# EFFECT OF POSITION OF STEEL PLATE SHEAR WALL WITH R.C. FRAME

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***Abstract: Structure outline and investigation is important to deliver the ability of opposing all the connected load without disappointment amid its expected life. The plan of elevated structures is represented by horizontal loads for the most part because of earthquake. The present investigation portrays the examination and plan of G+19(story) tall structure with Steel Plate Shear Wall (SPSW).Steel Plate Shear Wall(SPSW) have been utilized as parallel load opposing framework with development of strain field activity. The plan and examination of the R.C. working with Steel Plate Shear Wall is done utilizing programming ETABS. The properties of Steel plate shear divider framework incorporate the solidness for control of basic displacement, story shear, overturning moment. The investigation is to convey reaction range examination of tall structure R.C. working by upgrading the situation of divider and decrease the segment. Utilizing reaction range examination look at the parameters like greatest story relocation, most extreme story float, base response and toppling minute accordingly range X and upsetting minute accordingly range Y.in this paper using response spectrum method for analysis.***

***Index Terms –maximum story displacement, story shear, base reaction, steel plate shear wall, reduce column section***

## I. INTRODUCTION

Shear dividers have been for quite some time utilized as horizontal load opposing frameworks. The fundamental capacity of steel plate shear divider is to oppose flat story shear and overturning moment because of horizontal burdens. Steel plate shear dividers (SPSW) can be utilized as horizontal load opposing framework for structures. A normal SPSW (Fig.1) comprises of firm even and vertical limit components (HBE and VBE) and infill plates. [1]Recent explores have exhibited that steel plate shear dividers, SPSWs, can go about as powerful and monetary seismic load opposing frameworks in the high hazard zones. SPSWs have high flexible solidness, substantial relocation pliability, and stable hysteretic conduct and high vitality disseminating capacity.[2] There are two kinds of SPSW system,(1) Standard framework utilized sole horizontal load opposing framework and stick compose pillar to section connection.(2) Dual framework is a piece of a parallel load opposing framework and introduced Since 1970's, steel shear dividers have been utilized as the essential parallel load opposing framework in a few present day and imperative structures. At first, and amid 1970's, solidified steel shear were utilized as a part of Japan in new development and in the U.S. for seismic retrofit of the current structures and additionally in new structures. In 1980's and 90's, unstiffened steel plate shear dividers were utilized as a part of structures in the United States and Canada. Prior outlines utilized stiffeners to anticipate clasping of infill plates under shear stresses.

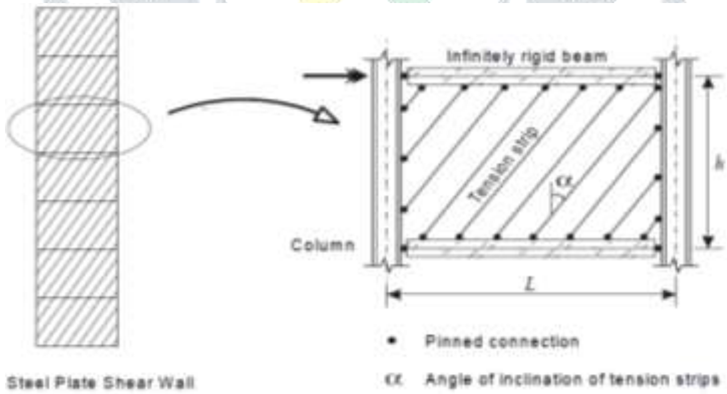



**Figure 1: Typical Steel Plate Shear Wall[1]**

## II. CONNECTION BETWEEN R. C. FRAME AND SPSW

The RC outline is wanted to be "unique" bendable moment frame. In any case, transitional RC moment edges may likewise be utilized alongside proper R factor. Customary moment frame are not suggested. Following two associations are recommended to interface the steel shear divider to RC minute edge. In the left detail, a constant plate is set on the inside face of segments and pillars with shear studs behind the plate implanted inside cement. In the detail to one side, the limit bars and segments are composite with steel segments and pillars installed inside the RC limit components. The bars and sections have "blade" plates which later will be utilized to weld the steel plate to them**.**

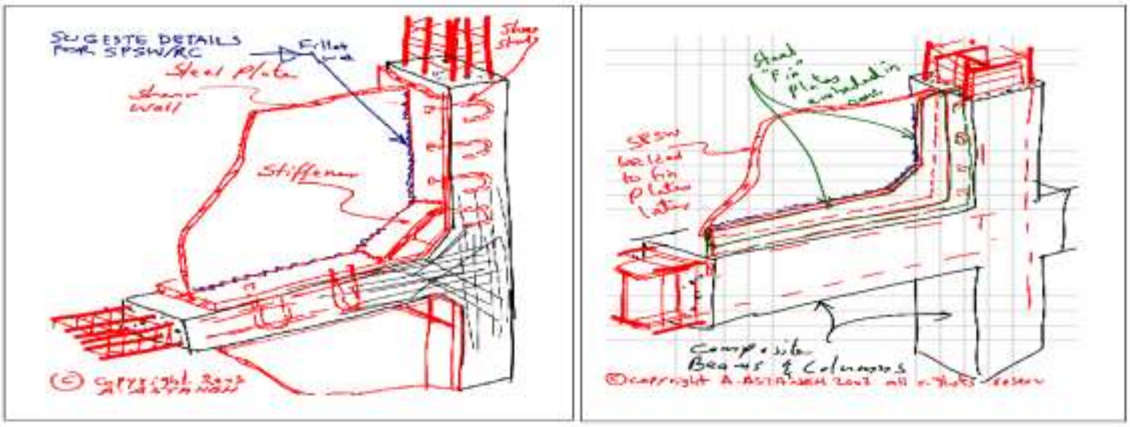
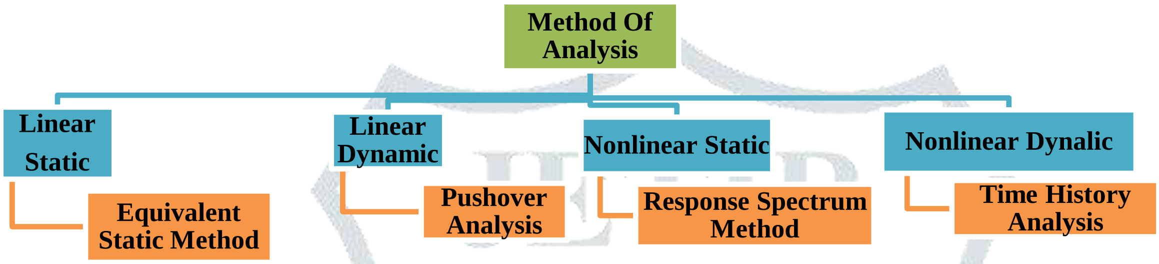


**Figure 2: Connection between R. C. Frame and SPSW [13]**

## III. WORK METHODOLOGY

Method of analysis.




A modular investigation of the structure is completed to get mode shapes, frequencies and modular cooperation factors. Using the increasing speed reaction range, and the reaction range technique for examination is created utilizing the accompanying advances. Comparable static load is determined which will give an indistinguishable greatest reaction from that acquired in every method of vibration. Maximum modular reactions are consolidated to discover add up to greatest reaction of the structure. The initial step is the dynamic examination while, the second step is a static investigation. The initial two stages don't have approximations, while the third step has a few approximations. Subsequently, reaction range examination is called a surmised investigation; however applications demonstrate that it gives generally a decent gauge of pinnacle reactions. Method is created for single point, single part excitation for traditionally damped straight frameworks. Notwithstanding, with extra approximations has been stretched out for multi-point-multi segment excitations and for non-traditionally damped frameworks. Response spectrum method may be performed for any building using the design acceleration spectrum specified in below equation (1).

$$A_h = \frac{\frac{Z}{2} x \frac{Sa}{g}}{\frac{R}{I}} \text{ (IS 1893:2016 cl 6.4.2, pg. 9)} \qquad \text{Eq. (1)}$$

Where,
Z is zone factor=0.16 for this study
I is importance factor=1.5
R is response reduction factor=5
Sa/g is spectral acceleration coefficient

### 3.1 BASIC DATA FOR THIS STUDY

**Table 1: General Data of Study**

| | | |
|---|---|---|
| No.of story | G + 19 | |
| Plan Area | 34 m x 32m | |
| Each story height | 3 m | |
| Concrete Grade | M30 | |
| Steel Grade | HYSD415 | |
| Steel plate Shear wall | Fe 345 | |
| Steel plate thickness | 8mm,12mm,16mm,20mm,24mm,28mm 32mm,36mm,40mm,44mm,48mm,52mm 56mm,60mm | |
| Masonry wall thickness | 175mm | |
| R.C shear wall | 150mm | |
| Beam size | B1= 230mm x 600mm(for span 8m) | |
| | B2= 230mm x 525mm(for span 6m) | |
| | B3= 230mm x 450mm(for span 2m) | |
| Slab Thickness | 175mm | |
| Live load | All shops and corridor | 5 kN/m² |

| | | |
|---|---|---|
| | (IS875(Part2)-1987) | |
| | Toilets (IS875(Part2)-1987) | 2 kN/m² |
| Floor finish | 1 KN/m² | |

### 3.2 COLUMN SECTION

**Table 2: different column section data**

| Column number | Group 1 | | Group 2 | | Group 3 | |
|---|---|---|---|---|---|---|
| | Base to 9th floor | 9th to 20 floor | Base to 9th floor | 9th to 20 floor | Base to 9th floor | 9th to 20 floor |
| C1 | 1000 x 750 | 900 x 750 | 900 x 750 | 900 x 600 | 750 x 600 | 750 x 525 |
| C2 | 300 x 450 | 300 x 450 | 300 x 450 | 300 x 450 | 300 x 450 | 300 x 450 |
| C3 | 900 x 750 | 600 x 750 | 900 x 600 | 750 x 600 | 750 x 525 | 600 x 525 |

### 3.3 ETABS2016 PLAN

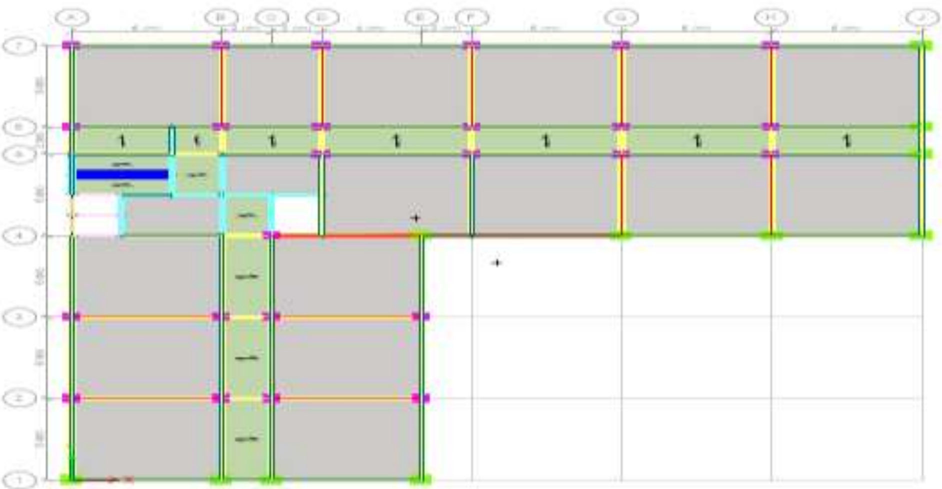


**Figure 3: ETAB2016 plan layout**

### 3.4 REGULAR AND IRREGULAR CONFIGURATION

According to IS 1893(Part 1):2016,cl 7.1,pg-14, working with straightforward customary geometry and consistently circulated mass and solidness in design and in height endure significantly less harm than working with sporadic setup. In view of my investigation design having L shape setup it is conceivable to create torsional impact. A building is said to be torsional sporadic when, the greatest even relocation of any floor toward the parallel power toward one side of the floor is in excess of 1.5 times its base level uprooting at the furthest end of a similar floor toward that path.

**Check for torsional irregularity** ***(IS 1893(Part 1):2016, cl 7.1, pg-14)***

- For x-direction check for torsional irregularity

$$\frac{\text{max.horizontal displacement}}{\text{min.horizontal displacement}} = \frac{1.215E-07}{1.159E-07} = 1.04$$

Which is not more than 1.5 so it is under permissible limit,

- For y-direction check for torsional irregularity

$$\frac{\text{max.horizontal displacement}}{\text{min.horizontal displacement}} = \frac{9.591E-08}{8.733E-08} = 1.09$$

Which is not more than 1.5 so it is under permissible limit.

**Maximum horizontal displacement at story21**

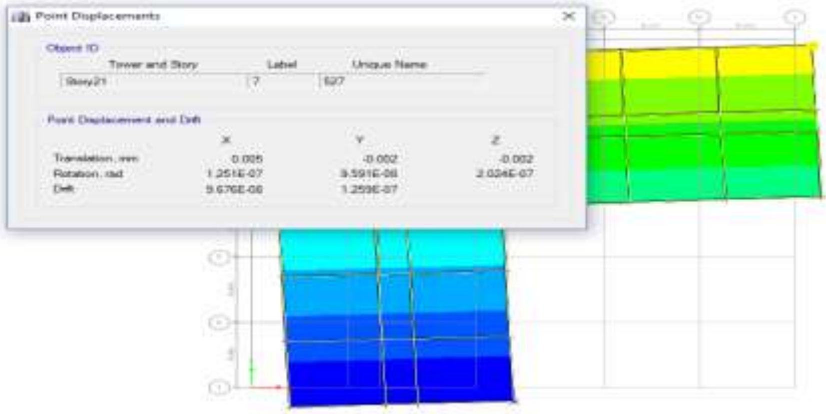



**Figure 4: Maximum Horizontal Displacement**

**Minimum horizontal displacement at story21**

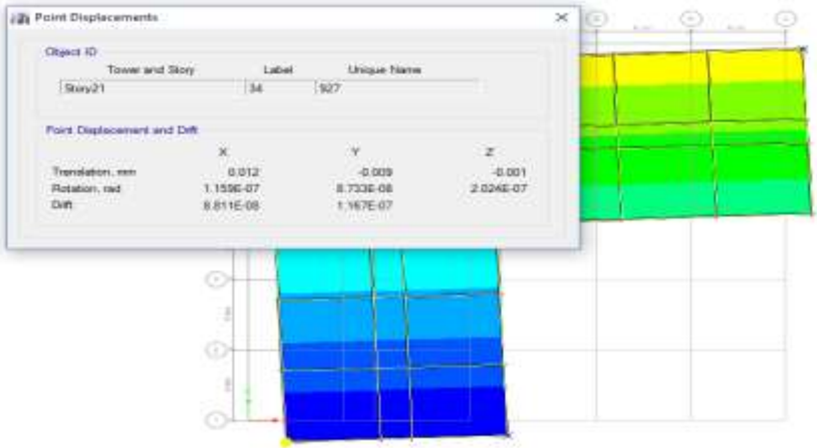



**Figure5: Minimum horizontal displacement**

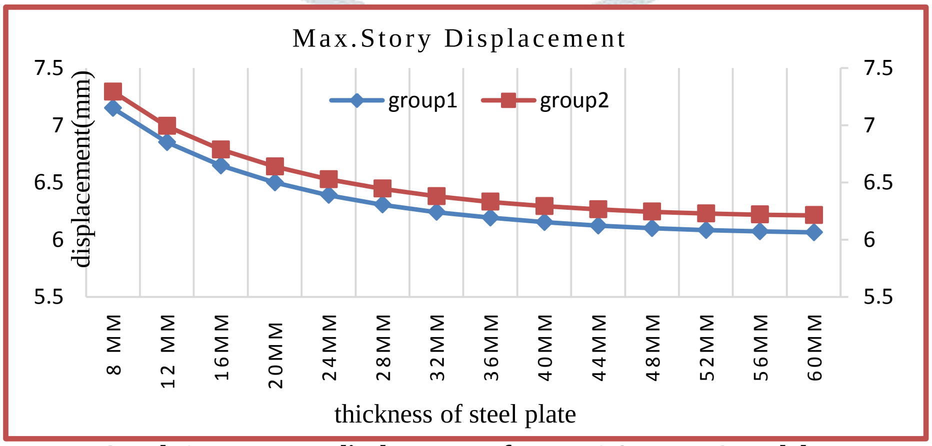
## IV. RESULT AND DISCUSSION

### 4.1 MAXIMUM STORY DISPLACEMENT

As per IS 16700:2017, cl 5.4.1, pg-5 maximum displacement shall be limited to H/250 when factored earthquake load is applied H is total height of building from ground level to terrace. For this study total building height is 60m (from ground level to terrace). [16] So, permissible maximum story displacement value is 240mm for this study.

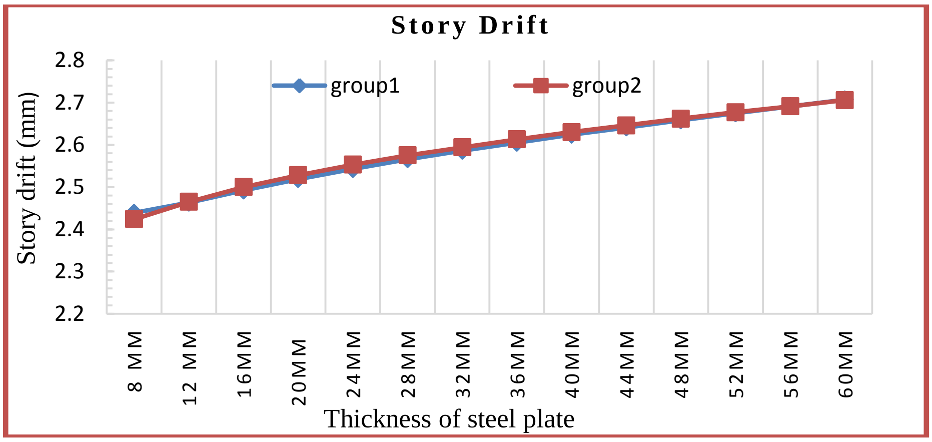
### 4.2 STORY DRIFT

As per IS 1893 (part 1):2016, cl 7.11.1.1 story drift in any story shall not exceed 0.004 times the story height. Here each story height is 3m. [16]So, allowable story drift is 12m for this study.



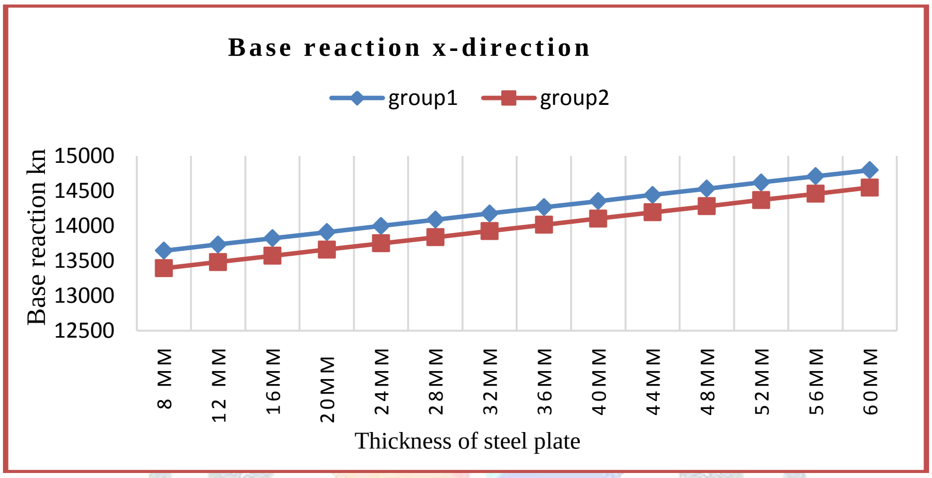

**Graph 1: Max story displacement of group 1 & group 2 modal**

In group 1 modal and group 2 modal maximum story displacement in 8mm thick steel plate shear wall. And both cases minimum displacement in 60mm thick steel plate shear wall, brief detail explain in graph 1.




**Graph 2: Story drift both group 1 & group 2 modal**

For this study allowable story drift is 12 mm.in graph 2 maximum story drift is 2.707 in group a modal having 60 mm thick steel plate shear wall.in group 2 modal maximum story drift is 2.706mm.




**Graph 3: Base reaction both group 1 & group 2 modal**

Base reaction of group 1 and group 2 modal are shown in graph 3.base reaction value is increases with the thickness of steel plate is increases. Maximum base reaction in 60mm thick steel plate shear wall in group 1 and group 2 modal.

## CONCLUSION

According to study maximum displacement of group 1 modals is in 8mm thick steel plate shear wall structure is 7.149mm in x-direction and 7.669 mm in y-direction, this value is under permissible limit. Thickness of steel plate shear wall varies up to 12 mm to 60mm but change in displacement is minor. According to study maximum displacement of group 2 modals is in 8mm thick steel plate shear wall structure in 7.293mm x-direction and 8.823 mm in y-direction, this value is under permissible limit. Thickness of steel plate shear wall varies up to 12 mm to 60mm but change in displacement is minor. Based on maximum displacement group 2 modal 12mm thick steel plate shear wall is suitable for this “L shape”tructure.beacuse displacement value is under permissible value in both group 1 and group 2 modal but cost of group 2 modal is reduce just because column section is reduce.

## ACKNOWLEDGMENT

I would like to express my special thanks to gratitude to my guide Prof. Jasmin Gadhiya and Co-guide Prof. Hardik Patel who gave me the golden opportunity to do this project on topic Effect of position of steel plate shear wall with R.C. frame, which also helped me in doing a lot of research and I came to know about so many new things. Also, the facts of works provided in this paper is dedicated to all the civil engineer to look world in smart way. And lastly, I want to thank my parents and friends for their unconditional support.

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