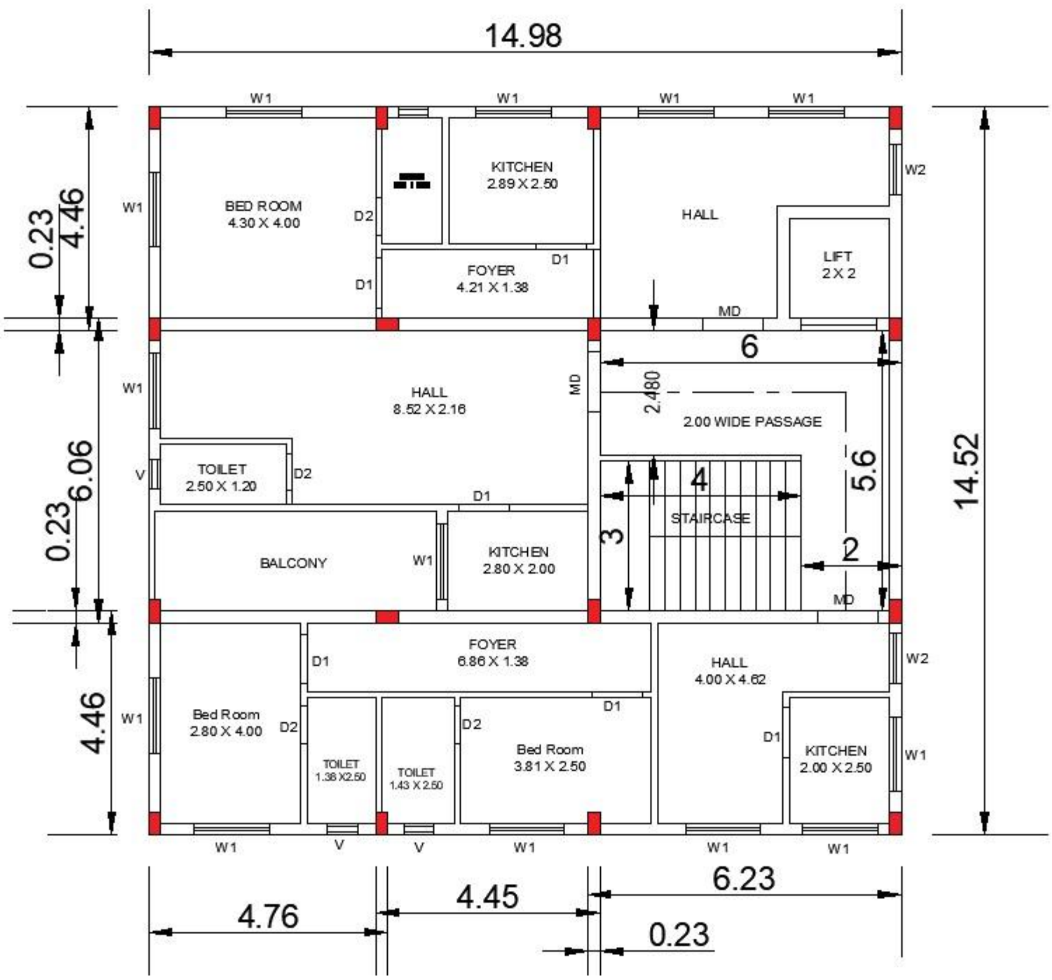



**Fig 3.4 Plan of 1st story to 5th story**

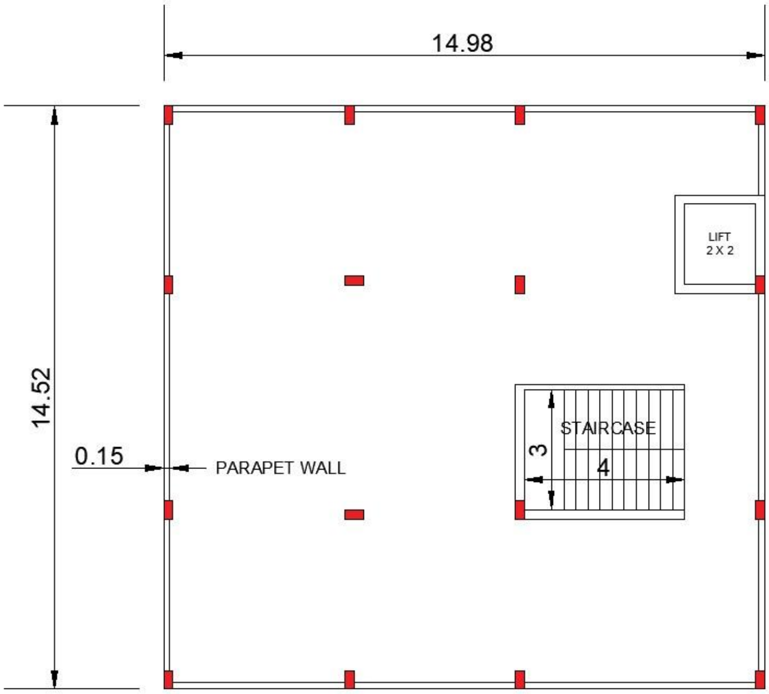



**Fig 3.5 Terrace plan**

## 3.2 ETABS

ETABS is a software program designed for structural engineers to analyse and design buildings. A key capability of ETABS is its ability to perform both static and dynamic analysis of structures.

### 3.2.1 STATIC ANALYSIS:

Static analysis simulates the behaviour of a building under constant loads, such as dead weight (the weight of the building itself) and live loads (occupancy and furniture). It calculates forces, deflections, and stresses in the building elements under these loads. This is typically sufficient for simpler structures or those in low seismic zones.

### 3.2.2 DYNAMIC ANALYSIS:

Dynamic analysis, on the other hand, considers how a building responds to time-varying loads, such as earthquakes or wind. It accounts for the inertia of the structure, its natural vibration modes, and how these factors influence the overall response.

### 3.2.3 MODELING OF STRUCTURE

Principle to ETABS displaying is that the speculation that superb ascent structures ordinarily contain indistinguishable or comparative floor designs that rehash inside the upward heading. Displaying highlights that smooth out scientific model age, and reproduce progressed seismic frameworks.

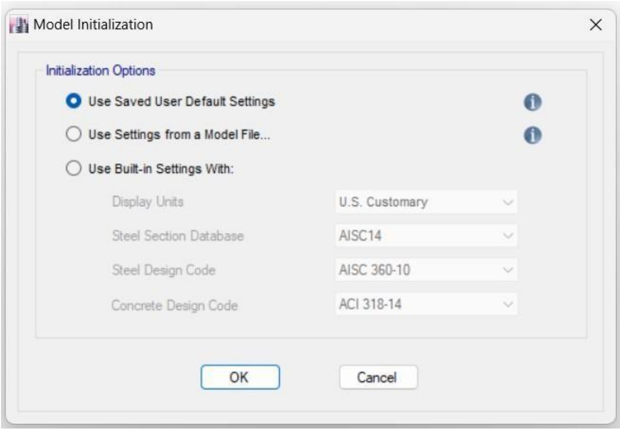



**Fig 3.6 Model Initialization**

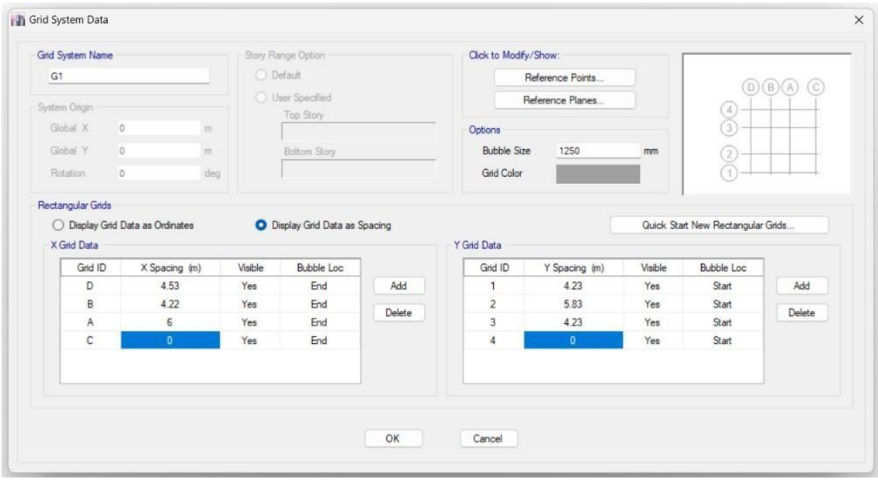



**Fig 3.7 Story data**

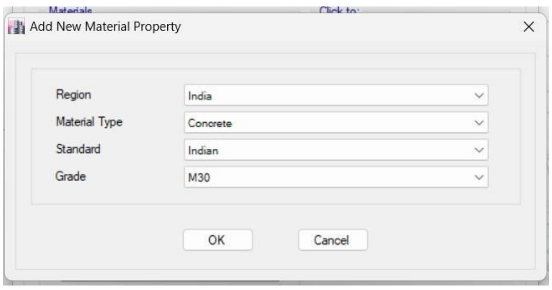



**Fig 3.8 Defining rebar and concrete properties**

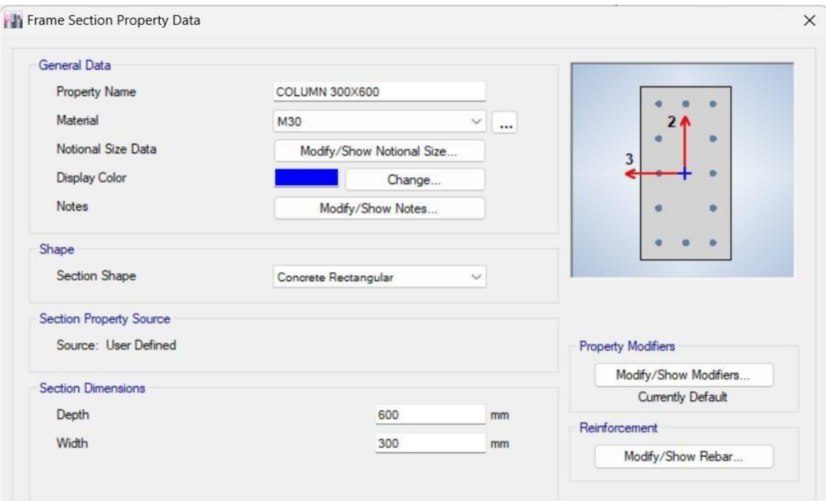



**Fig 3.9 Defining Column Properties**

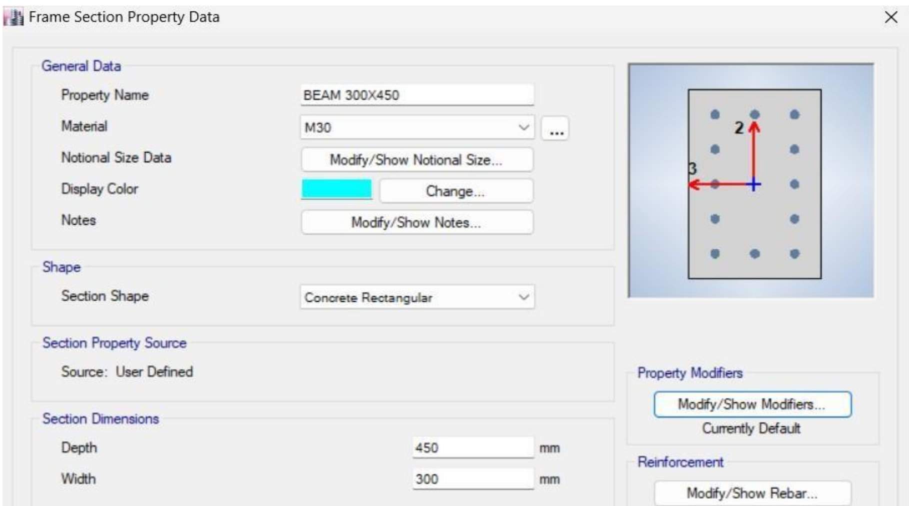



**Fig 3.10 Defining Beam properties**

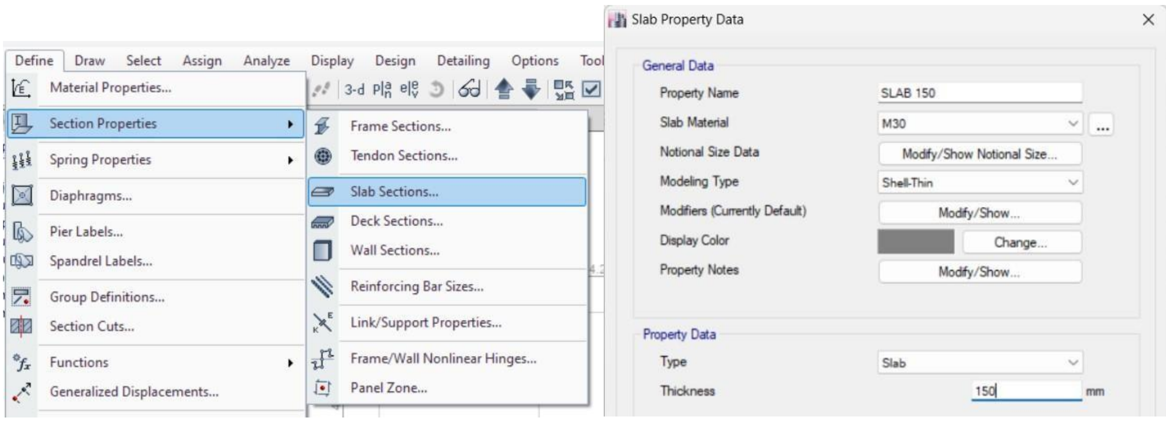



**Fig 3.11 Defining Slab properties**

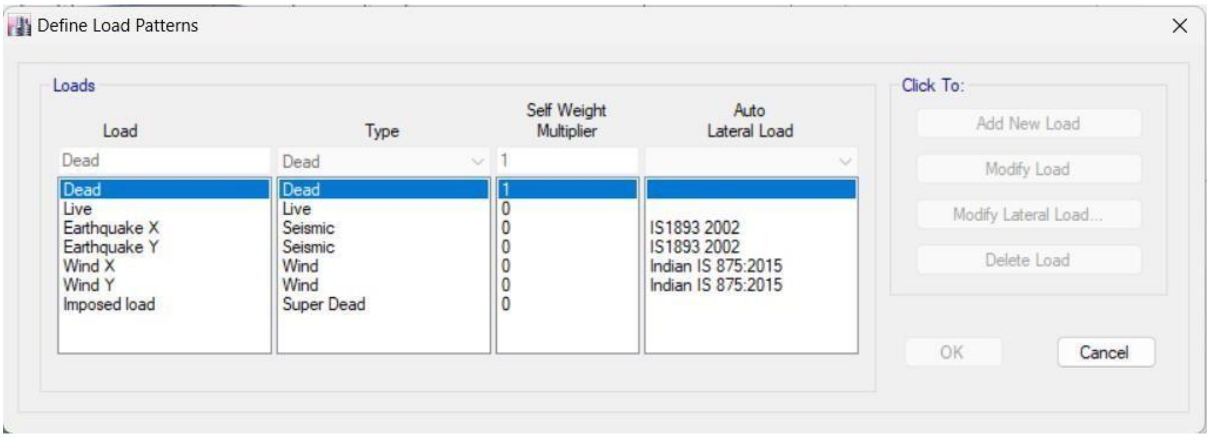



Fig 3.12 Load pattern definition

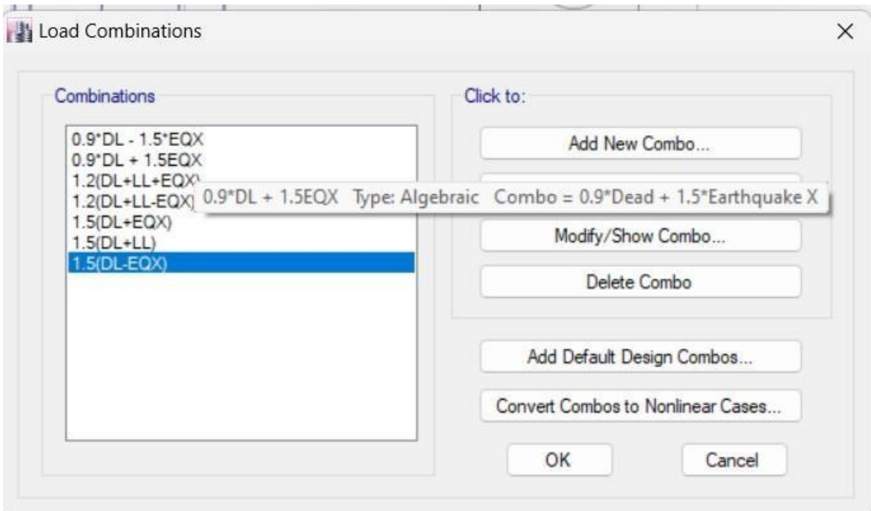



Fig 3.13 Load combination definition

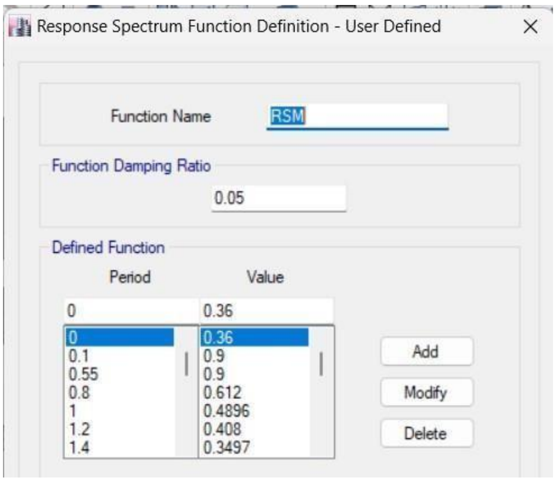



Fig 3.14 Defining Response Spectrum Function

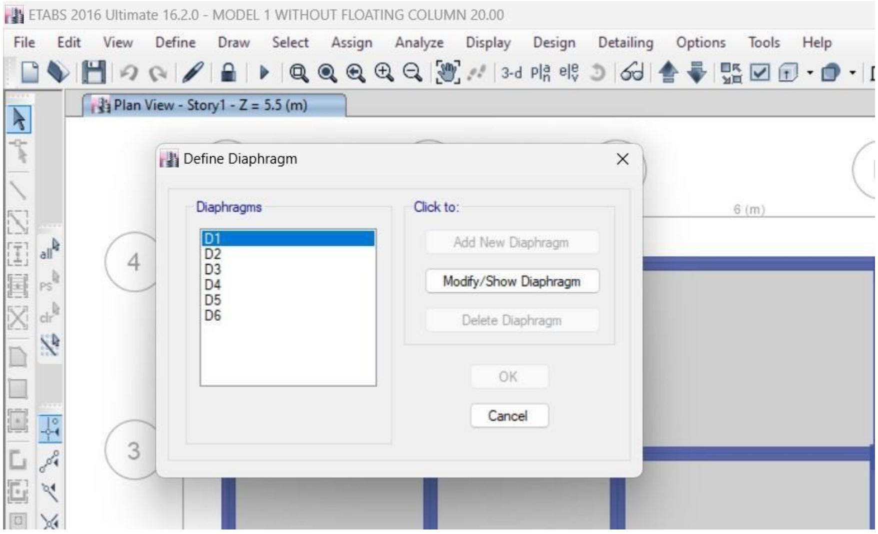



Fig 3.15 Defining Diaphragm

## 3.3 MODEL 1 – MULTI STORY BUILDING (G+5) WITHOUT FLOATING COLUMN

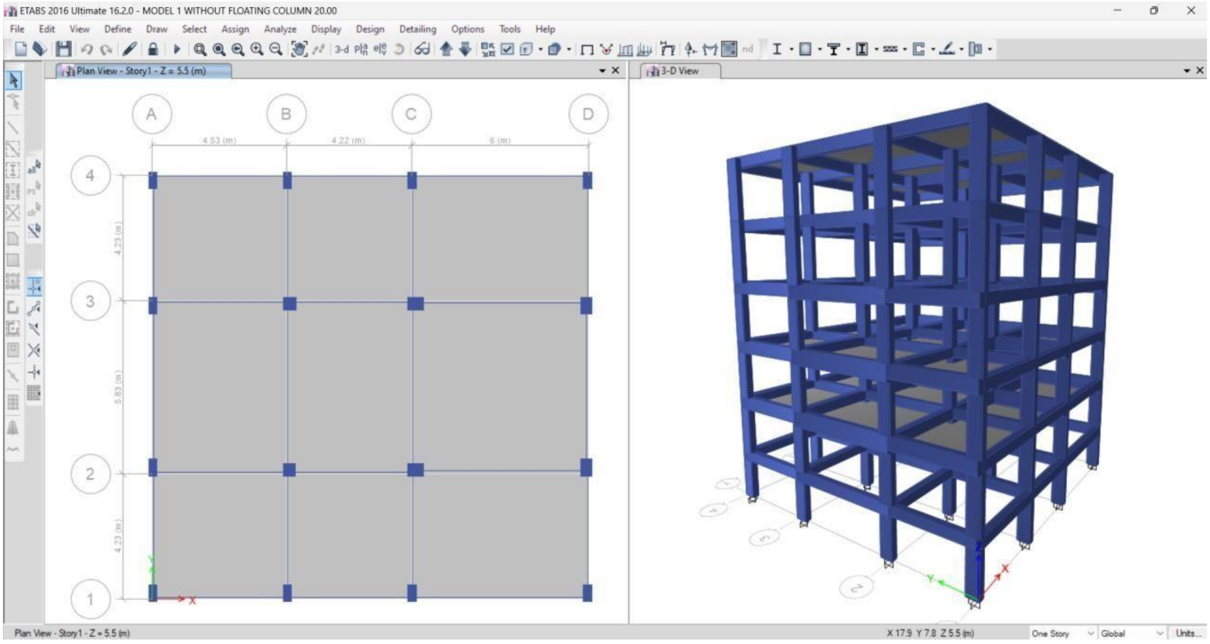



Fig 3.16 Model 1 – Plan & 3D view of Building without floating column

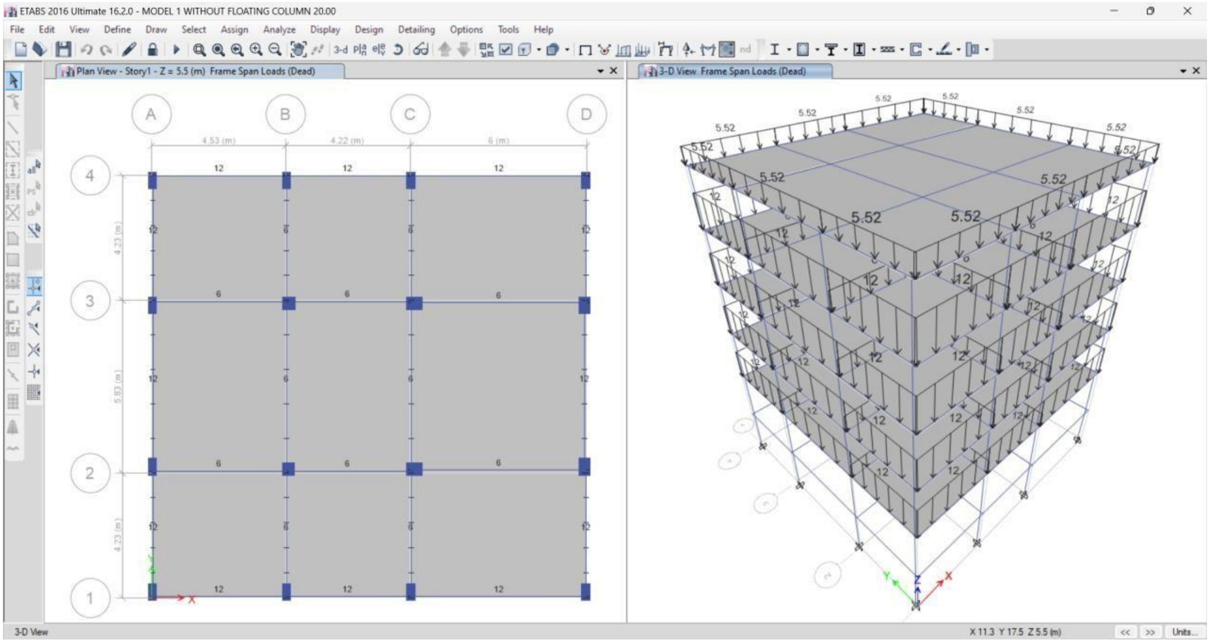



**Fig 3.17 Model 1 – Application of External & Internal Wall load on beams**

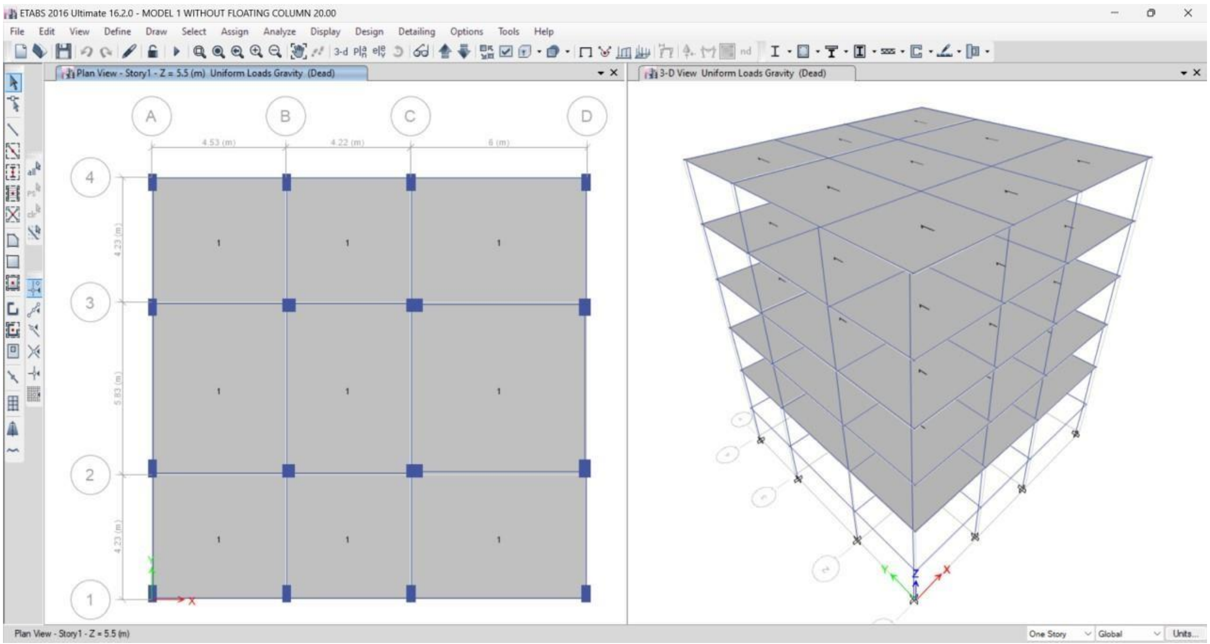



**Fig 3.18 Model 1 – Plan & 3D view of Application of Live load on slab**

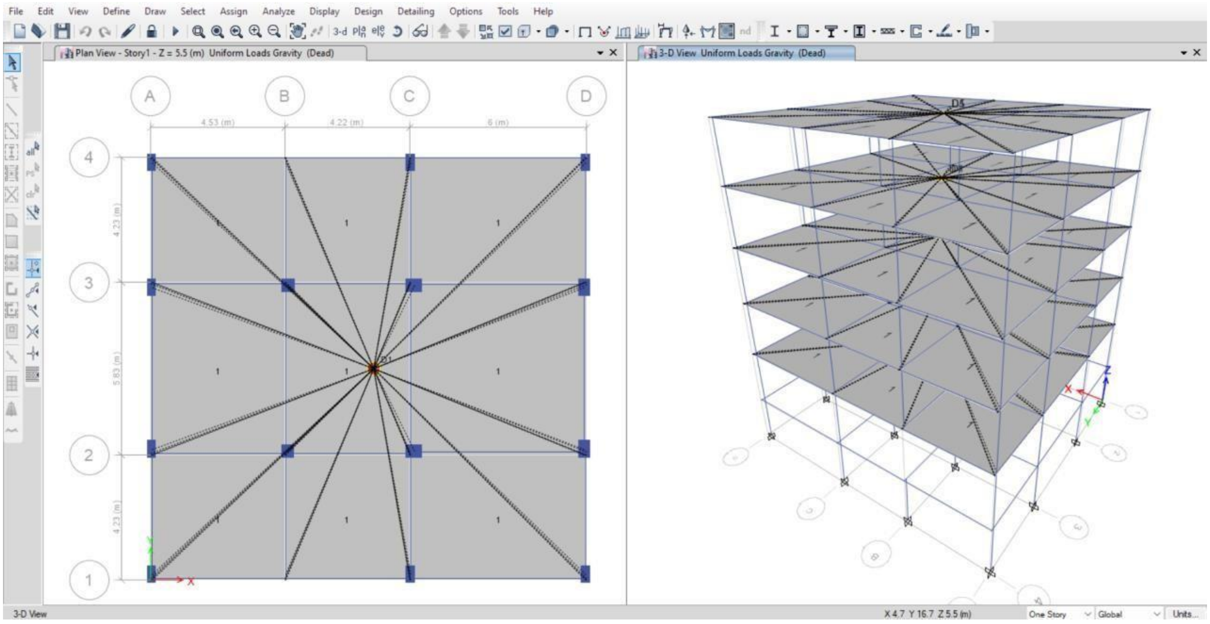



**Fig 3.19 Model 1 – Diaphragm application on each story**

## 3.4 MODEL 2 – MULTI STORY BUILDING (G+5) WITH EDGE FLOATING COLUMN FROM 1st STORY

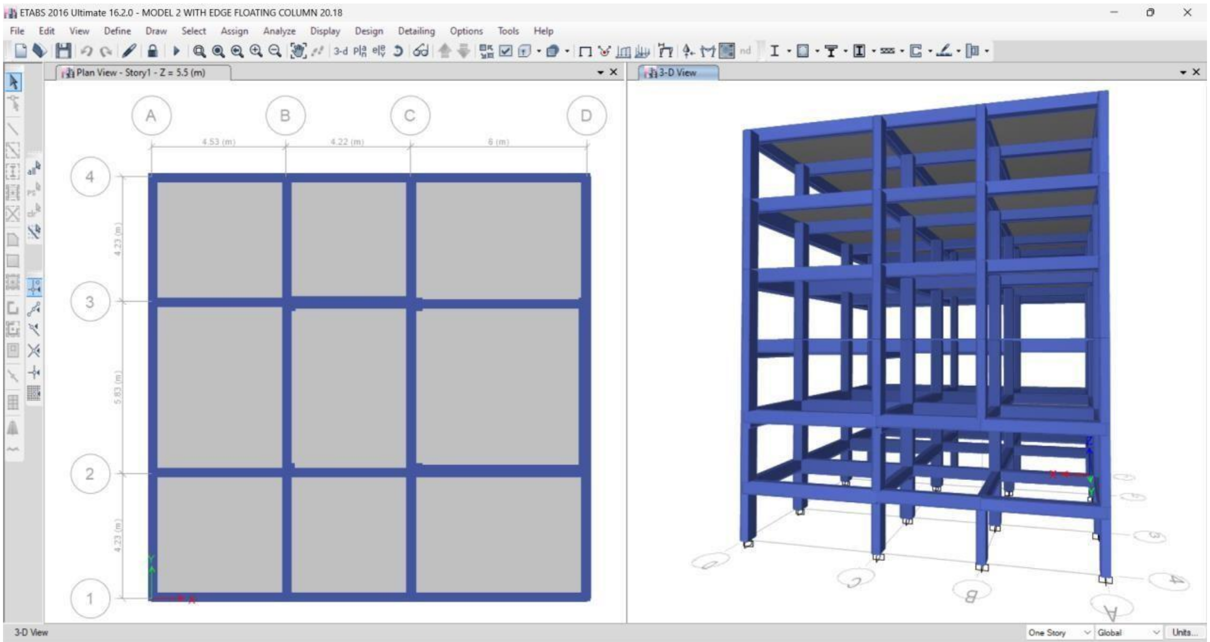



**Fig. 3.20 Model 2 – Plan & 3D view of Building with edge floating column from story 1**

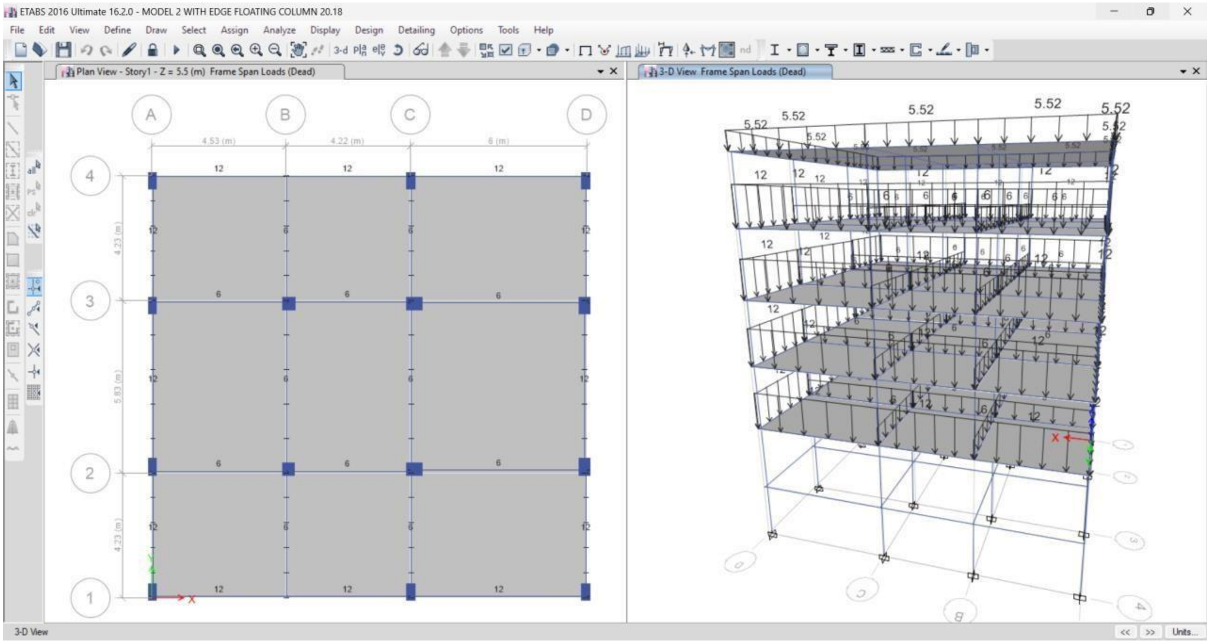


**Fig 3.21 Model 2 - Application of External & Internal Wall load on beam**

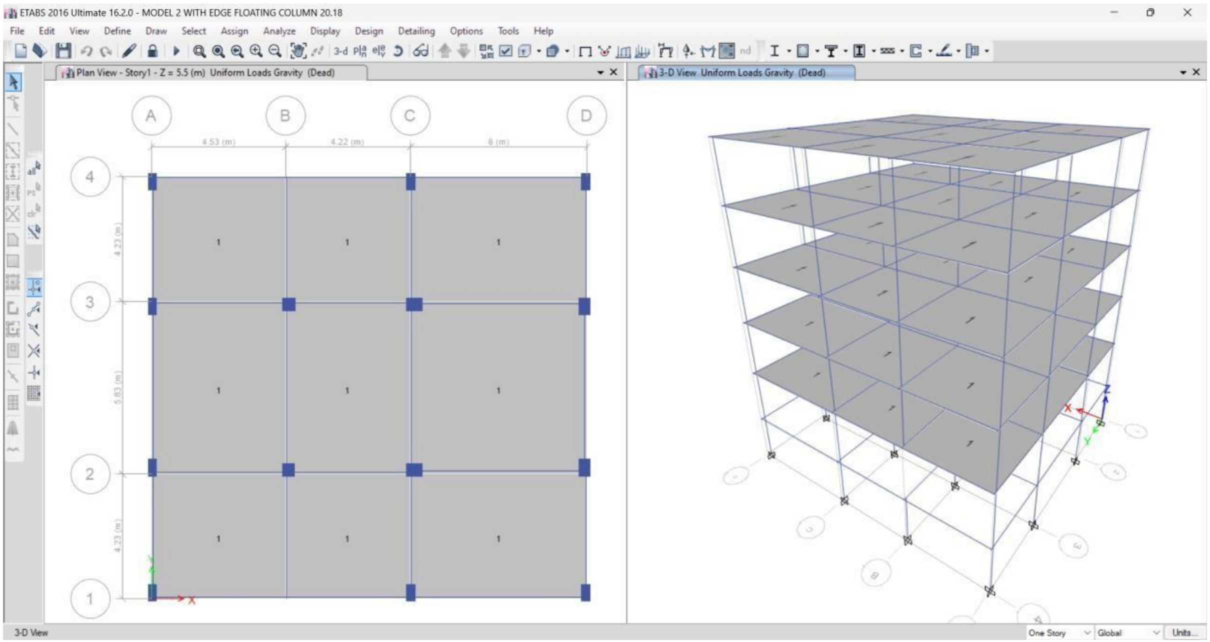


**Fig 3.22 Model 2 – Plan & 3D view of Application of Live load on slab**

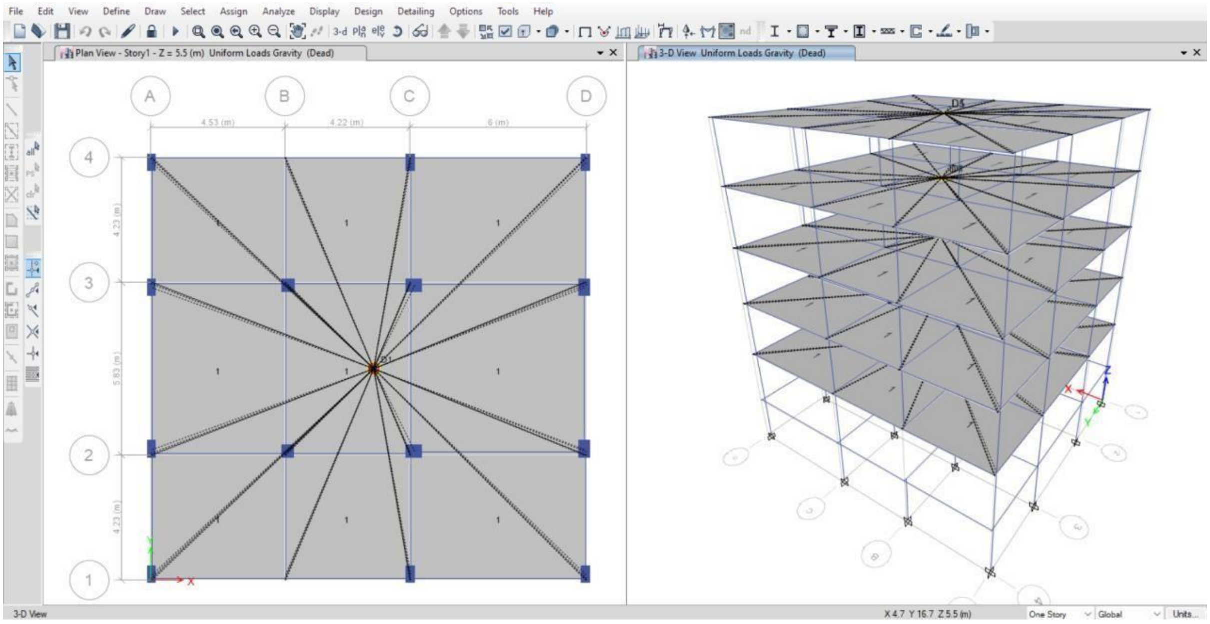



Fig 3.23 Model 2 – Diaphragm application on each story

## 3.5 MODEL 3 - MULTI STORY BUILDING(G+5) WITH CENTRE FLOATING COLUMN AT 4$^{TH}$ STORY

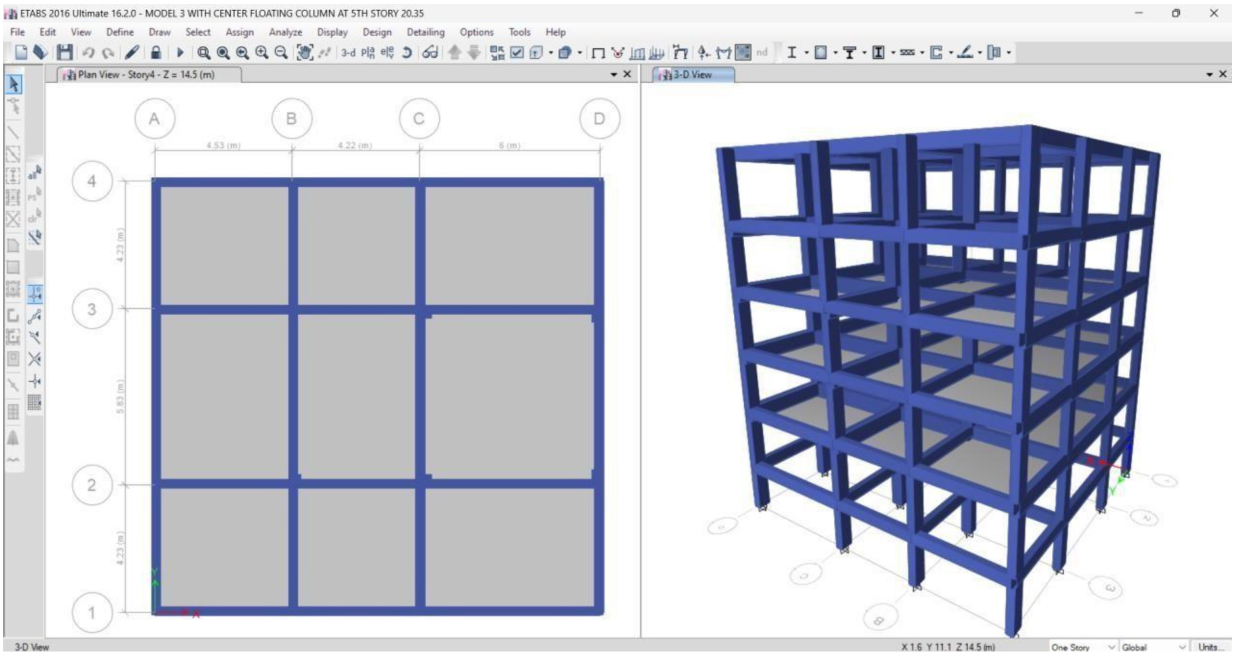



Fig 3.24 Model 3 – Plan & 3D view of Building with centre floating column at 4$^{th}$ story

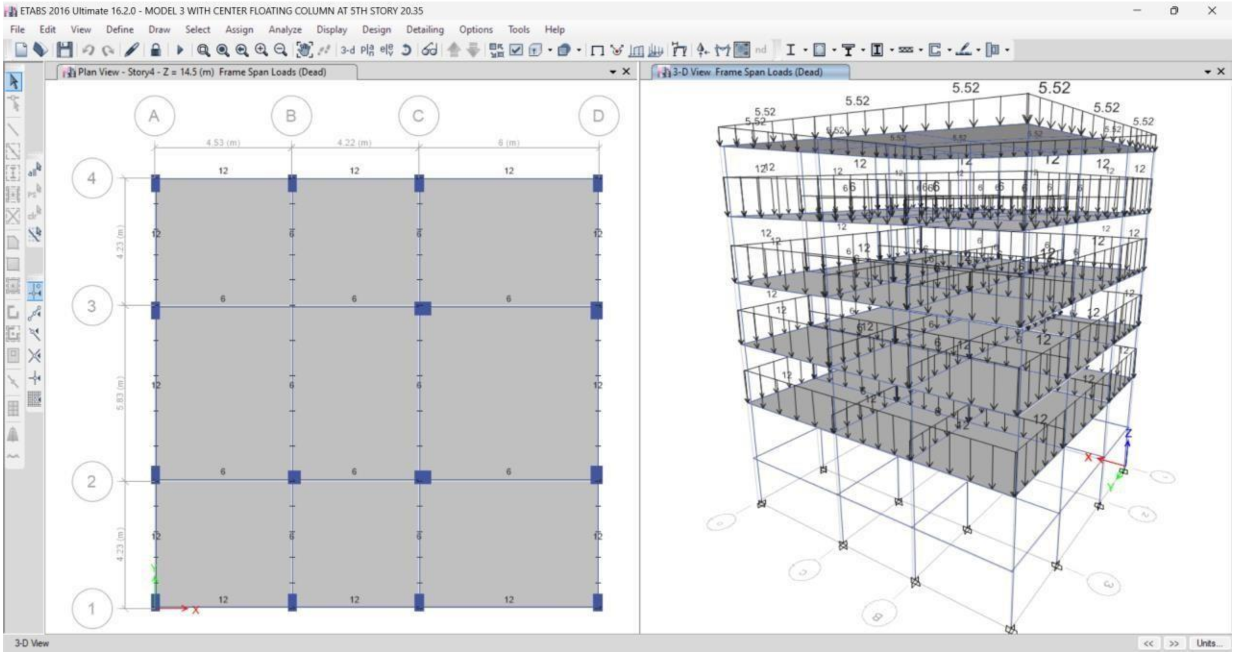



**Fig 3.25 Model 3 – Application of External & Internal Wall load on beams**

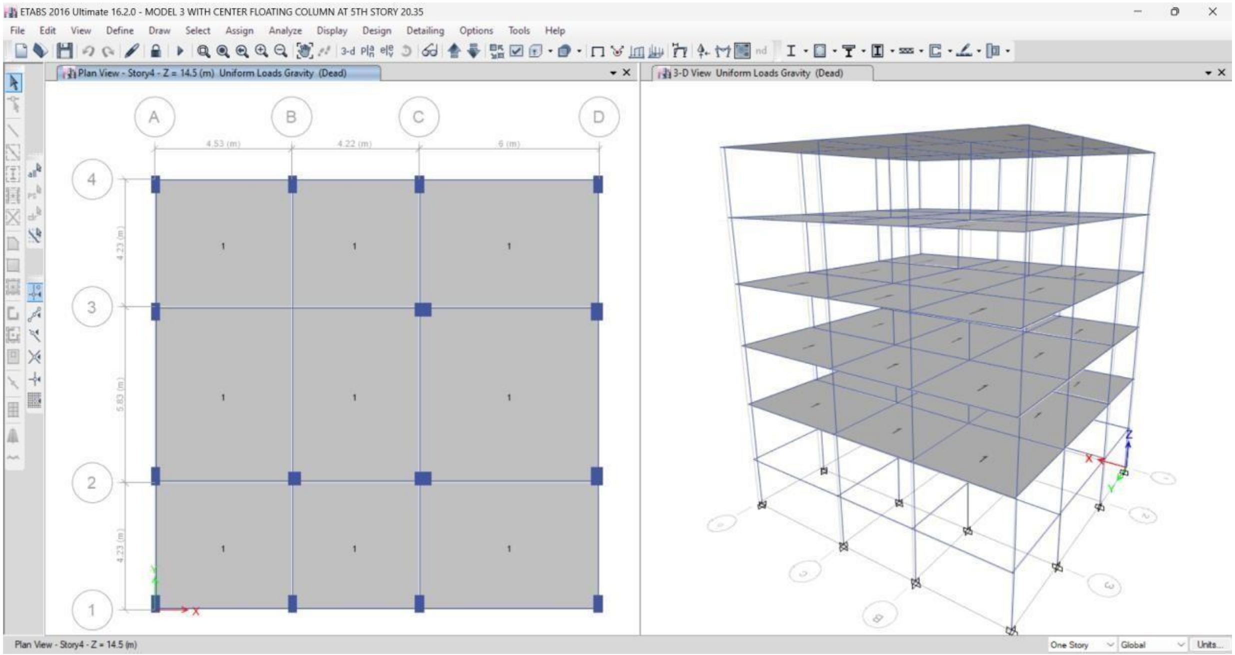



**Fig 3.26 Model 3 - Plan & 3D view of Application of Live load on slab**

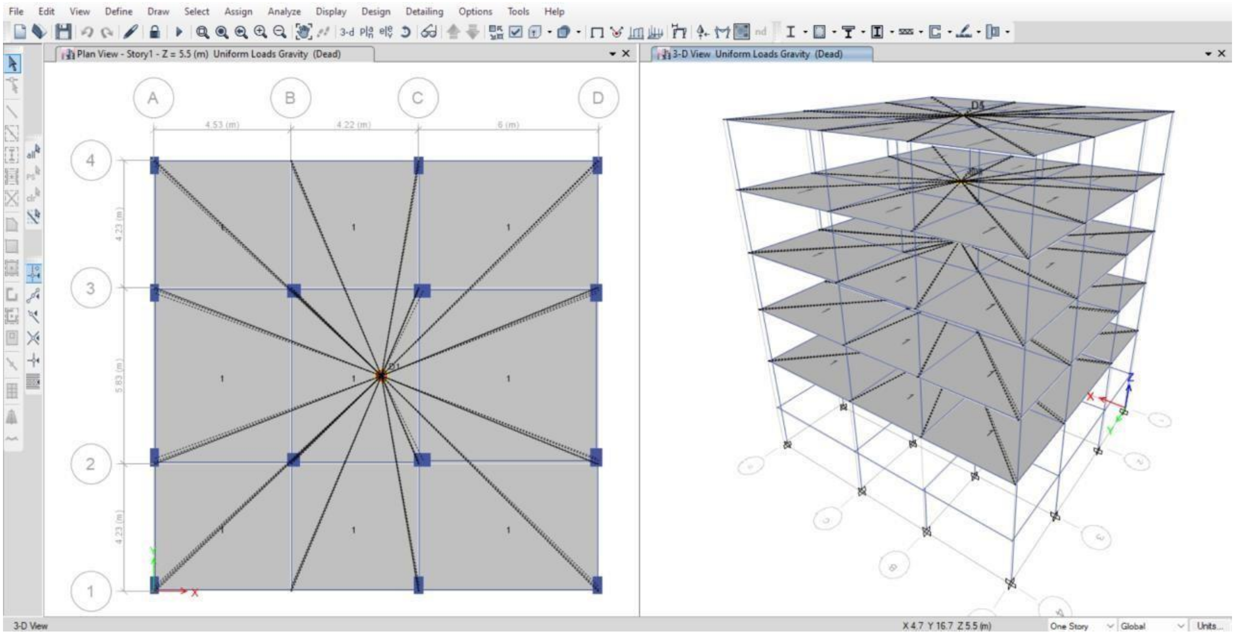


**Fig 3.27 Model 3 - Diaphragm application on each story**

## 3.6 TYPES OF LOADS

When demonstrating is finished, ETABS precisely creates and relegates code-based stacking conditions for gravity, seismic, wind, and warm powers. Clients may indicate a tremendous scope of burden cases and combinations. Examination abilities then, at that point supply progressed nonlinear ways for portrayal of static-sucker and dynamic reaction.

**Static load cases**

- Dead load
- Live load

**load cases**

- Earthquake – x (IS 1893:2002)
- Earthquake – y (IS 1893:2002)

**Load combinations**

- Load case - 1.2 (DL + LL + EQX)

# CHAPTER 4

# ANALYSIS

## 4.1 STATIC ANALYSIS METHOD

Static analysis in ETABS provides valuable insights into the behaviour of a structure under constant loads. These results are crucial for understanding the internal forces and deformations the structure experiences.

**Support Reactions:** This data reveals the forces acting on the supports (foundations) of the structure due to the applied static loads. It helps ensure the foundation is designed to handle these forces and prevent failure.

**Member Forces (Axial, Shear, Moment):** These results detail the internal forces acting on individual beams, columns, and other structural elements. Engineers use this information to size members appropriately and ensure they can withstand the imposed loads without exceeding.

**Stress Distribution:** Static analysis can also calculate the stress distribution within members. This helps identify areas where stresses might be concentrated, allowing for targeted reinforcement or member redesign if necessary. their capacity.

## 4.2 SEISMIC ANALYSIS (RESPONSE SPECTRUM -ANALYSIS)

Dynamic analysis, particularly using the response spectrum method, delves deeper into how a structure reacts to dynamic loads, primarily earthquakes. This analysis provides critical information for seismic design:

**Story Shears and Drifts:** Dynamic analysis calculates the lateral forces and resulting displacements (drifts) experienced at each floor level of the structure. This information helps ensure the building can withstand the lateral forces and deformations imposed by an earthquake without collapse.

**Story Displacement:** This value represents the absolute lateral movement of a specific floor relative to a fixed reference point (usually the base of the structure). It reflects the overall deformation of the building due to the applied loads.

## 4.3 ANALYSIS OF MODEL 1 – WITHOUT FLOATING COLUMN

### 4.3.1 STATIC ANALYSIS [1.2(DL + LL + EQX)]

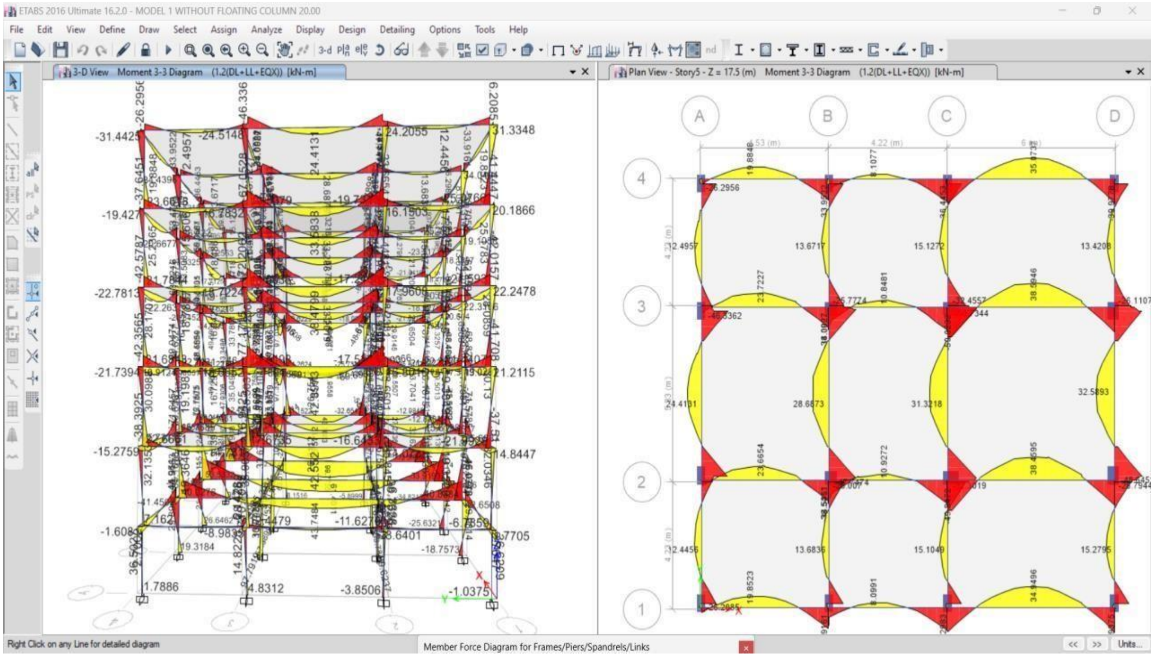



**Fig 4.1 Member forces with respect to**

**Load combination [1.5 (DL + LL + EQX)] - Bending Moment**

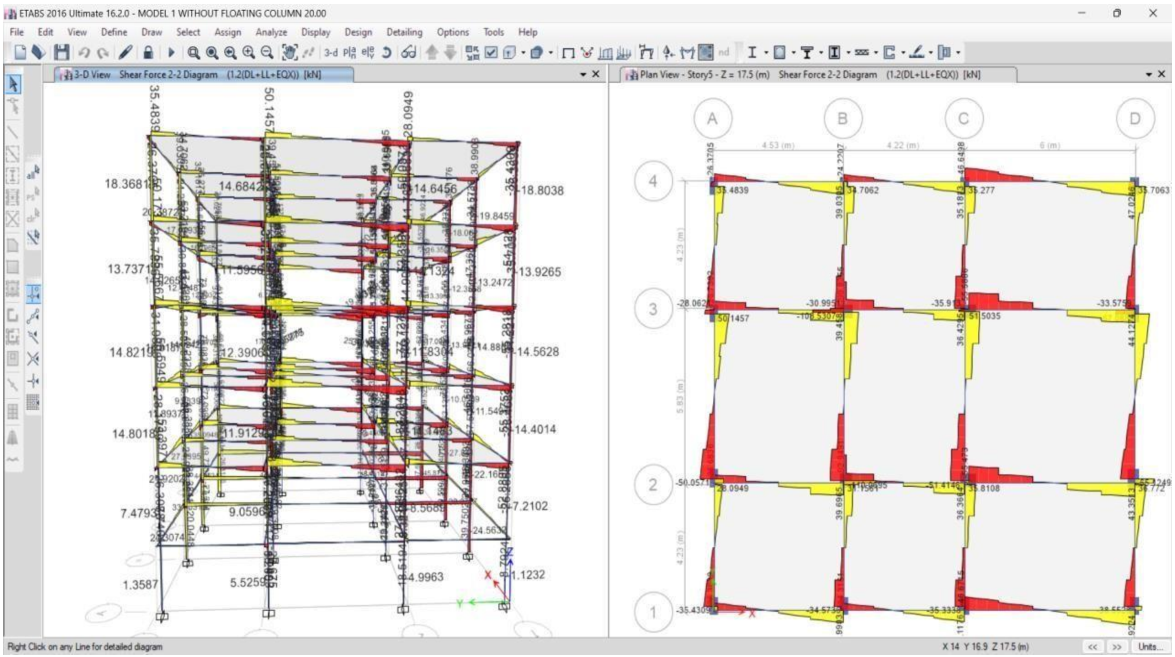



**Fig 4.2 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Shear Force**

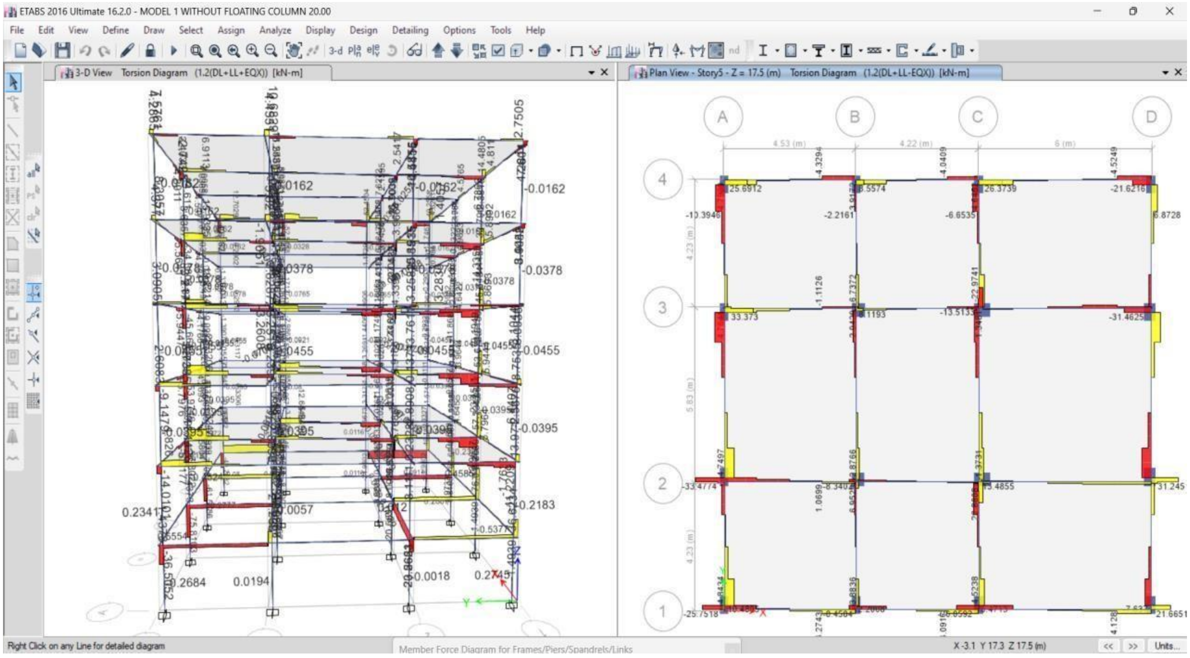



**Fig 4.3 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Torsion**

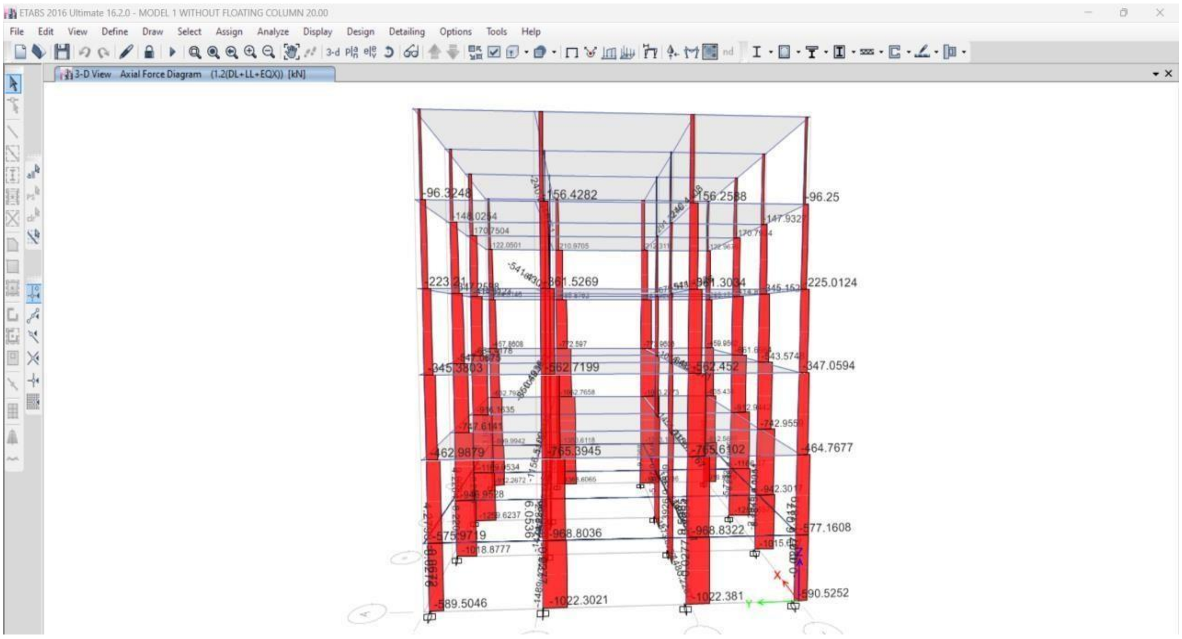



**Fig 4.4 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Axial forces**

## 4.3.2 DYNAMIC ANALYSIS

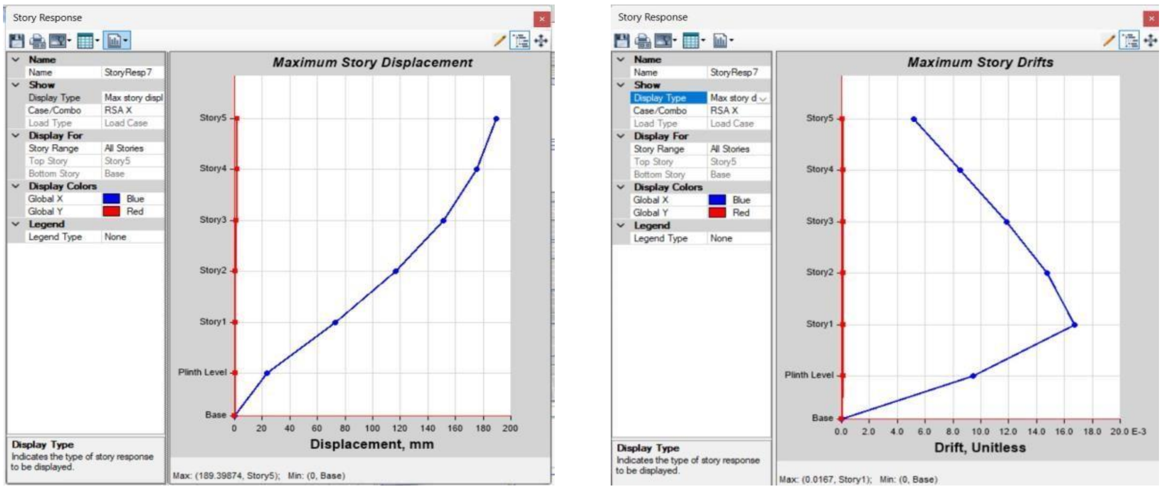



**Fig 4.5 Story displacements & drift with respect to Response Spectrum Analysis**

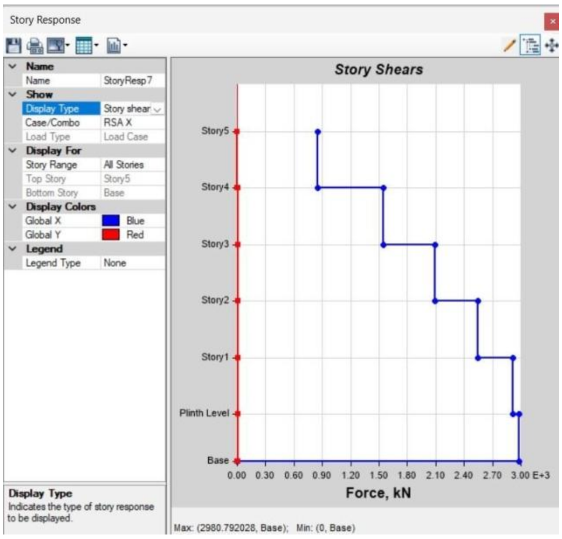



**Fig 4.6 Story shear with respect to Response Spectrum Analysis**

## 4.4 ANALYSIS OF MODEL 2 – WITH EDGE FLOATING COLUMN FROM 1st STORY

### 4.4.1 STATIC ANALYSIS [1.2(DL + LL + EQX)]

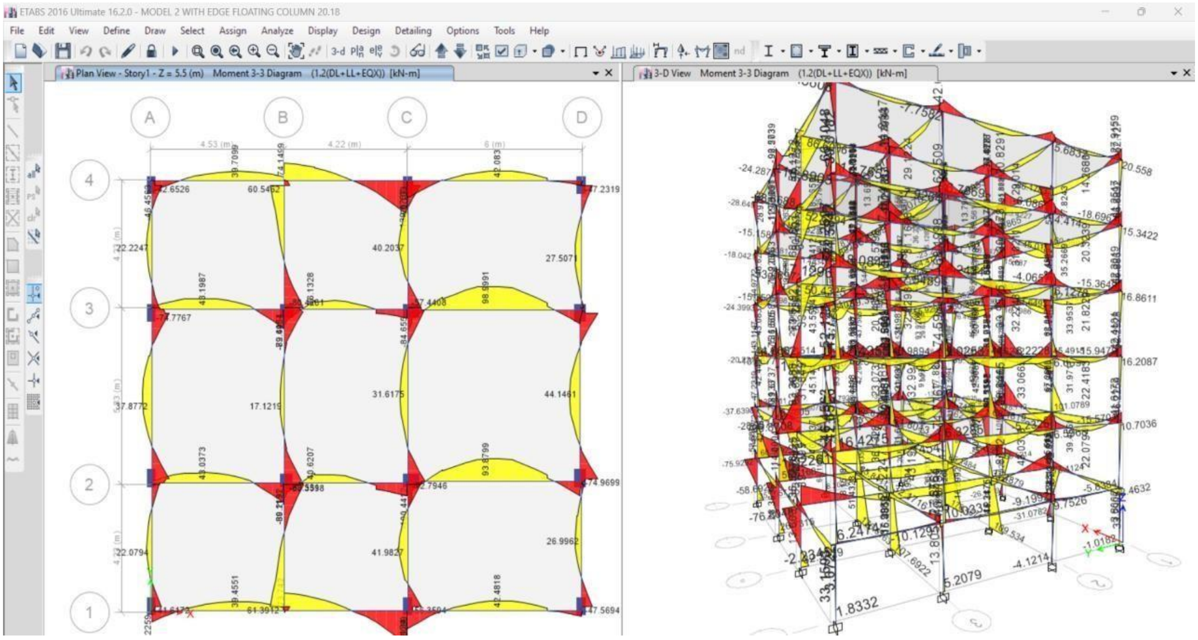



**Fig 4.7 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Bending Moment**

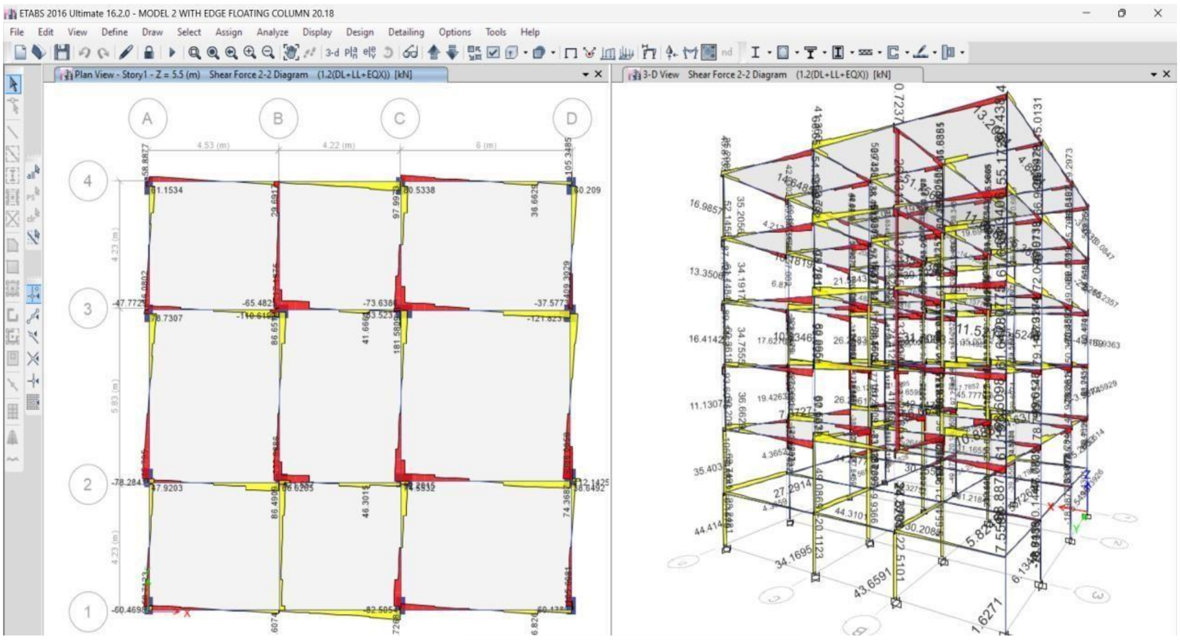



**Fig 4.8 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Shear force**

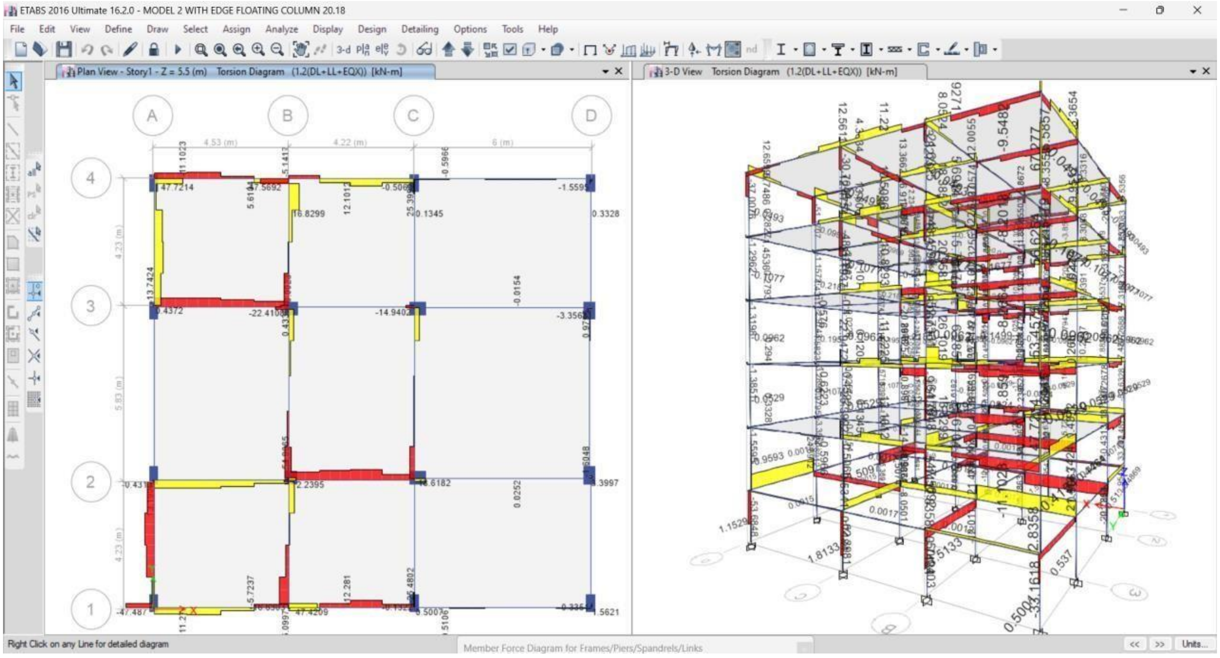


**Fig 4.9 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Torsion**

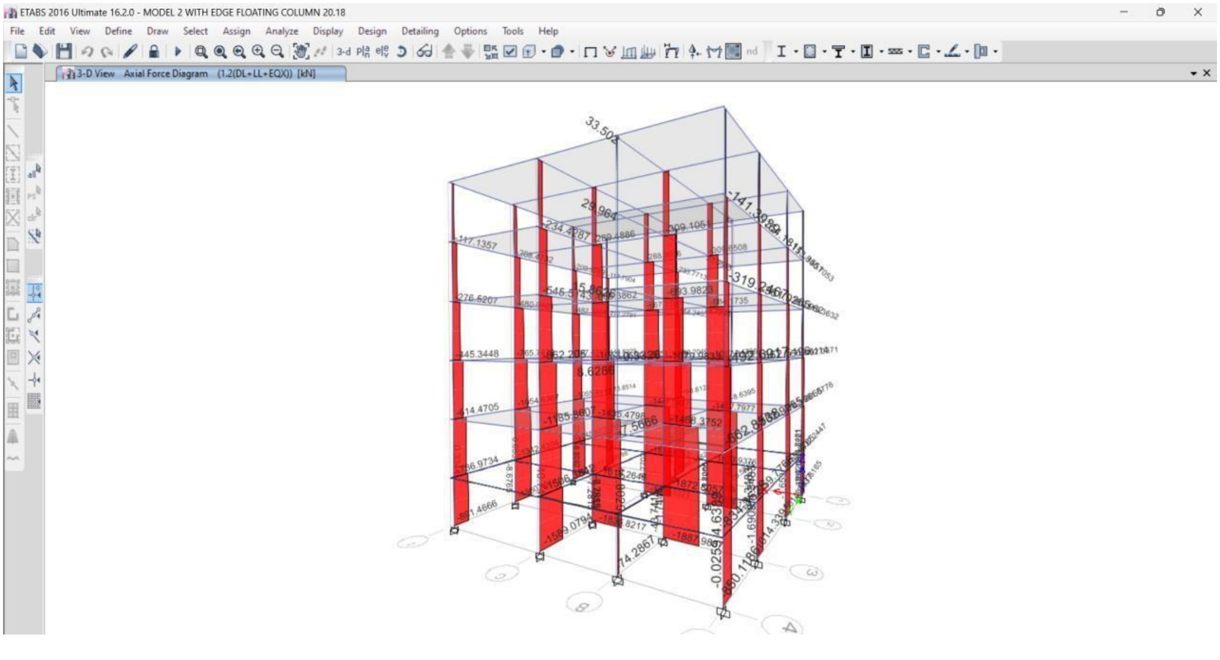


**Fig 4.10 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Axial force**

### 4.4.2 DYNAMIC ANALYSIS (RESPONSE SPECTRUM ANALYSIS)

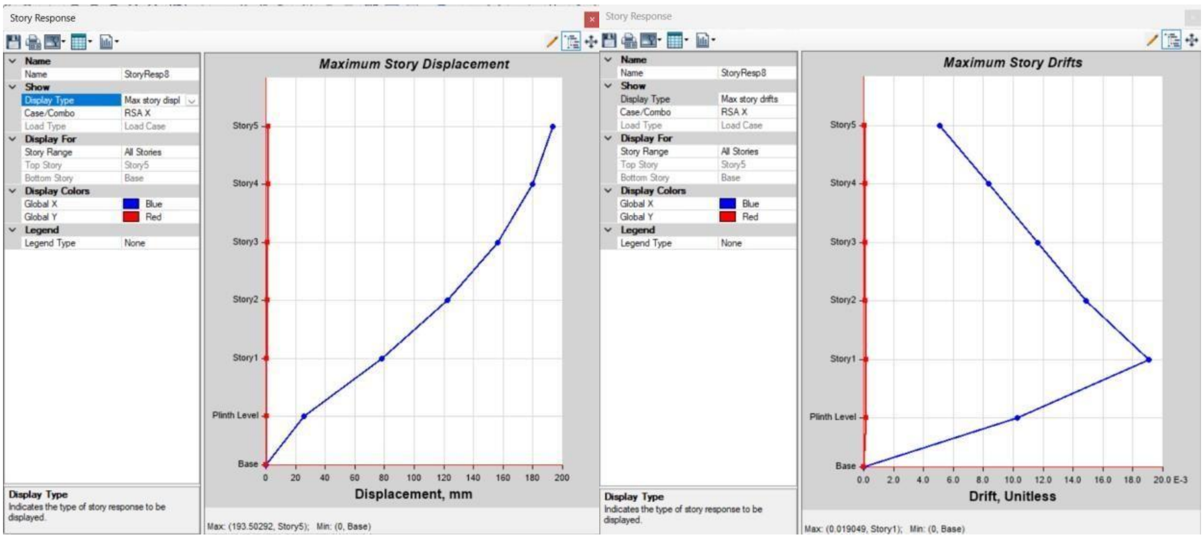



**Fig 4.11 Story displacements & drift with respect to Response Spectrum Analysis**

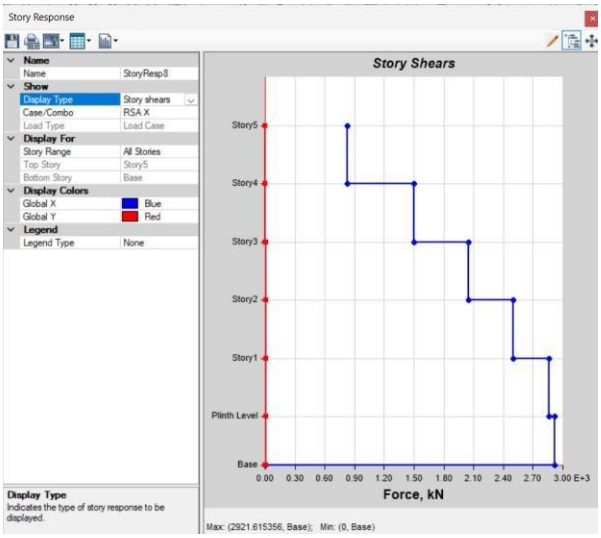



**Fig 4.12 Story shear with respect to Response Spectrum Analysis**

## 4.5 ANALYSIS OF MODEL 3 – WITH CENTRE FLOATING COLUMN AT 4TH STORY

### 4.5.1 STATIC ANALYSIS [1.2(DL + LL + EQX)]

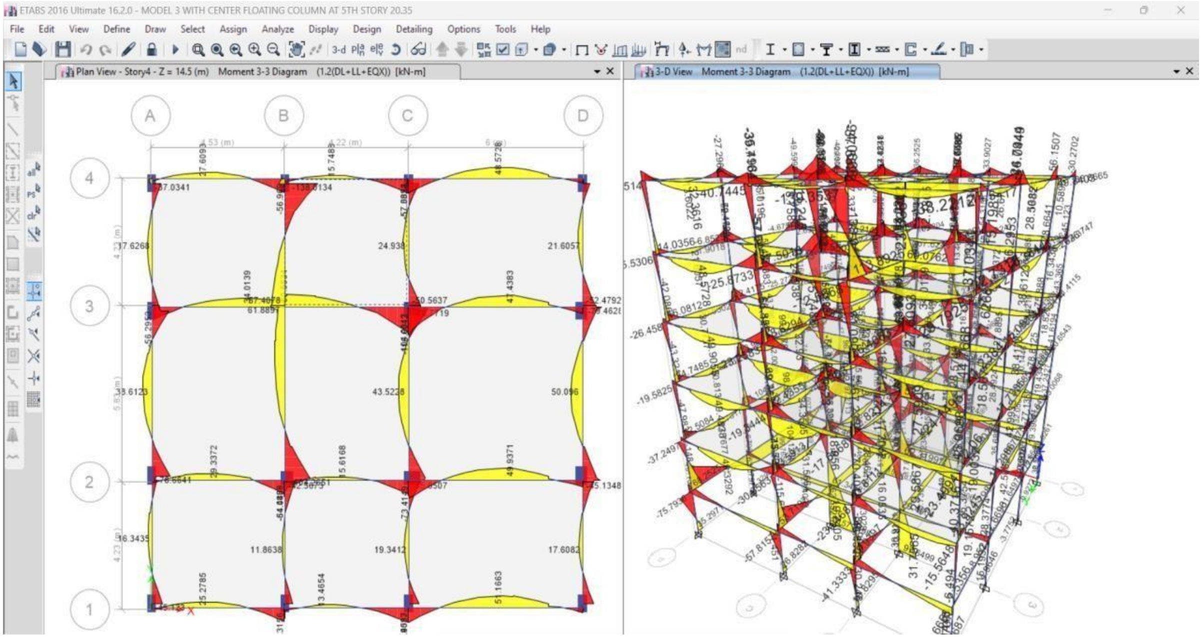



**Fig 4.13 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] – Bending Moment**

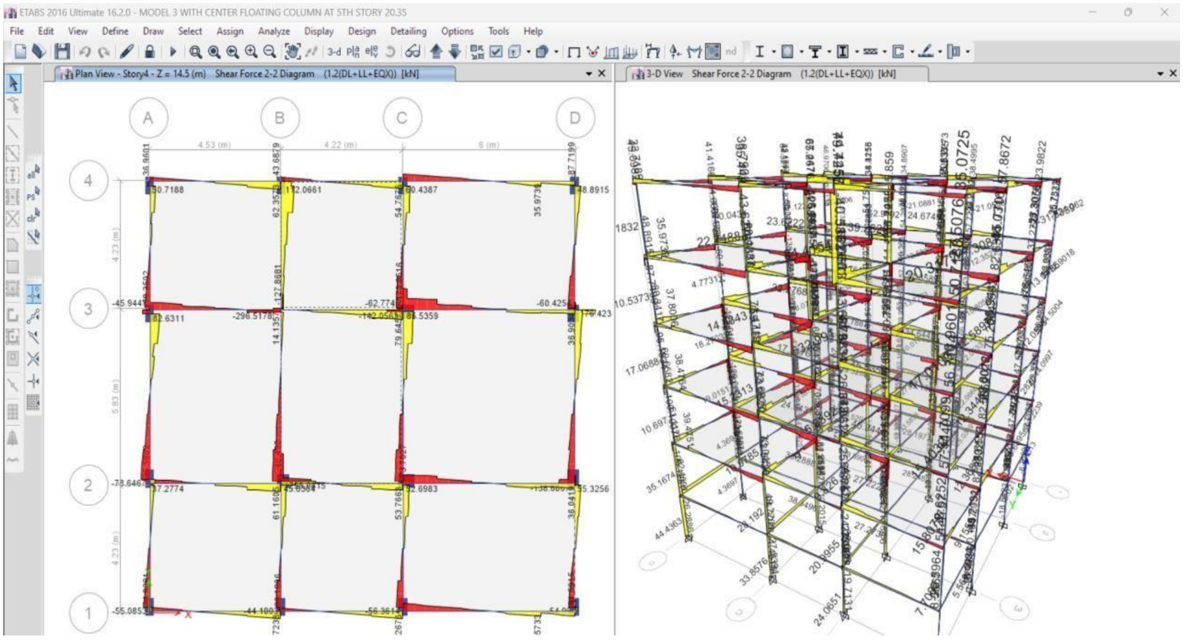



**Fig 4.14 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - shear force**

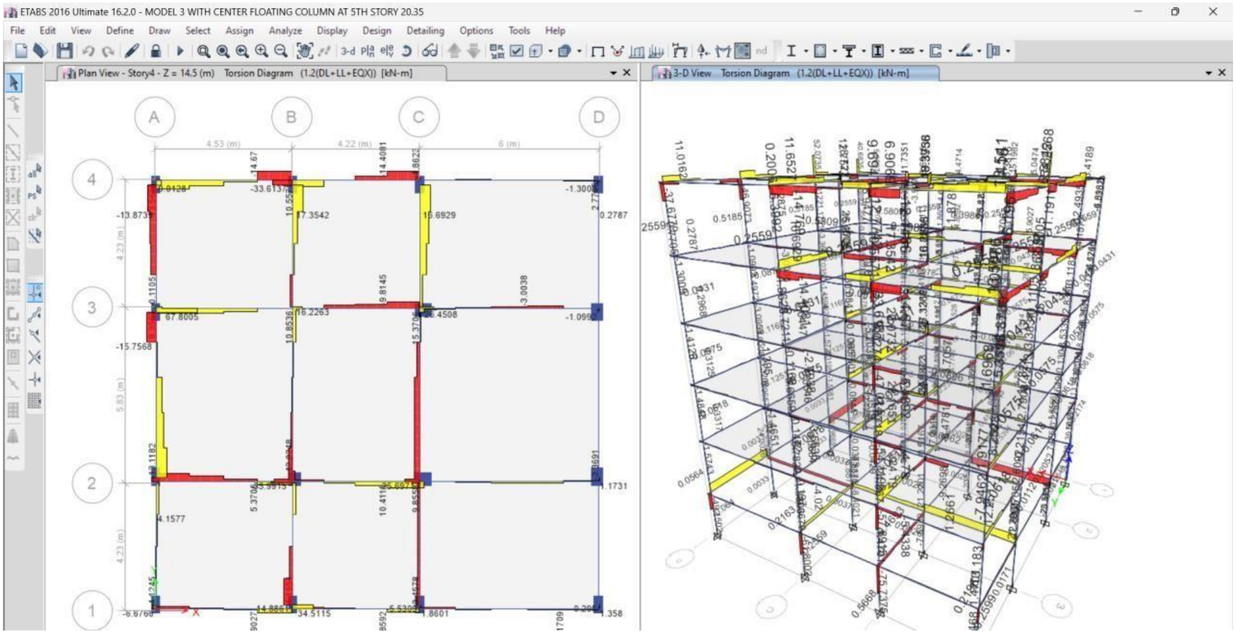


**Fig 4.15 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Torsion**

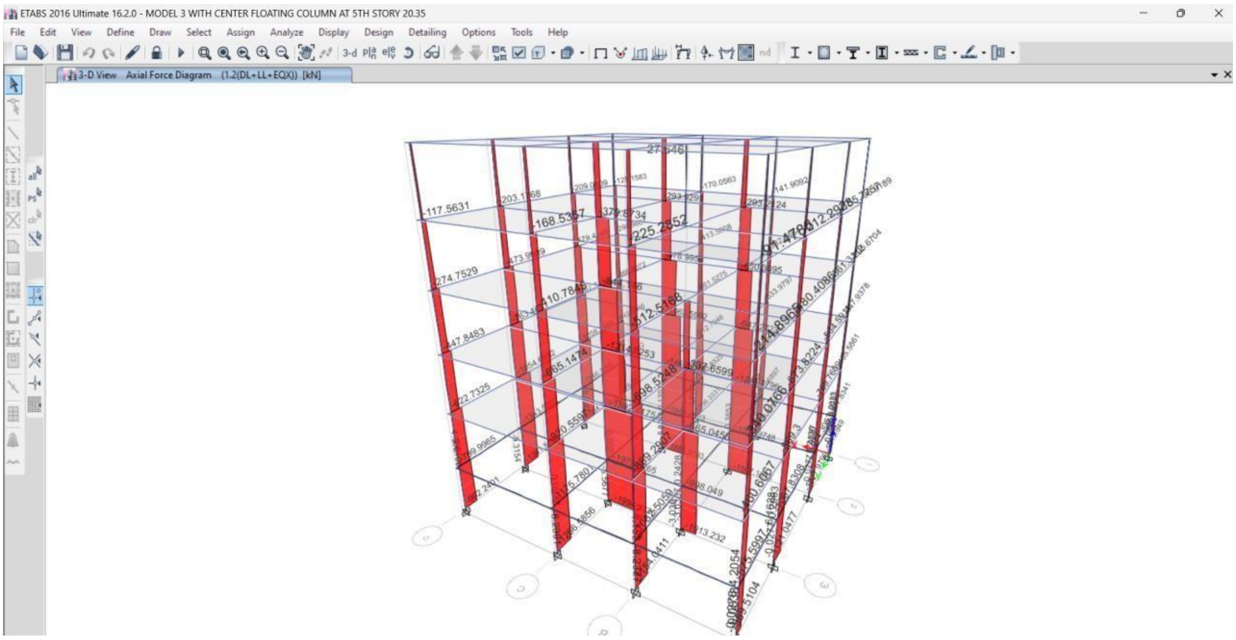


**Fig 4.16 Member forces with respect to Load combination [1.5 (DL + LL + EQX)] - Axial force**

## 4.5.2 DYNAMIC ANALYSIS (RESPONSE SPECTRUM ANALYSIS)

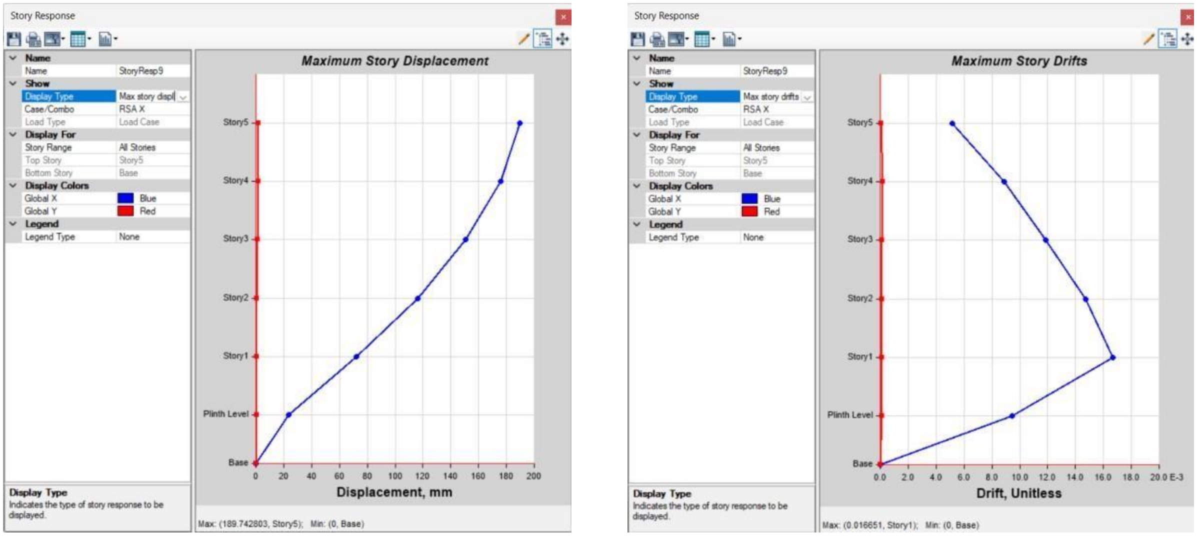



**Fig 4.17 Story displacement and drift with respect to Response Spectrum Analysis**

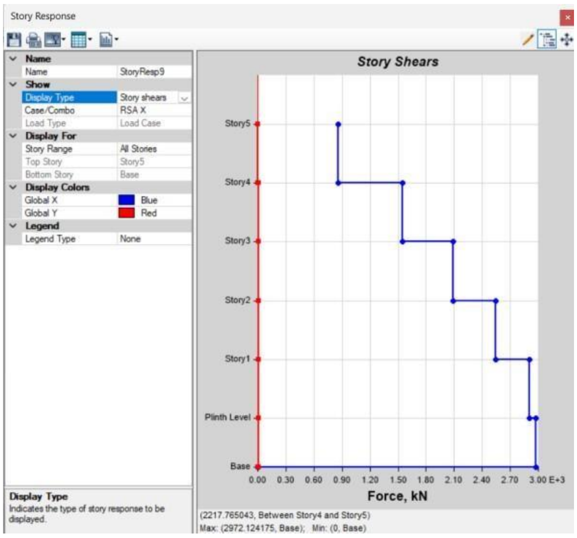



**Fig 4.18 Story shear with respect to Response Spectrum Analysis**

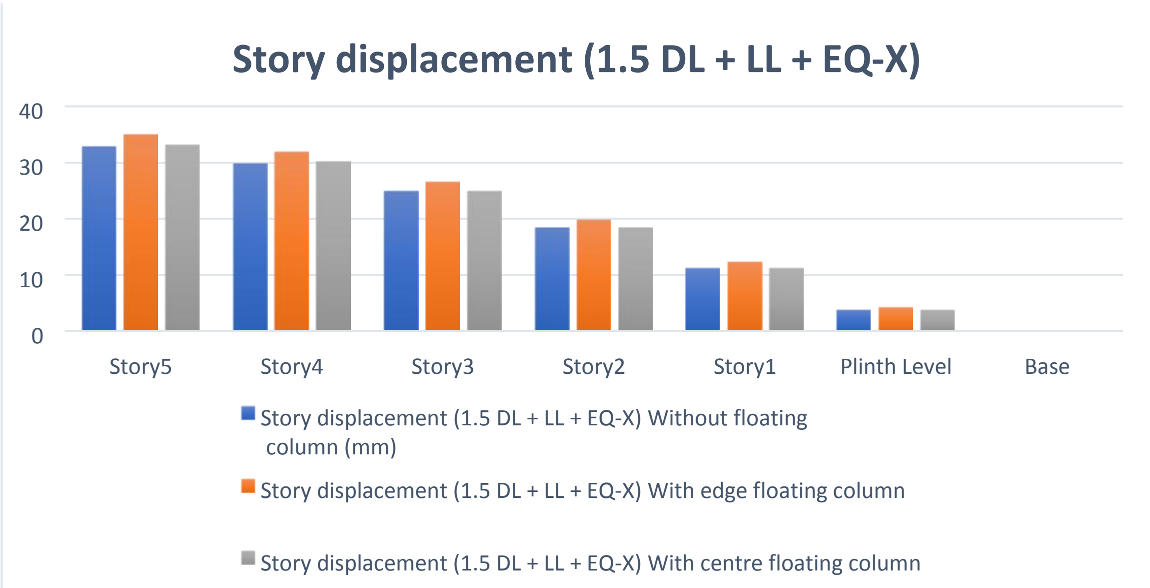
# CHAPTER 5
# RESULTS AND DISCUSSION

## 5.1 COMPARISON OF STORY DISPLACEMENT

### 5.1.1 COMPARISON OF STORY DISPLACEMENT OF MODELS WITH RESPECT TO STATIC ANALYSIS [1.2(DL + LL + EQX)]

**Table 5.1 Comparison of story displacement of models with respect to static analysis**

| Story displacement (1.5 DL + LL + EQ-X) | | | |
|---|---|---|---|
| **Floors** | **Without floating column (mm)** | **With edge floating column** | **With centre floating column** |
| Story5 | 32.831 | 34.99 | 33.086 |
| Story4 | 29.863 | 31.789 | 30.135 |
| Story3 | 24.785 | 26.484 | 24.798 |
| Story2 | 18.353 | 19.791 | 18.348 |
| Story1 | 11.104 | 12.169 | 11.085 |
| Plinth Level | 3.664 | 4.025 | 3.657 |
| Base | 0 | 0 | 0 |

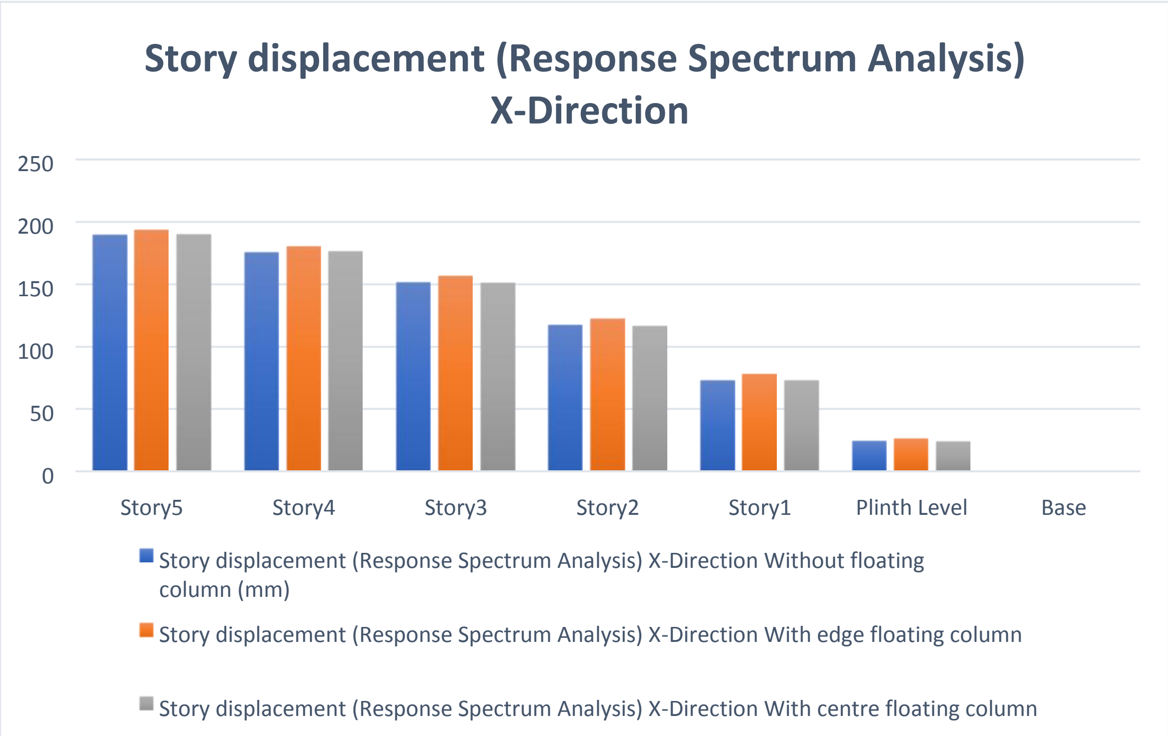



**Graph 5.1 Comparison of story displacement of models with respect to static analysis**

### 5.1.2 STORY DISPLACEMENT OF MODELS WITH RESPECT TO DYNAMIC ANALYSIS

**Table 5.2 Comparison of story displacement of models with respect to dynamic analysis**

| Story displacement (Response Spectrum Analysis) X-Direction | | | |
|---|---|---|---|
| **Floors** | **Without floating column (mm)** | **With edge floating column** | **With center floating column** |
| Story5 | 189.399 | 193.503 | 189.743 |
| Story4 | 175.365 | 179.807 | 175.901 |
| Story3 | 151.303 | 156.253 | 150.943 |
| Story2 | 116.68 | 122.164 | 116.319 |
| Story1 | 72.699 | 77.931 | 72.466 |
| Plinth Level | 23.682 | 25.703 | 23.614 |
| Base | 0 | 0 | 0 |



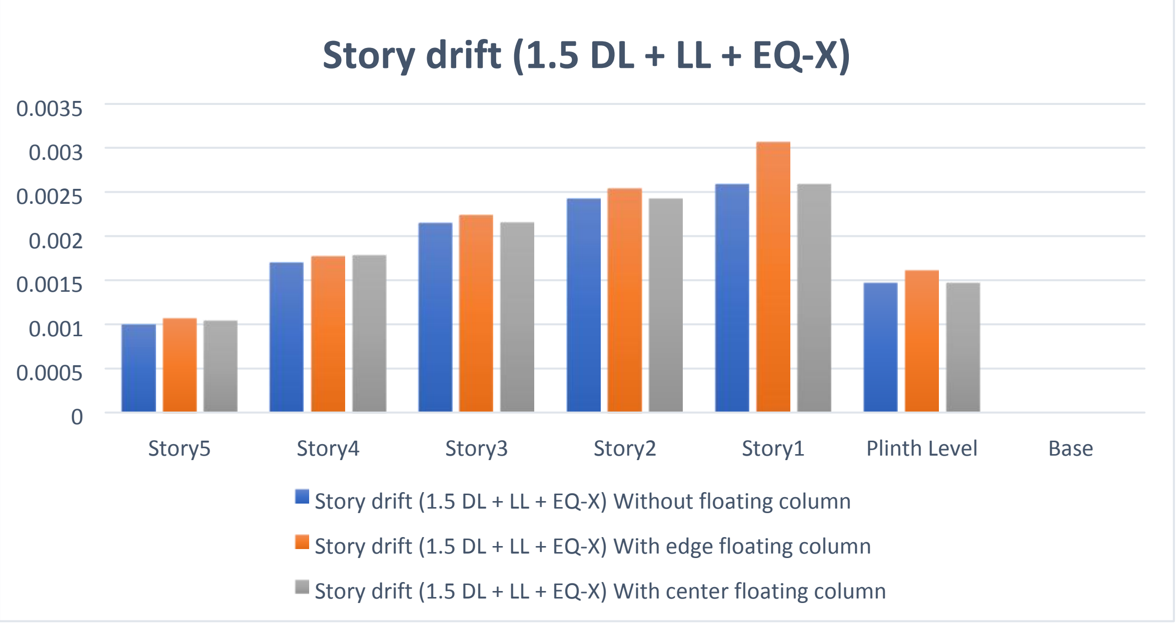

**Graph 5.2 Comparison of story displacement of models with respect to dynamic analysis**

## 5.2 COMPARISON OF STORY DRIFT

### 5.2.1 COMPARISON OF STORY DRIFT OF MODELS WITH RESPECT TO STATIC ANALYSIS [1.2(DL + LL + EQX)]

**Table 5.3 Comparison of story drift of models with respect to static analysis**

| Story drift (1.5 DL + LL + EQ-X) | | | |
|---|---|---|---|
| **Floors** | **Without floating column** | **With edge floating column** | **With centre floating column** |
| Story5 | 0.000989 | 0.001067 | 0.001037 |
| Story4 | 0.001693 | 0.001769 | 0.001779 |
| Story3 | 0.002144 | 0.002231 | 0.00215 |
| Story2 | 0.00242 | 0.002541 | 0.002422 |
| Story1 | 0.00259 | 0.003056 | 0.00259 |
| Plinth Level | 0.001465 | 0.00161 | 0.001463 |
| Base | 0 | 0 | 0 |

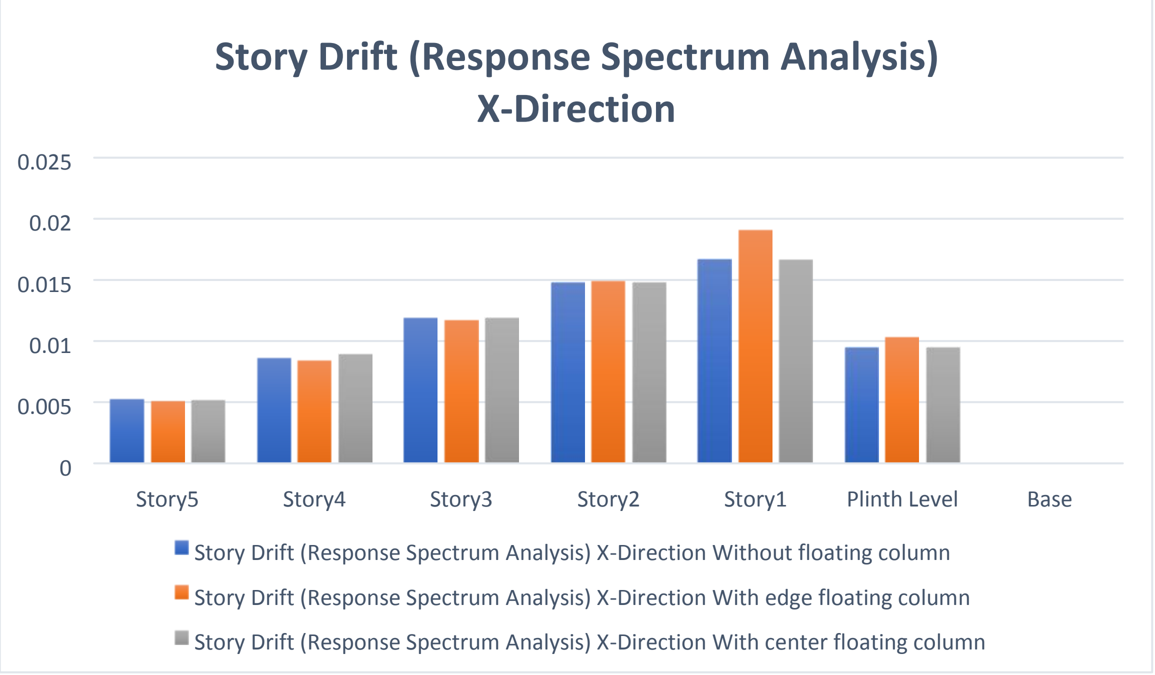



**Graph 5.3 Comparison of story drift of models with respect to static analysis**

## 5.2.2 STORY DRIFT OF MODELS WITH RESPECT TO DYNAMIC ANALYSIS

**Table 5.4 Comparison of story drift of models with respect to dynamic analysis**

| Story Drift (Response Spectrum Analysis) X-Direction | | | |
|---|---|---|---|
| **Floors** | **Without floating column** | **With edge floating column** | **With center floating column** |
| Story5 | 0.005189 | 0.005057 | 0.005133 |
| Story4 | 0.00854 | 0.008352 | 0.008878 |
| Story3 | 0.011852 | 0.011664 | 0.011854 |
| Story2 | 0.014761 | 0.014839 | 0.014719 |
| Story1 | 0.0167 | 0.019049 | 0.016651 |
| Plinth Level | 0.009473 | 0.010281 | 0.009446 |
| Base | 0 | 0 | 0 |



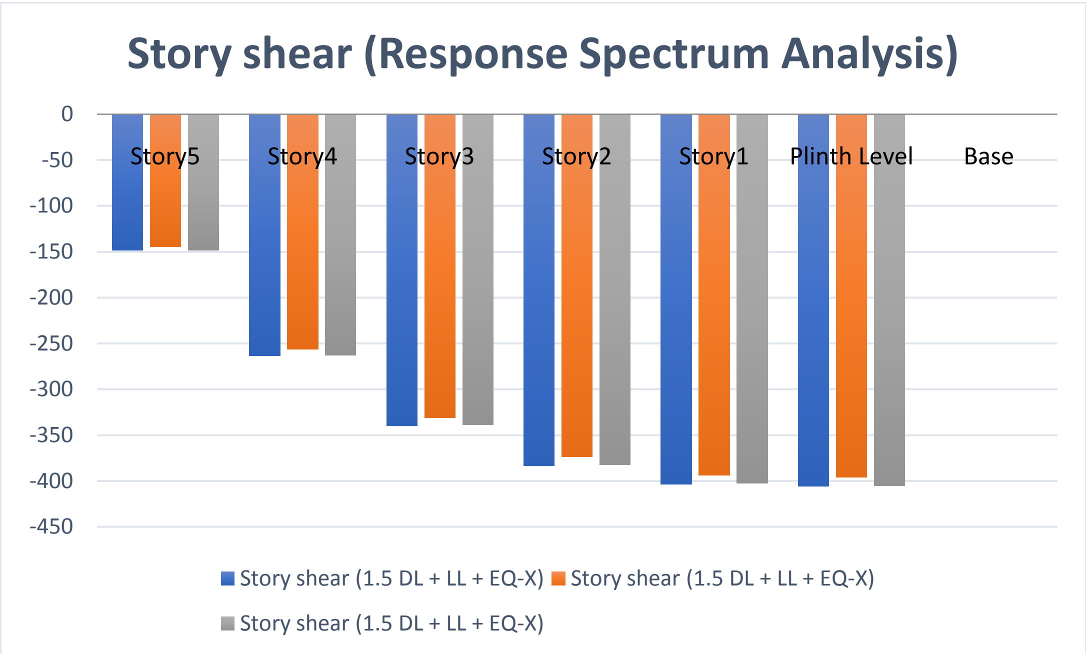

**Graph 5.4 Comparison of story drift of models with respect to dynamic analysis**

## 5.3 COMPARISON OF STORY SHEAR

### 5.3.1 COMPARISON OF STORY SHEAR OF MODELS WITH RESPECT TO STATIC ANALYSIS

**Table 5.5 Comparison of story shear of models with respect to static analysis**

| Story shear (1.5 DL + LL + EQ-X) | | | |
|---|---|---|---|
| **Floors** | **Without floating column (KN)** | **With edge floating column** | **With center floating column** |
| Story5 | -148.5604 | -144.5749 | -148.6274 |
| Story4 | -263.4982 | -256.5285 | -263.0348 |
| Story3 | -339.8361 | -331.0167 | -339.0165 |
| Story2 | -383.5671 | -373.863 | -382.7567 |
| Story1 | -403.7516 | -393.6956 | -402.9424 |
| Plinth Level | -406.159 | -396.0101 | -405.35 |
| Base | 0 | 0 | 0 |

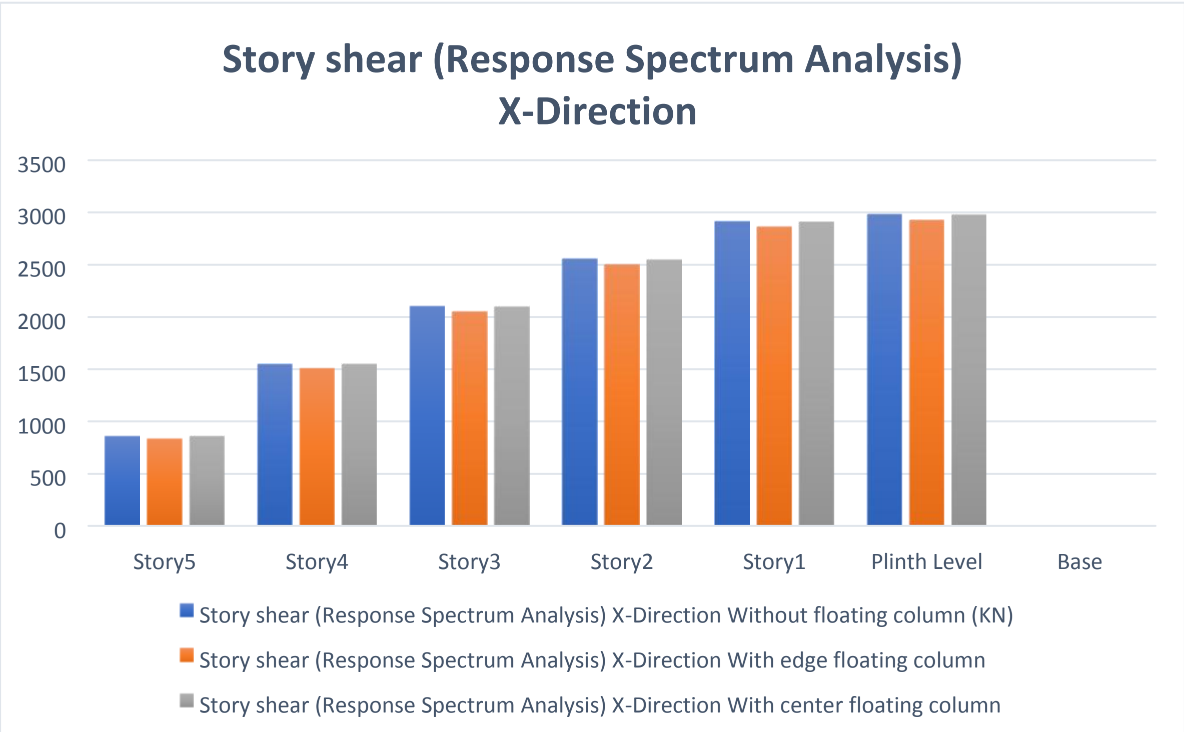



**Graph 5.5 Comparison of story shear of models with respect to static analysis**

### 5.3.2 STORY SHEAR OF MODELS WITH RESPECT TO DYNAMIC ANALYSIS

**Table 5.6 Comparison of story shear of models with respect to dynamic analysis**

| Story shear (Response Spectrum Analysis) X-Direction | | | |
|---|---|---|---|
| **Floors** | **Model 1 Without floating column (KN)** | **Model 2 With edge floating column (KN)** | **Model 3 With centre floating column (KN)** |
| Story5 | 855.2742 | 827.3653 | 855.3669 |
| Story4 | 1545.5355 | 1502.5781 | 1545.1282 |
| Story3 | 2096.6121 | 2047.4009 | 2089.5629 |
| Story2 | 2550.2817 | 2498.8392 | 2541.9896 |
| Story1 | 2912.0511 | 2859.1041 | 2903.4269 |
| Plinth Level | 2980.792 | 2921.6154 | 2972.1242 |
| Base | 0 | 0 | 0 |




**Graph 5.6 Comparison of story shear of models with respect to dynamic analysis**

## 5.4 BASE REACTIONS

### 5.4.1 BASE REACTIONS WITH RESPECT TO MODEL 1 (WITHOUT FLOATING COLUMN)

**Table 5.7 Base reactions with respect to model 1 (without floating column)**

| **Base Reactions (Without Floating Column)** | | | | | | |
|---|---|---|---|---|---|---|
| **Load Case/Combo** | **FX (KN)** | **FY (KN)** | **FZ (KN)** | **MX (KN-m)** | **MY (KN-M)** | **MZ (KN-m)** |
| Dead | 0 | 0 | 13765.83 | 98318.212 | -102126.1157 | 0 |
| Live | 0 | 0 | 2107.775 | 15060.052 | -15544.840 | 0 |
| Earthquake X | - 324.948 | 0 | 0 | 0 | -4549.73 | 2321.49 46 |
| Earthquake Y | 0 | 467.98 | 0 | 6552.4966 | 0 | - 3494.45 4 |
| Wind X | - 332.333 | 0 | 0 | 0 | - 3671.0972 | 2374.52 29 |
| Wind Y | 0 | - 343.03 | 0 | 3789.2711 | 0 | - 2529.85 7 |
| RSA X Max | 2882.66 14 | 12.462 | 0 | 149.9759 | 34846.315 2 | 20716.2 91 |
| RSA Y Max | 12.462 | 4001.8 57 | 0 | 48855.141 | 138.4779 | 34139.6 84 |
| 1.2(DL+LL+EQ X) | - 389.938 | 0 | 19048.32 66 | 136053.91 82 | - 146664.8236 | 2785.79 36 |

### 5.4.2 BASE REACTIONS WITH RESPECT TO MODEL 2 (WITH EDGE FLOATING COLUMN)

**Table 5.8 Base reactions with respect to model 2 (with edge floating column)**

| Base Reactions (With Edge Floating column from 1st story) | | | | | | |
|---|---|---|---|---|---|---|
| **Load Case/Combo** | **FX(KN)** | **FY(KN)** | **FZ(KN)** | **MX(KN-M)** | **MY(KN-M)** | **MZ(KN-M)** |
| Dead | 0 | 0 | 13738.83 | 98125.354 | -102002.89 | 0 |
| Live | 0 | 0 | 2107.775 | 15060.052 | -15544.840 | 0 |
| Earthquake X | -315.5911 | 0 | 0 | 0 | -4420.0069 | 2254.6422 |
| Earthquake Y | 0 | -456.192 | 0 | 6389.190 | 0 | -3406.9668 |
| Wind X | -332.3335 | 0 | 0 | 0 | -3671.0972 | 2374.5229 |
| Wind Y | 0 | -343.0314 | 0 | 3789.2711 | 0 | -2529.8568 |
| RSA X Max | 2819.81 19 | 7.1754 | 0 | 85.79 | 34085.2393 | 20253.28 64 |
| RSA Y Max | 7.1754 | 3995.86 18 | 0 | 48854.0499 | 78.6641 | 32683.14 75 |
| 1.2(DL+LL+EQX) | 378.7093 | 0 | 19015.9362 | 135822.4886 | -135753.277 | -2705.5706 |

### 5.4.3 BASE REACTIONS WITH RESPECT TO MODEL 3 (WITH CENTER FLOATING COLUMN)

**Table 5.9 Base reactions with respect to model 3 (with centre floating column)**

| Base Reactions (With Centre Floating column 5th story) | | | | | | |
|---|---|---|---|---|---|---|
| **Load Case/Combo** | **FX(KN)** | **FY(KN)** | **FZ(KN)** | **MX(KN-M)** | **MY(KN-M)** | **MZ(KN-M)** |
| Dead | 0 | 0 | 13750.64 75 | 98167.2 18 | - 102055.5906 | 0 |
| Live | 0 | 0 | 2107.775 | 15060.0 52 | - 15544.840 | 0 |
| Earthquake X | - 324.270 8 | 0 | 0 | 0 | - 4540.7538 | 2314.463 |
| Earthquake Y | 0 | - 467.221 | 0 | 6542.49 39 | 0 | - 3491.900 |
| Wind X | - 332.333 | 0 | 0 | 0 | - 3671.0972 | 2374.522 9 |
| Wind Y | 0 | - 343.031 | 0 | 3789.27 11 | 0 | - 2529.856 |
| RSA X Max | 2874.32 53 | 10.4705 | 0 | 124.212 | 34746.097 | 20631.70 16 |
| RSA Y Max | 10.4705 | 3991.73 94 | 0 | 48732.7 19 | 112.2846 | 34109.76 51 |
| 1.2(DL+LL+EQX) | 389.124 | 0 | 19030.10 | 135872. 72 | - 135671.6129 | - 2777.356 |

# CHAPTER 6
# CONCLUSION

Based on the results obtained, the following conclusions were drawn:

- From the above models, Interior placement of a floating column at the 4th story reduces maximum story displacement by 1.96% compared to an edge floating column placed from the 1st story to top of the building.

- Buildings experience the greatest amount of story drift at the level where an edge floating column is present.

- Compared to a building without floating columns, story shear decreases by up to 3.26% in a building with an edge floating column, while it increases by 0.01% in a building with an internal floating column.

- Placing floating columns in corners leads to greater story displacement and drift. This occurs because corner columns have less structural support to resist lateral forces from wind or earthquakes.

- Floating columns are primarily designed to carry vertical loads, such as gravity (dead and live loads), but they are not well-suited to resist lateral forces induced by wind or earthquakes.

- The floating column method will be adopted unless the building has specific space requirements.

# CHAPTER 7
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