International Journal of Technical Innovation In Modern Engineering & Science (IJTIMES),(UGC APPROVED)
Impact Factor: 5.22 (SJIF-2017),e-Issn:2455-2585
"Recent Trends in Structural Engineering" (RTSE-2018)
Volume 4, Special Issue 01, Sept.-2018

EFFECTIVENESS OF STEEL PLATE SHEAR WALL FOR MULTI STOREY BUILDING.

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Abstract-The steel plate shear wall (SPSW) system has emerged as a promising lateral load resisting system. In recent years. Steel plate Shear walls are vertical elements of the horizontal force resisting system. Steel plate shear walls have been used more and more in the steel Structures to resist earthquake and wind forces. This system offers several advantages as compared to the other usual lateral load resisting systems. Steel saving speed of erection, reduced foundation cost, and increased usable space in buildings are some apparent advantages of the steel plate shear walls. Steel plate shear walls also provide major stiffness against building storey drift for the multi storey building. In this review describes the analysis and design of multi storey building frame with Steel plate shear wall (SPSW). In this review equivalent static analysis is carried out for steel moment resisting building frame having (G+6) storey situated in zone V. The analysis and design of steel plate shear wall and the multi storey building are carried out using Software E-TABs 2016. In this review comparatives study of Steel plate shear wall and frame without shear wall has been taken. The main parameters considered in this review are to compare the seismic performance of buildings such as; bending moment, shear force, deflection, time history, storey drift, base shear. The result from Steel plate shear wall review is that the steel plate increases stiffness of the structure.

Keywords- steel plate shear wall, seismic force, reduced foundation cost, E-Tabs, time history, storey drift, (G+6) storey situated in zone V.

I. INTRODUCTION

Steel plate shear walls have been used more and more in the steel structures to resist earthquake and wind forces. Since 1970 steel plate shear wall have been used in several modern lateral load resisting system. This paper presents an analytical study on seismic performance of multi storey building with and without steel plate shear wall. In the past two decades the steel plate shear wall (SPSW), also known as the steel plate wall (SPW), has been used in a number of buildings in Japan and North America as part of the lateral force resisting system. In earlier days, SPSWs were treated like vertically oriented plate girders and design procedures tended to be very conservative. Nippon Steel Building, Tokyo, Japan— 20-story building, Shinjuku Nomura Building, Tokyo, Japan— 51-story building (693'), Sylmar Hospital, Los Angeles, CA—six-story building are best examples of use of steel plate shear wall. The steel plate shear walls consist of thin vertical steel plates welded or bolted to their surrounding columns and beams. These panels can be installed in one or more bays in all the stories of a steel structure. The surrounding frame may be either simple or moment-resisting.

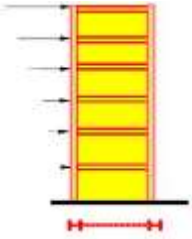

Figure1.1: A typical steel plate shear wall.

A. TYPES OF STEEL PLATE SHEAR WALL

There are two types of steel plate shear wall:-
(1) Stiffened steel plate shear wall
(2) Unstiffened steel plate shear wall

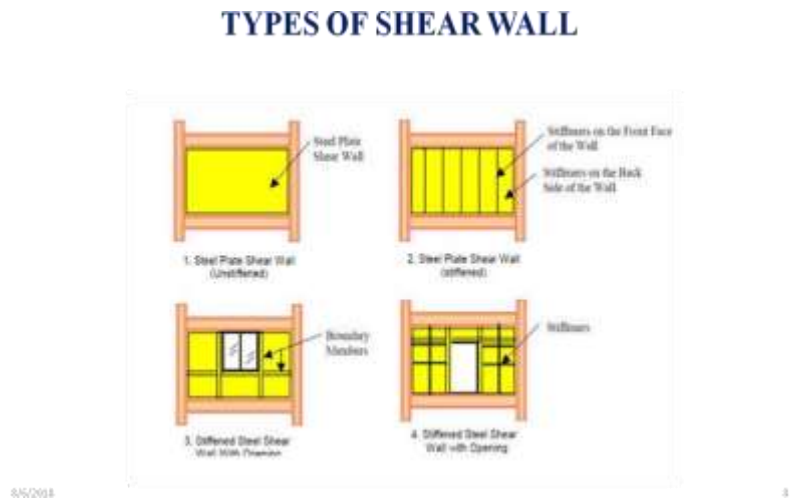

Fig.1: Types of Steel plate Shear Wall

In Stiffened SPSW shear strength capacities based on the plate girders requirements to the shear buckling in the web plate. Shear strength of Un-Stiffened SPSW depends on relative stiffness and strengths of the boundary element.

B. ADVATAGES OF STEEL PALTE SHEAR WALL.

- Steel shear walls are very efficient and economical lateral load resisting systems.
- The steel shear wall system has relatively high initial stiffness, thus very effective in limiting the drift.
- Compared to reinforced concrete shear walls, the steel shear wall is much lighter which can result in less weight to be carried by the columns and foundations as well as seismic load due to reduced mass of the structure.
- Due to relatively small thickness of steel plate shear walls compared to reinforced concrete shear walls, from architectural point of view, steel plate shear walls occupy much less space than the equivalent reinforced concrete shear walls. In high-rises, if reinforced concrete shear walls are used, the walls in lower floors become very thick and occupy large area of the floor plan.
- Compared to reinforced concrete shear walls, steel plate shear walls can be much easier and faster to construct when they are used in seismic retrofit of existing building.

Steel plate shear wall systems that can be constructed with shop welded-field bolted elements can make the steel plate Shear walls more efficient than the traditional system

II. REVIEW OF LITERATURE

A. Ugale Ahish B.et al.in observed that due to use of SPSW in building there is decrease in value of bending moment, shear force, deflection and axial force for some columns and also quantity of steel is reduced. In comparison with conventional bracing systems, steel panels have the advantage of being a redundant, continuous system exhibiting relatively stable and ductile behavior under severe cyclic loading (Tromposch and Kulak, 1987). This benefit along with the high stiffness of the plates acting like tension braces to maintain stability, strongly qualifies the SPW as an ideal energy dissipation system in high risk seismic regions, while providing an efficient system to reduce lateral drift. Thus, some of the advantages of using SPWs compared with conventional bracing systems are as follows:

- Reduces seismic force demand due to higher SPW ductility characteristics and inherent redundancy and continuity.
- Accelerates structural steel erection by using shop-welded and field-bolted steel panels, and thus, less inspection and reduced quality control costs
- Permits efficient design of lateral-resisting systems by distributing large forces evenly.

B. Pundhkar r.s using response spectrum analysis as per IS 800:2002 and IS 800:2007 we compare the seismic performance of the Building for Deflection.In this literature author take model of (G+19)storey situated in zone III then compared with moment resisting frame (MRF) and X-braced frame. Modeling is done by using strip modeling. The analysis of steel plate shear wall building is carried out using Software SAP2000 V15. The main parameter considers in this paper to compare the seismic performance of buildings for deflection. The models are analyzed by Response Spectrum analysis as per IS 1893:2002 and design has been carried out by using IS 800-2007.

Strip Modeling: This is the most popular way of modeling thin, non-compact shear walls. It is purely based on the diagonal tension field action developed immediately after the buckling of the plate. This type of modeling is recommended by the code of Canada, the CAN/CSA-S16-01 in the analysis and design procedure of the SPSWs. In the analysis software the steel plate in the wall panel is to be replaced by a series of truss members (struts) or the strips along the tension field. There are two ways of modeling by this method. The first one is the strips inclined at uniform angle with the horizontal and the other is the multi-strip model as shown in the following fig. 1and fig. 2. Respectively.

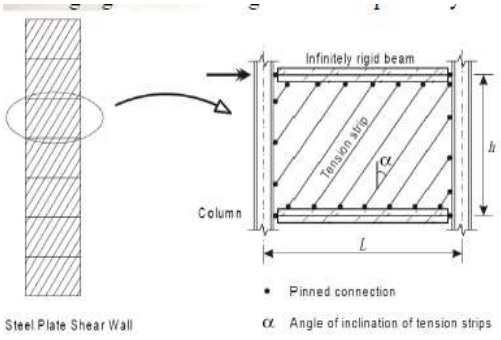

Fig. 1: Strip Model Representation of a SPSW

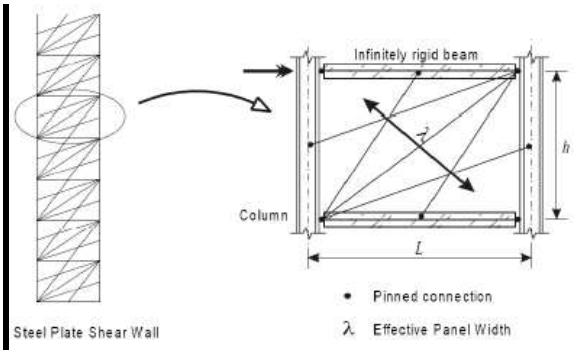

Fig. 2: Multi-angle strip model of a SPSW

C. Anjaana R K Unnithan et al. researched on response spectrum curve, displacement, velocity and acceleration reduces as the damping increases and finally sets to zero. Maximum displacement occurs at a time period of 3.33 sec. Maximum velocity occurs at a time period of 0.416 sec. Maximum acceleration occurs at a time period of 0.4247 sec. From 4.75mm to 12.75mm This structure was initially design using reinforced concrete shear wall but according to Engineering News record (1978) due to patent problem the RC walls were converted to steel shear walls. The structure consisted of moment perimeter frame and "T" shaped stiffened steel shear walls. The wall panels were about 10-ft high and 16.5 feet long and had vertical stiffeners on one side and horizontal stiffener on the other side. The panels were connected to boundary box and H steel columns using bolts. The construction contractor in this case has made a comment that "The next high-rise building we do won't likely be designed with bolted steel seismic walls" (ENR, 1978). According to ENR article, the contractor on another high-rise in Tokyo switched from bolted steel panels to welded panels after failing to achieve the required precision.

D. Qiuhong ZHAO and **Abolhassan ASTANEH-ASL** observe that there are three types of steel plate shear wall systems are shown in Figure 1. In type I, the steel plate shear wall is welded (or bolted) to the boundary elements in only one bay. The system is a "dual" system with the moment frame and the steel shear wall in the same bay. In type II, two type I systems are connected by the horizontal coupling beams and work together. Type III is an innovative steel shear wall system developed and used by Magnusson Klemencic Associates. It is similar to type II, except that the edge columns in the moment frame are very large concrete-filled steel tubes (CFT's) instead of the usual wide flange (WF) section. Due to the high axial stiffness of the CFT's, most of the gravity load is carried by them. These large CFT columns are connected to horizontal beams using special moment connections to form special ductile moment frame.

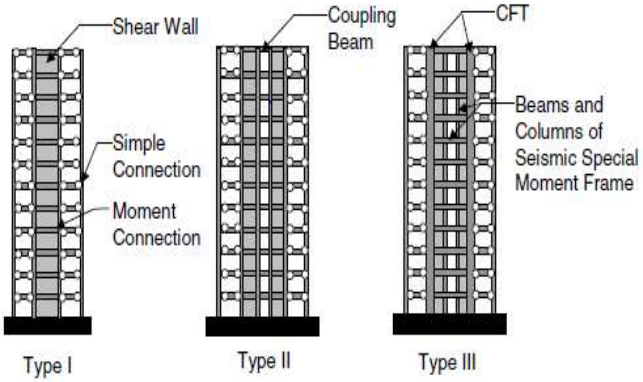

Figure 1. Three common types of steel shear wall systems.

The focus of steel shear wall project was the behavior of the innovative steel shear wall system Type III, which was developed and used by Magnusson Klemencic Associate.

III. CONCLUSION

From the study of above research paper it can be concludes that

1. The steel plate can be used for high rise building to dynamic evaluation of lateral force resisting system.
2. In SPSW in building there is decrease in value of bending moment, shear force, deflection and axial force for some columns and also quantity of steel is reduced.
3. There are three types of shear wall system in type I, the steel plate shear wall is welded (or bolted) to the boundary elements in only one bay. In type II, two type I systems are connected by the horizontal coupling beams and work together. Type III is an innovative steel shear wall system developed and used by Magnusson Klemencic.

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