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SEISMIC PERFORMANCE OF STEEL PLATE SHEAR WALL

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Abstract - *This project aims to study the seismic performance of the steel plate shear wall system in a (G+6) story building. The building drawings are prepared in AUTOCAD. Equivalent static analysis is carried out with the help of ETABS. For the shear wall, we are using a steel plate of 8 mm thickness, bounded by a beam of ISHB 550. Here we are studying various responses such as bending moment, story displacement, story drift, and shear wall stress.*

Key Words: Steel plate shear wall, ETABS.

1.INTRODUCTION

Engineers can do nothing but increase vertical development because the population is growing while the amount of available land is staying the same. As they got taller and thinner, tall structures were more vulnerable to seismic damage. An earthquake can be described as any kind of seismic event which may be either natural or initiated by humans, which generates seismic waves. Earthquakes are caused commonly by the rupture of geological faults; but they can also be triggered by other events like volcanic activity, mine blasts, landslides, and nuclear tests.[1]

1.1 Shear Wall

Seismic load resisting systems are one of the many seismic mitigation strategies that have been advocated to lessen the damage. It improved the performance of the structure in the earthquake. Shear walls are frequently utilized in systems that resist the lateral load. A shear wall is a vertical structural element used to resist horizontal forces such as wind and earthquake forces. One of the breakthroughs in the steel plate shear wall.[2]

1.2 Steel Plate Shear Wall

Steel plate shear wall known as SPSW consists of vertical infill steel plates with one bay length and one-story height. These infill plates are placed in all stories or selected stories and are connected to the beam-column boundary.[2]

2. OBJECTIVE AND SCOPE

- Study the response of a (G+6) story building with a steel plate shear wall.
- To develop simplified models for the analysis of steel plate shear wall system using ETABS.
- Study the behavior of building with steel plate shear wall.

Nowadays most Highrise buildings have RCC shear walls which under earthquakes are prone to more damage and are irreparable. Whereas in steel plate shear wall (SPSW), the steel plate tends to buckle and deform and dissipate energy. As a result, it can be easily replaceable.

3. METHODOLOGY

- Literature review.
- The setting of objectives.
- Fixing the plan for the building.
- Preparation of drawings in AutoCAD.
- Importing to ETABS.
- Modeling of the building with steel plate shear wall.
- Analysis of steel plate shear wall.
- The modified approach of analysis of steel plate shear wall.
- Study on the response of steel plate shear walls such as bending moment, story displacement, and story drift.
- Result and discussion.

3.1 Geometric Characteristics

1. Concrete – M25
2. Steel – Fe415
3. Load Combination – As per IS Codes
4. Seismic Zone – III
5. Storey Height – 3 m
6. Wind Speed – 50 m/s
7. Zone Factor – 0.36

3.2 Frame and Slab Sections

Name	Dimension(mm)
Beam 1	300 * 450
Beam 2	230 * 450
Beam 3	230 * 380
Column 1	300 * 450
Column 2	250 * 400
Column 3	200 * 350
Steel Beam	ISHB 350
Slab 1	175
Slab 2	125
Steel Plate	8

Table-1: Dimensions of frames and slab sections

4. RESULTS

4.1 Story Displacement – Story Height Graph

Here a graph is plotted with Story displacement on X-axis and Story Height on Y-axis. For the load combinations - DCon 25 and DCon 21.

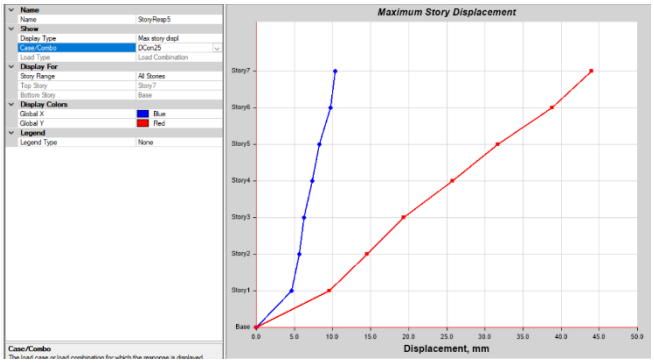

Fig-1: *Story* Displacement – Story Height Graph (DCon 25-0.9 DL+ 1.5 EY)

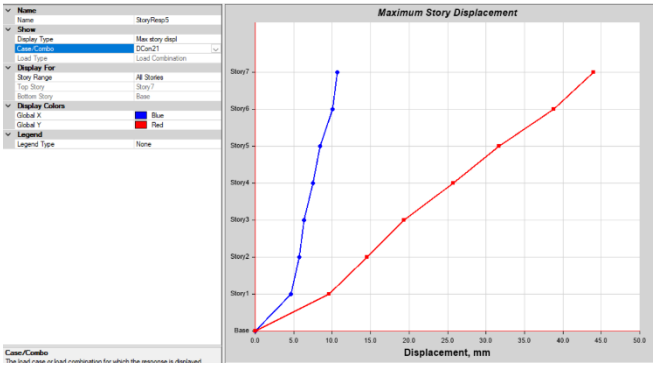

Fig-2: Story Displacement – Story Height Graph (DCon 21-1.5(DL+EY)

4.2 Steel Plate Shear Wall Stress

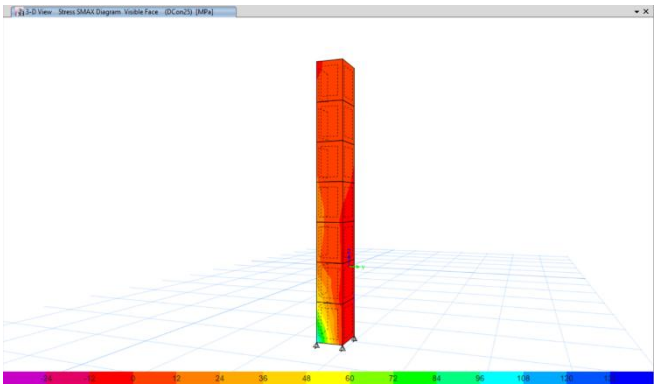

Fig-3: steel plate shear wall stress for DCon 25-0.9DL+1.5EY

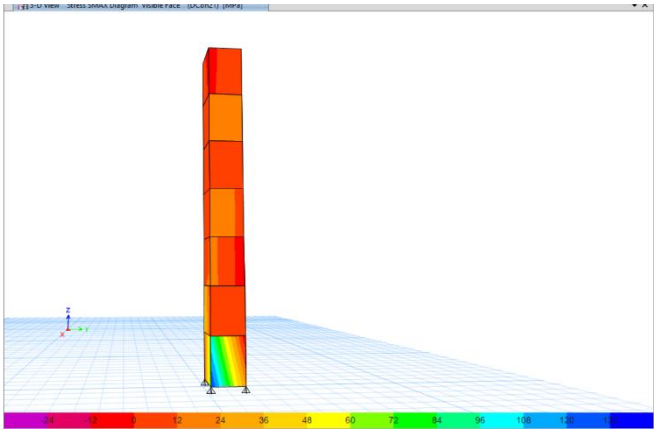

Fig4: steel plate shear wall stress for DCon 21-1.5(DL+EY)

4.3 Bending Moment

Story	Beam	Load Combination	Bending Moment-KN/M
3	B78	Dcon24	139.8192

Table-2: Beam Bending moment

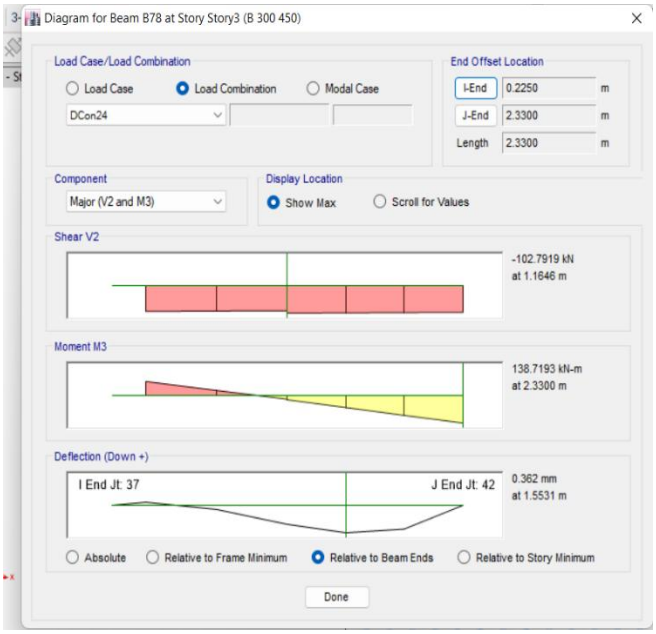

Fig-5: bending moment diagram for B78 – story 3 – Dcon 24- 0.9DL-1.5EX

Storey	Column	Load Combination	Bending Moment-KN/M
1	C46	Dcon22	113.813

Table-3: Column Bending moment

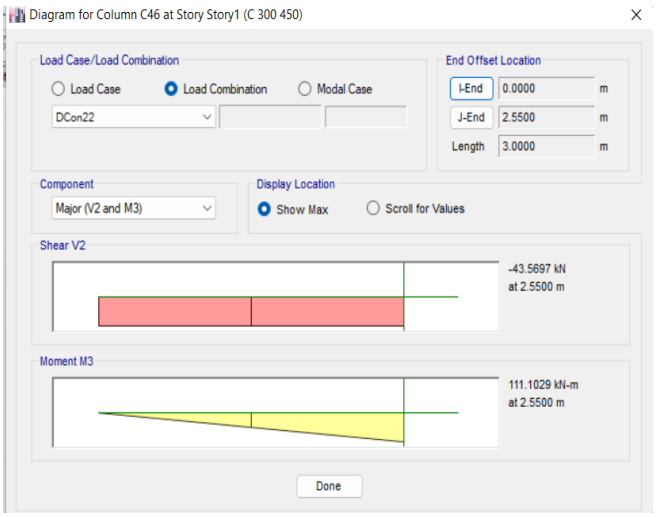

Fig-6: bending moment diagram for C46 – story 1 – Dcon 22- 1.5(DL-EY)

4.4 story drift

STORY	LOAD CASE	Steel Plate Shear Wall-Drift X
1	SEISMIC X	1.88
2	SEISMIC X	1.993
3	SEISMIC X	2.124
4	SEISMIC X	2.443
5	SEISMIC X	2.369
6	SEISMIC X	2.369
7	SEISMIC X	1.964

Table-4: Drift x

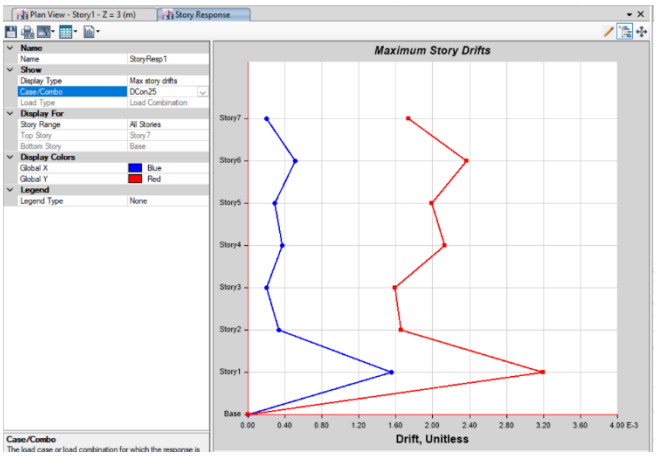

Fig-7: Story drift for DCon 25- 0.9DL+1.5EY

Story	Load Case	Steel Plate Shear Wall-Drift Y
1	SEISMIC Y	4.186
2	SEISMIC Y	2.853
3	SEISMIC Y	2.914
4	SEISMIC Y	3.754
5	SEISMIC Y	3.612
6	SEISMIC Y	4.056
7	SEISMIC Y	3.247

Table-4: Drift y

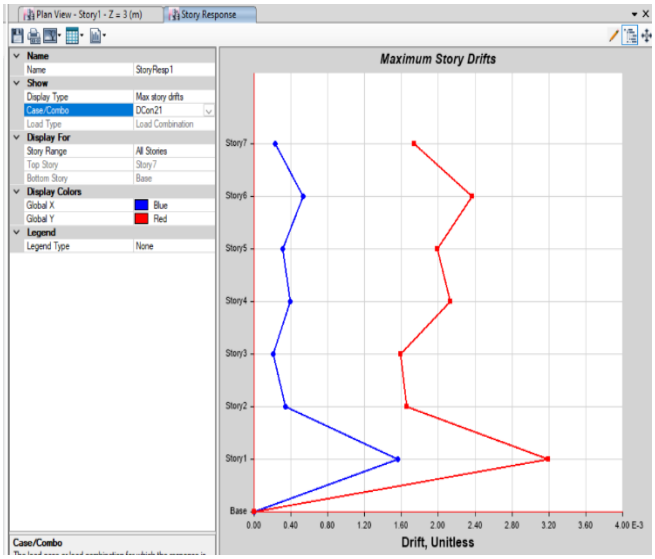

Fig-7: Story drift for DCon 21-1.5(DL+EY)

3. CONCLUSIONS

- Equivalent Static Analysis for a (G+6) story building was carried out.
- A steel plate shear wall was used instead of RCC shear wall.
- Steel plate shear walls can be used as an effective load resisting system instead of RCC shear walls.
- Storey drift for the building with steel plate shear wall was found to be 2.443 while earthquake force was in the x-direction,4.186 while earthquake force was in the y-direction.
- Storey drift was within the permissible limit as specified in IS Code.
- The bending moment is calculated and it is found that it was within the permissible limit.
- Design is found to be safe.

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