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Location of Steel Plate Shear Wall for Rectangular Building

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Abstract: ***This paper describes the analysis and comparison of steel building with steel plate shear wall (SPSW) at different locations. In this work time history analysis is carried out for 25 storey building situated in seismic zone 3.Analysis of building is carried out using ETab software. The main parameters consider in this paper to compare the seismic performance of buildings are displacement and base shear .The models are analyzed as per IS 1893:2002 and IS 800:2007.***

Keywords: Steel plate shear walls, Time History Analysis, Seismic Zone, Seismic Performance, Base Shear

1. Introduction

Nowadays there has been large increase in the number of tall buildings. Generally these structures have low loads on them. So they have elastic behavior. But under large seismic event these structures subjected to forces greater than its elastic limit. Therefore the effects of lateral loads have greater importance.

A. Sources of Lateral Loads

There are different sources of lateral loads. That is

Wind
Seismic
Flood or Tsunami
Earth pressure

In this generation also foreign countries are deploying steel structures. The steel structures conquer the world soon. So we must know about steel structures and their lateral load resisting systems.

B. Load Resisting Systems

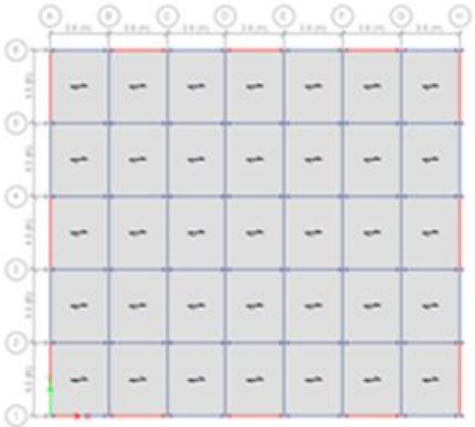
There are different lateral load resisting systems like,

Moment resisting frames
Bracings
Steel plate shear wall

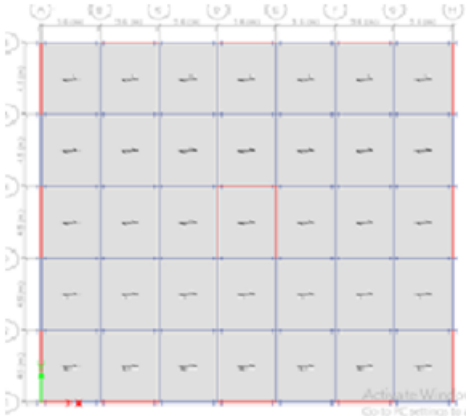
Objective of this paper is to find the effective location of steel plate shear wall (SPSW).

During the last decades many researchers concentrated on SPSW. They found that a tension strain in plate is not uniform and it is higher at boundary elements [1]. Many experiments highlighted the importance of sufficient strength of boundary elements for effective performance of SPSW [3].Connection between boundary elements and infill plate are also investigated [4] and found that regardless the connections boundary elements shows good performance. Modular construction techniques are also suggested for low seismic regions. [5].Researchers also investigated the length of connection between boundary elements and SPSW.

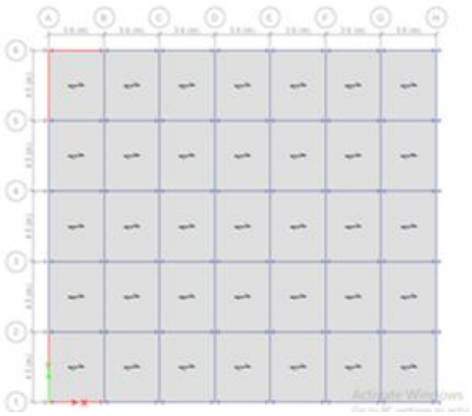
2. Structural Plan



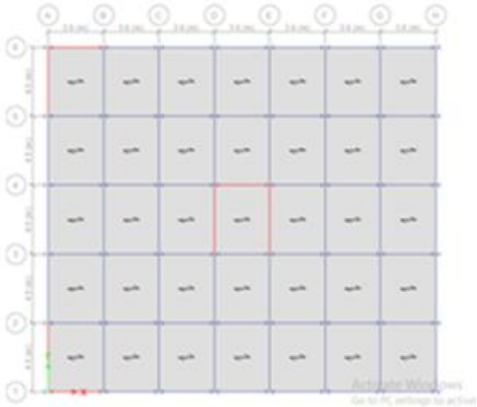
Model 1: SPSW at alternate positions



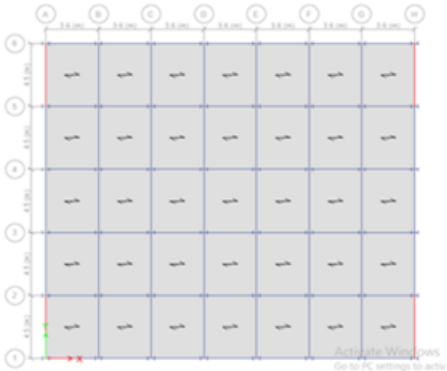
Model 2: SPSW at Alternative Positions and at Core



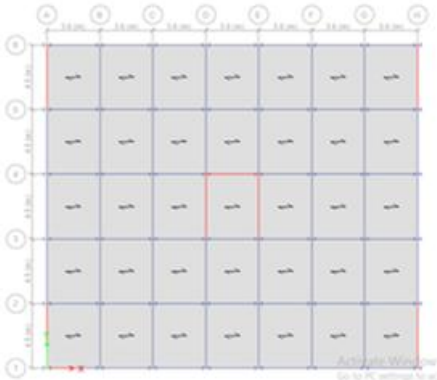
Model 3: SPSW at Left Corner Positions



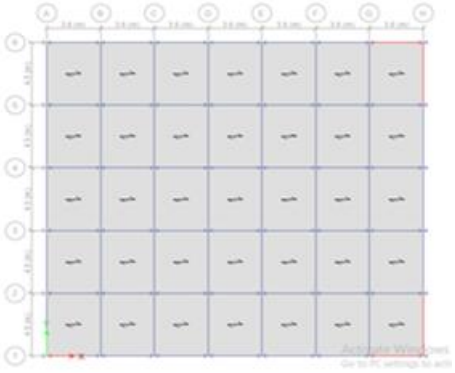
Model 4: SPSW at Left Corner Positions and At Core



Model 5: SPSW at Left and Right Extreme Sides



Model 6: SPSW at Left and Right Extreme Sides and At Core



Model 7: SPSW At right Corner Positions

Model 8: SPSW At right Corner Positions and at Core

Model 9: SPSW at top and bottom extreme sides and At Core

Model 10: SPSW at All Corner Positions and At Core

Figure 1: Plan of selected building with SPSW at different locations

A. Data Assumed for the Structure

The building is considered as a 25 storey building for residential purpose. Each storey has a height of 3m.The plan dimensions of building is 24.5m x 22.5m.Spacing between columns in x direction is 3.6 m and y direction is 4.5 m. It is considered as the building is located in seismic zone 3.Loadings are according to the codal provisions. Thickness of SPSW is taken as 6 mm.

B. Seismic Analysis Using IS 1893(PART 1): 2002

For design of steel structures following load combinations are given in IS 1893:2000
1.7 (DL+LL)
1.7 (DL+ELX)
1.7 (DL+ELY)
1.7 (DL-ELX)
1.7 (DL-ELY)
1.3 (DL+LL+ELX)
1.3 (DL+LL+ELY)
1.3 (DL+LL-ELX)
1.3 (DL+LL-ELY)

The parameters used for compare the seismic performance are;

Displacement
Base shear

3. Comparison of Results

Results are tabulated below.

Table 1

MODEL	BASE SHEAR (KN)	DISPLACEMENT (mm)	NUMBER OF PLATES
1	154	8.3	12
2	179	10.6	15
3	112	171	4
4	115	93	7
5	119	119	4
6	125	93	7
7	112	171	4
8	115	94	7
9	102	68	7
10	197	40	11

4. Conclusion

Here we can see that maximum base shear is for model ten. Number of plates used is 11, and the displacement is 40 mm which is within the limits. So this location is selected as the effective location of SPSW.

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