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Design and Analysis of Soft storey G+17 Rectangular shaped building using STAAD Pro V8i Software

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Abstract : The building business is currently expanding quickly in nations like India. The country's ongoing development is the cause of the growth. High-rise structures are created in this way and serve many functions. Soft storey becomes an unavoidable component of multi-story buildings in India under such circumstances. softer stories often used for offices, parking, etc. If we utilize manual methods, unique structures will take longer to calculate because they require more time. STAAD Pro gives us an immediate answer. It is simple to use for structure analysis and design for greater accuracy. The limit state mechanism in STAAD Pro is used in accordance with Indian Standard Code & Practices. We may draw the conclusion that this program is quite accurate in its designs and can save a lot of time. The G+17 in this project

In this research, an analysis has been done to better understand the seismic response of soft story buildings under earthquake loading using several models (Bare frame, Infill frame, Bracing Frame, Shear wall frame). It has been found that using diverse models rather than a soft storey increases the structure's resistance.

***keywords*- Soft Storey, Storey displacement, Seismic analysis, Wind analysis, Shear wall, STAAD Pro.**

1. INTRODUCTION

Today, soft storeys are a common element of contemporary urban Indian architecture. Due to the absence or lack of infill walls, there is a discontinuity in the rigidity of the structure at the soft storey of a building. The weak or soft storey can be found anywhere in the building's story levels; however, it typically resides at the ground floor level. Since the last few years, the lack of parking spaces for flats in populous cities has become a significant issue.] As a result, building multi-story structures with an open first floor is now a widespread practice. The term "Soft Storey" or "Open Ground Storey Building" is used to describe these types of buildings, which have masonry walls infilling all upper storeys but no masonry walls infilling the ground storey. Buildings with "soft storeys" have a particular storey that is significantly less rigid than the storeys around it. infill walls at that storey, whilst other storeys have full infill, is incorporated into a building, resulting in that storey's lower rigidity compared to other storeys. Therefore, to accommodate parking, we left the ground floor freely known as the "soft storey" (Fig. 1), which lacks in-filled stone walls to resist lateral forces. Staad pro Due to increased occupancy, vehicular parking is a big concern today, which is why RC buildings with open first floors are nothing more than (soft storey) structures. A vast number of existing buildings, especially those with soft upper stories, are subject to damage, and many of these buildings provide social needs like parking for cars, lobbies for receptions, and large spaces, among others. Such structures have soft storeys, which we offer to lessen movement at higher levels while preventing storey distortion and deflection.

1.1 SOFT STOREY

Reinforced concrete (RC) frame multistory high-rise construction is now a popular practice in nations like India. The most frequent kind of vertical irregularity can be found in structures with an open ground story. Many recently built buildings have the unique characteristic of having certain stories left open for parking, reception, offices, service purposes, etc. These structures are also known as open storey, soft storey, or buildings on stilts. Due to the lack of stone walls, these stories weaken and become softer than the other stories. Buildings with structural imbalances are unsafe and hazardous, and soft-story buildings are known to be vulnerable to collapsing during earthquakes.

1.2 BEHAVIOUR OF SOFT STOREY

The inter-story drift in the soft storey is significant in buildings with soft stories. However, in the other levels, the forces in the columns are significantly decreased due to the existence of brick infill walls that share the stresses, substantially reducing the strength demand on the columns in such storey for these buildings. A major amount of the overall building deflections tends to concentrate in the open floor if it is significantly less rigid or more flexible. Other stories are substantially stiffer than the open storey because of the existence of walls. As a result, the other floors practically move as a single block, with the soft story experiencing the majority of the building's horizontal displacement. Because of this, the building exhibits erratic motion and acts like several units. In the event of an earthquake, a building with only one open floor at ground level will behave like an inverted pendulum, with the open story columns serving as the pendulum rod and the remaining portions of the structure as the rigid pendulum mass. As a result, the ground story alone experiences significant movement, severely stressing the columns in the open ground storey. If the columns are weak (without the necessary strength to withstand these high loads), they may sustain serious damage, which could even cause the building to collapse. Buildings with soft storeys made of RC frames are frequently studied and developed as bare frames. however, in fact As a result, it is interesting to compare and study the displacement, stiffness, and other properties of the same frame when it is modeled as a soft storey frame and a bare frame. This comparison will help to clarify how the soft story frame's performance differs from that of the bare frame. In this study, four alternative models created in accordance with IS 1893 (Part 1) have been explored to understand the behavior of multistory RC frame buildings under the influence of wind and seismic forces. utilizing the commercial program STAAD Pro in 2002.

2.RESEARCH METHODOLOGY

Using staad Pro to design and analyze a multi-story rectangular skyscraper. a challenging process. I can give you a general breakdown of the procedures, though. To be clear, this is a simplified version, and the precise procedure may change based on the demands of your project. A general flowchart is shown below**:**

2.1 Analysis Procedure in STAAD.Pro

Step 1 - Define the code (i.e., IS 1893: 2002) and geometry of structure.

1. The grids of the structure are created.
2. Numbers of Stories are formed.
3. Beams, columns and roofs are made.

Step 2 - Define section of Members

1. Beams and columns
2. Shear Wall

Step 3 - Assign supports

1. Fix

Step 4 - Assign property to members

1. Columns
2. Beams
3. Roofs
4. Bracing
5. Shear Wall

Step 5 - Define Materials of Members.

1. Steel
2. Concrete

Step 6 - Defining Load
1. Dead and Live Load
2. Earthquake Load & Wind Load
3. Load Combinations

Step 7- Analysis of structure
1. Static analysis

Step 8 - Run Analysis

2.1 Is codes Details

IS 456 (Part 4] - Indian Standard Code of Practice for Reinforced and Unreinforced Concrete was published in 2000 by the Bureau of Indian Standards.

IS: 875 (Part 3) — For buildings and structures, the Indian Standard Code of Practice for Design Loads (Other Than Earthquake) was adopted in 1987 for Wind Loads.

IS: 875 (Part 2) — Indian Standard Code of Practice for Design Loads (Other Than Earthquake), For Buildings and Structures, 1987 for Imposed Loads.

IS: 875 (Part 1] - Indian Standard Code of Practice for Design Loads (Other Than Earthquake) For Buildings & Structures was established in 1987 for Dead Loads.

IS: 1893{Part1} - Indian Standard Standards for Designing Buildings to Withstand Earthquakes, 2002.

2.2 PLANNING

Plan: Shows an orthographic representation of the XY plane in the context of a given user coordinate system.

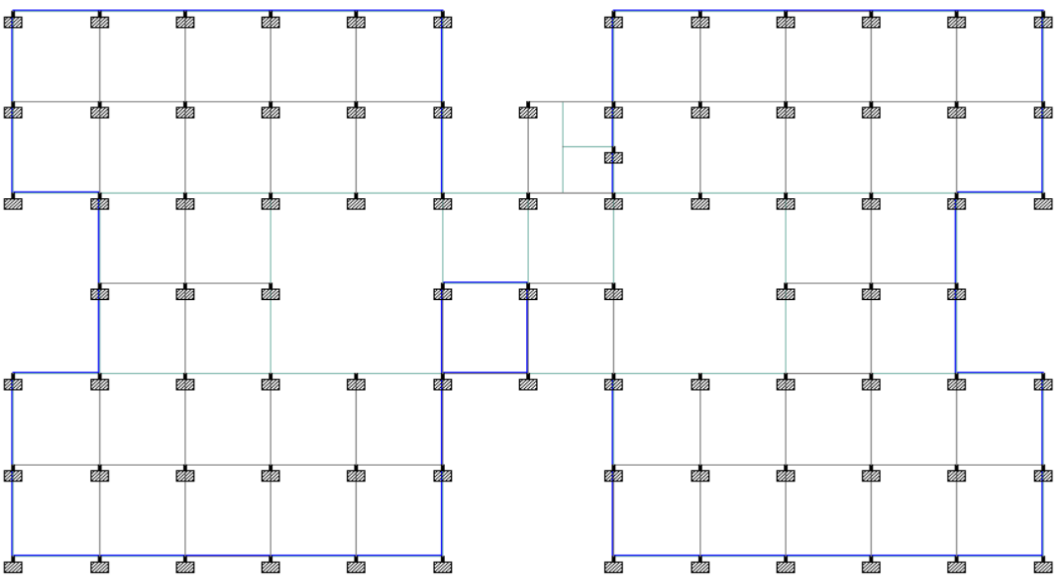

Figure 1: Plan of G+17 residential building

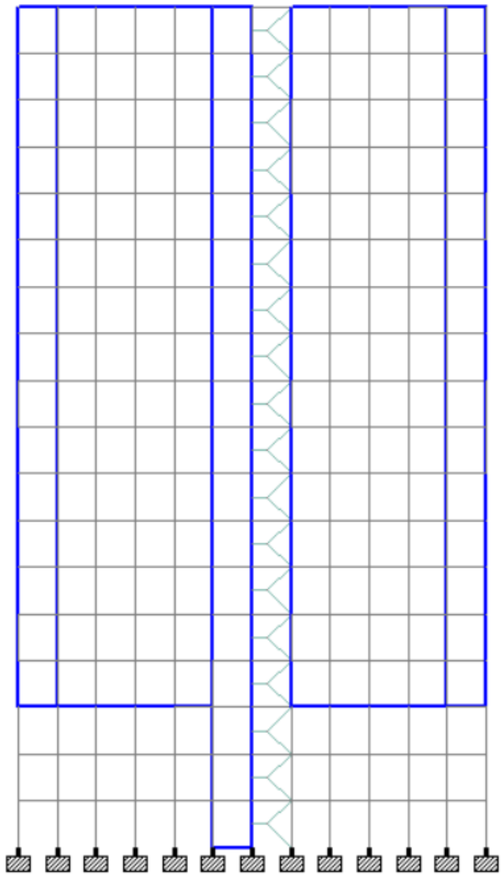

Figure 2: Elevation of G+17 residential building

2.3 MODEL SPECIFICATIONS

STAAD Pro Physical Modeler uses physical modelling to streamline the modelling of a structure, which more precisely depicts the construction process of a model.

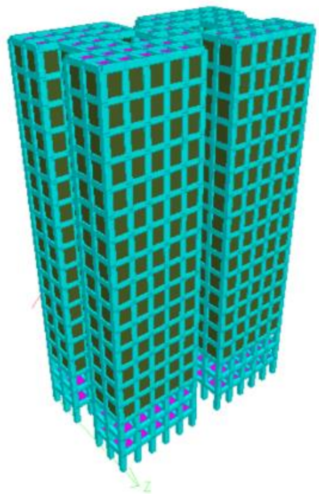

Figure 1: Modelling of G+!7 a Structure

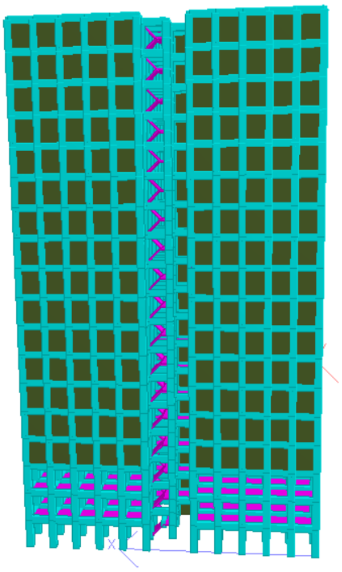

Figure 2: side view of G+17 Structure

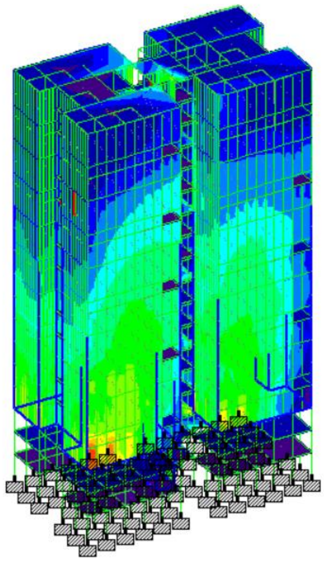

Figure 3: Displacement on Structure

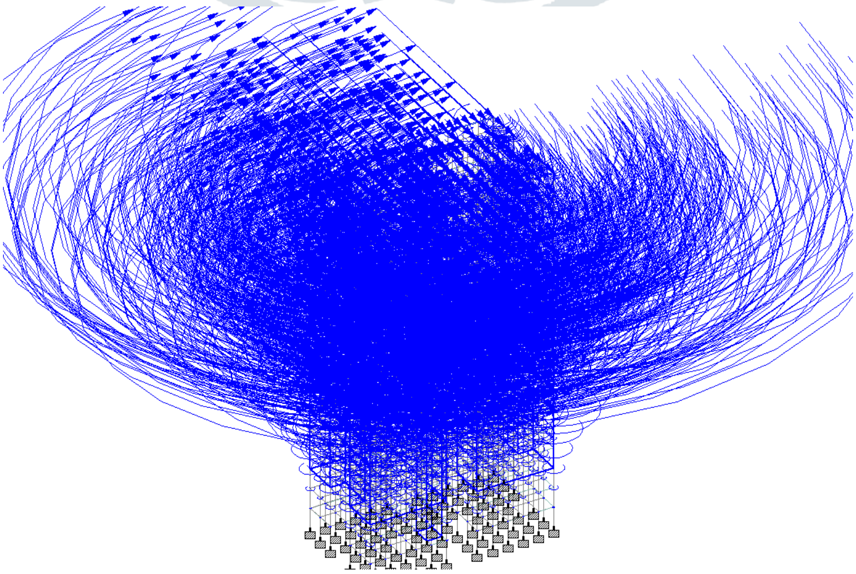

Figure 4: Seismic Load in Z-Direction

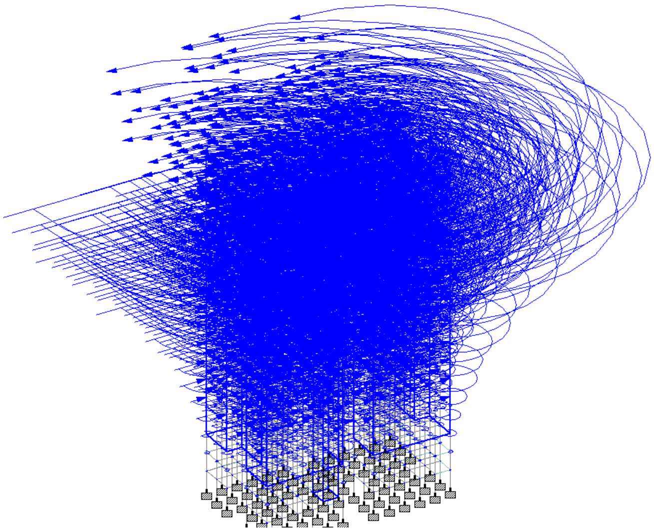

Figure 5: Seismic Load in X-Direction

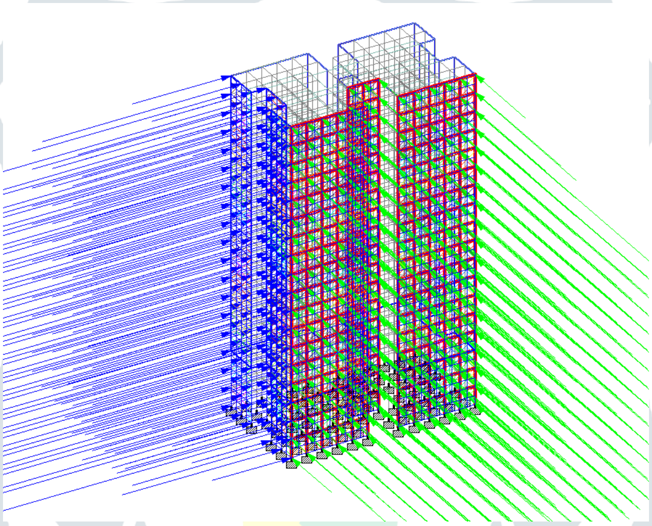

Figure 6: Wind Load in X-Direction

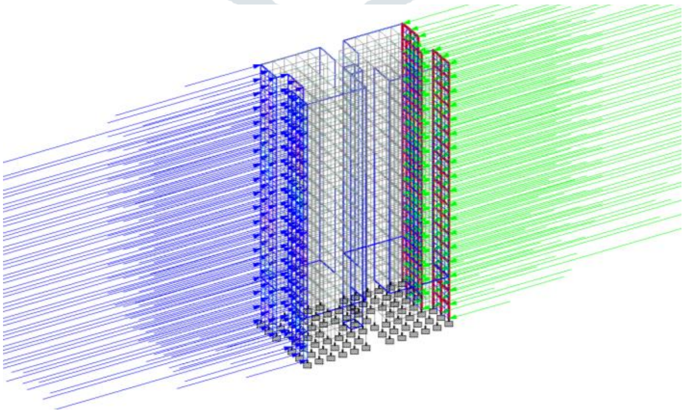

Figure 7: Wind Load in Z-Direction

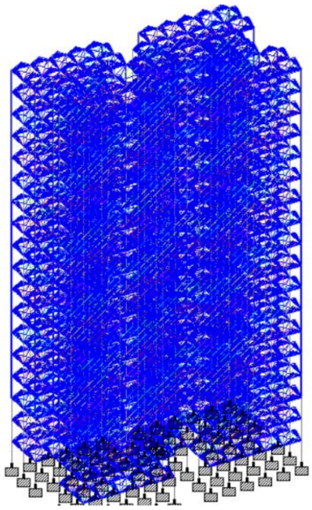

Figure 8: Live Load

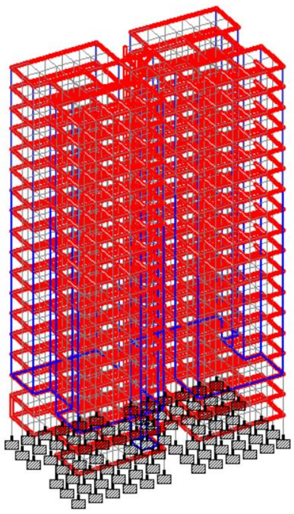

Figure 9: Dead Load

2.3.1 Architectural details to study the behavior of RCC building under high Seismic forces as here taken

- Area covering: 30 x 17 m. (As shown in fig 01)
- Total Height of the building: 54 m
- Floor to Floor Height: 3 m
- Floor to Floor Height AT service floor: 3.4 m

2.3.2 Codes used for analysis of the structure

- R.C.C. design : IS 456: 2000
- Earthquake design : IS1893: 2016
- Code for Dead load : IS875: Part 1
- Code for Live load : IS875: Part 2
- Code for wind load : IS875: Part 2

2.3.3 The basic parameters considered for the Analysis and design

- Slab depth: 150 mm thick : Assumed
- Live load in floor area : 2 kN/sq. m: As per IS 875 Part 2
- Live load in Balcony area:2 kN/sq. m : As per IS 875 Part 2
- Live load in passage area: 2 kN/sq m : As per IS 875 Part 2
- Live load in urinals: 2 kN/sq m : As per IS 875 Part 2
- Floor finish load: 1.5 kN/ sq m : As per IS 875 Part 1
- Wall thickness: 230 mm thick wall : Assumed
- Stair case loading: 3 kN/sq m : As per IS 875 Part 2
- Lift shaft: 230 mm thick shear wall : Assumed

2.3.4 Earthquake parameters considered

- Zone : II (NAGPUR)
- Soil type : Medium soil
- Importance factor : 1
- Time period : Based on IS 1893

2.3.5 Load case details

- Earthquake load
- Dead load
- Live load
- Wind load
- Load combination

3. RESULT AND DISCUSSIONS

From present study the following results have been obtained:

1) Even soft story design provisions are not implemented when a building is erected in compliance with codal provisions for Displacement correction and with capacity design without infill strut element, and no soft storey behaviour has been noticed.

2) The soft storey forms have been observed in all buildings when the factor proposed by IS 1893 (Part 1): 2002 is not applied to members of the ground storey.

3) Displacement of the structure are more in case of bare frame. And these can be lowered by making the provision of bracings at the level of soft storey.

4) A quick and accurate structural design tool is STAAD Pro. It also provides structural design that is economical. The variety in steel error is due to human error.

5) From the current analysis, it can be inferred that the multiplication factor value provided in IS 1893 (Part 1): 2002 is exaggerated.

3.1 DISPLACEMENT DETAILS

Beam	L/C	Displacement m	X mm	Y mm	Z mm	Resultant mm
1	1 EX	0.000	0.000	0.000	0.000	0.000
		0.625	-0.000	-0.013	-0.001	0.013
		1.250	-0.000	-0.006	-0.001	0.006
		1.875	-0.000	0.005	0.000	0.005
		2.500	0.000	0.000	0.000	0.000
	2 EZ	0.000	0.000	0.000	0.000	0.000
		0.625	0.000	0.001	0.001	0.001
		1.250	-0.000	0.000	0.000	0.000
		1.875	-0.000	0.000	0.000	0.000
		2.500	0.000	0.000	0.000	0.000
	3 WX	0.000	0.000	0.000	0.000	0.000
		0.825	-0.000	-0.007	-0.001	0.007
		1.250	-0.000	-0.003	-0.001	0.003
		1.875	0.000	0.002	-0.000	0.002
		2.500	0.000	0.000	0.000	0.000
	4 WZ	0.000	0.000	0.000	0.000	0.000
		0.625	-0.000	-0.000	-0.000	0.000
		1.250	-0.000	-0.000	-0.000	0.000
		1.875	-0.000	0.000	0.000	0.000
		2.500	0.000	0.000	0.000	0.000
	5 LL	0.000	0.000	0.000	0.000	0.000
		0.625	-0.000	-0.001	0.000	0.001
		1.250	-0.000	-0.001	0.000	0.001
		1.875	-0.000	-0.001	0.000	0.001
		2.500	0.000	0.000	0.000	0.000
	6 DL	0.000	0.000	0.000	0.000	0.000
		1.875	0.000	0.002	-0.000	0.002
		2.500	0.000	0.000	0.000	0.000

3.2 DISPLACEMENT DETAILS GRAPHS

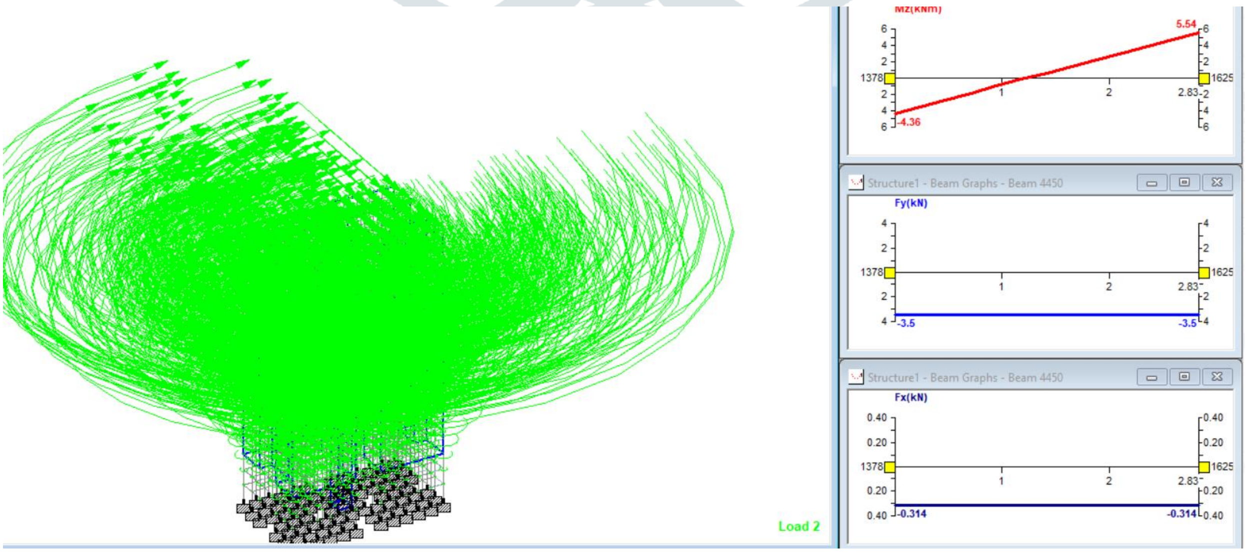

Figure 8: Seismic Load Displacement in X-Direction

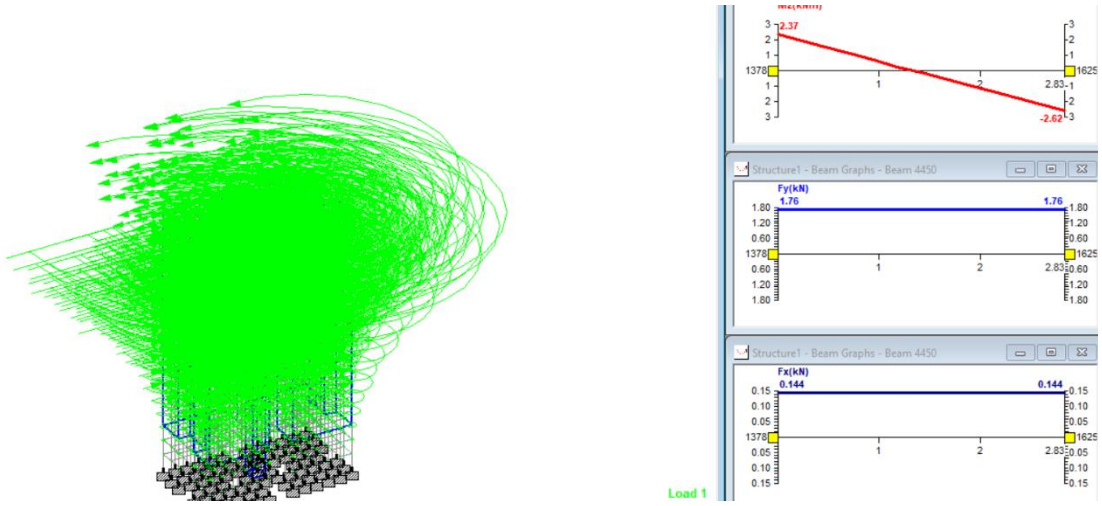

Figure 9: Seismic Load Displacement in Z-Direction

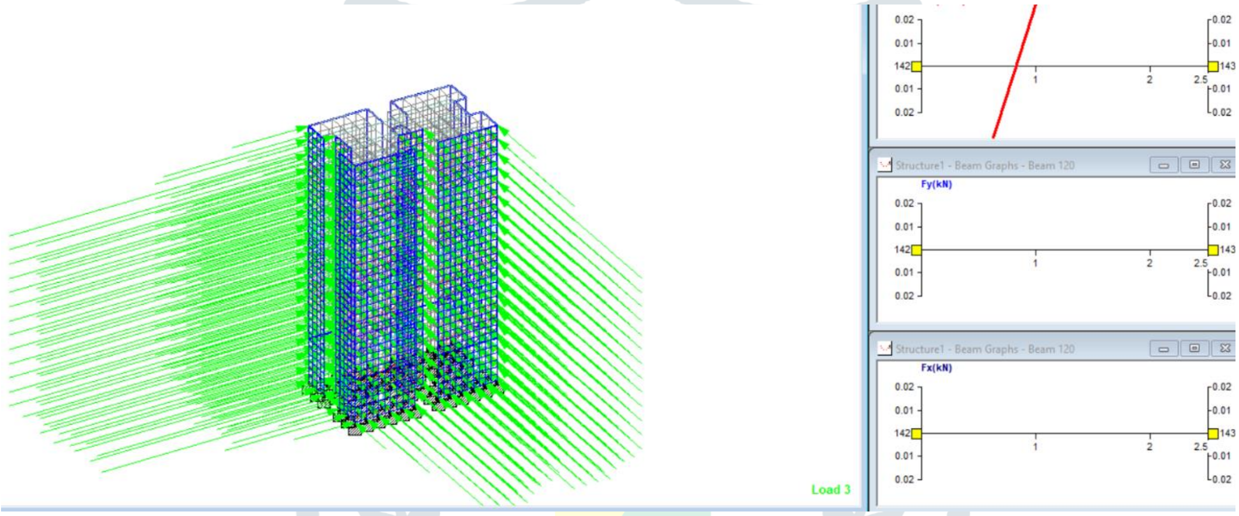

Figure 10: Wind Load Displacement in X-Direction

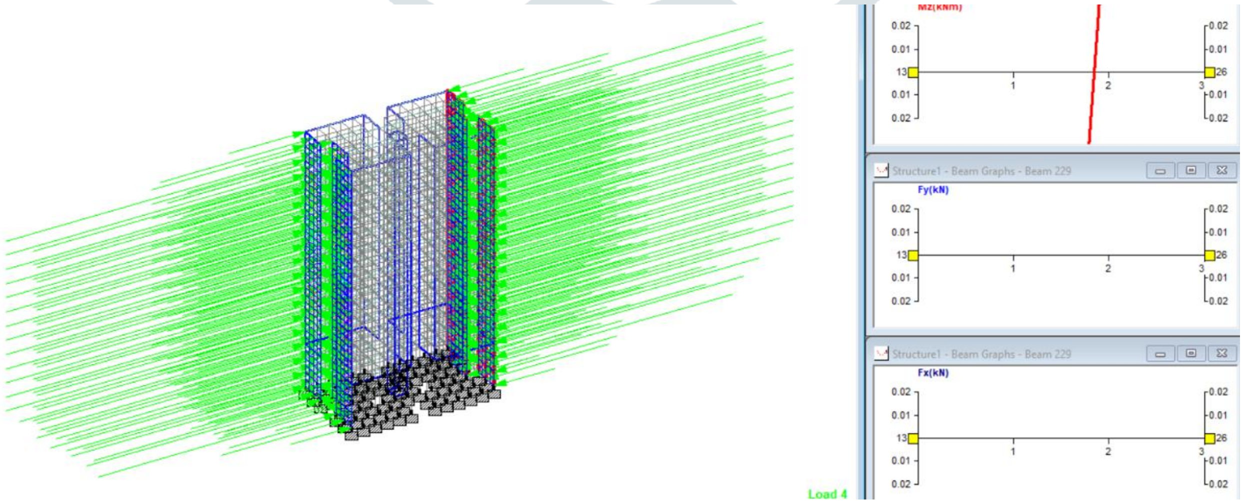

Figure 11: Wind Load Displacement in Z-Direction

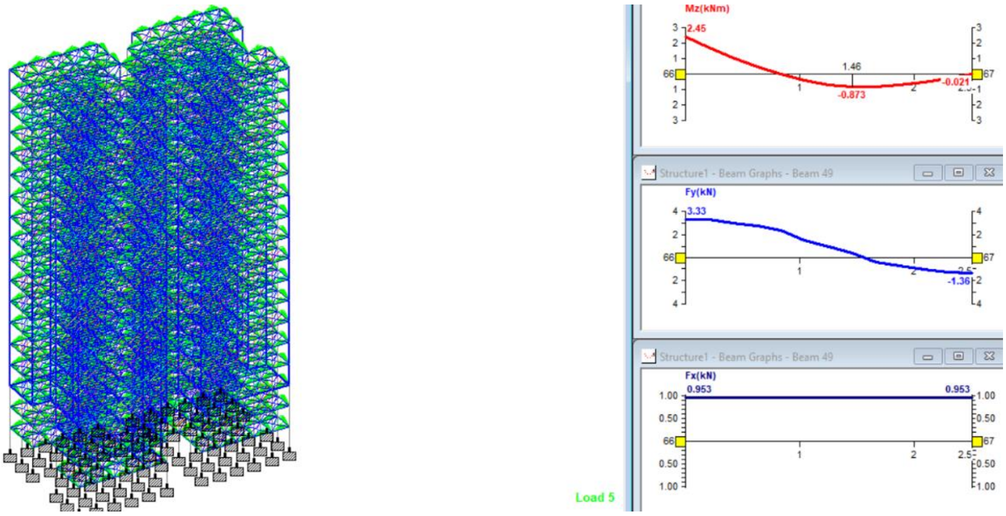

Figure 12: Live Load Displacement

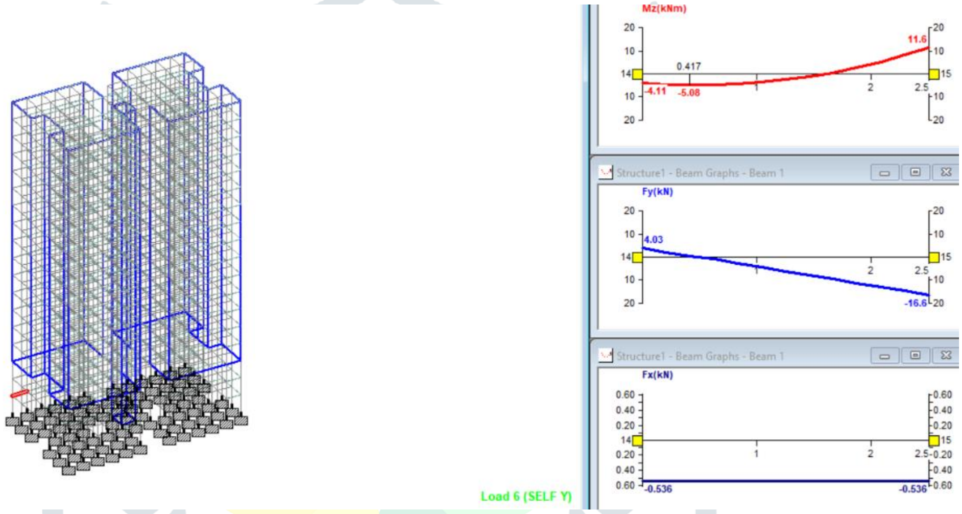

Figure 13: Dead Load Displacement

4. ACKNOWLEDGMENT

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