



Introducing two most common types of shear walls and their construction methods

Ali Fathalizadeh^{a*}

^a*Iran University of Science and Technology, Tehran, Iran*

Abstract

In this article we have reviewed shear walls as an effective way for resisting lateral loads in tall buildings. Then two most popular types of shear walls, steel and concrete walls, are reviewed and their construction methods are discussed. At the end we have concluded that shear walls are one of the most effective and operational solutions for resisting earthquake and wind forces.

© 2017 Journals-Researchers. All rights reserved

Keywords: Shear walls, Concrete shear wall, Steel shear wall, Construction, Lateral loads

1. Introduction

In structural engineering, a shear wall is a structural system composed of braced panels (also known as shear panels) to counter the effects of lateral load acting on a structure [1]. Wind and seismic loads are the most common loads that shear walls are designed to carry. Vibrations, which are caused under the earth's surface, generate waves, which disturb the earth's surface, termed as earthquakes. It was said that earthquakes would not

kill human but structures, which are not constructed with considering the earthquake forces do. Shear walls are built to resist the lateral forces produced during earthquake or wind. Shear walls behavior depends upon the material used, wall thickness, wall length, wall positioning in building frame also [2].

* Corresponding author. e-mail: ali.fath91@yahoo.com.

2. Structural Forms of Shear Walls

Monolithic shear walls are classified as short, squat or cantilever according to their height to depth ratio [Fig.1].

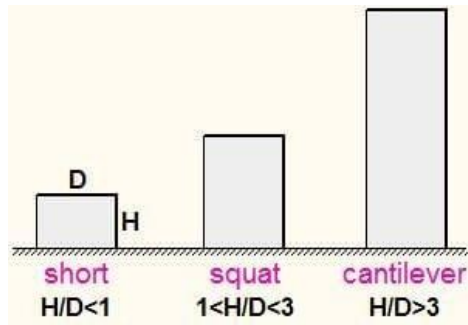


Fig.1 Shear walls classifying according to their height to depth ratio

Generally, shear walls are either plane or flanged in section [Fig.2].

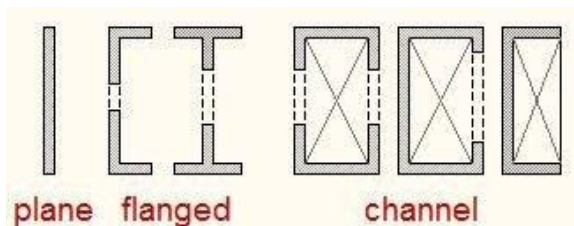


Fig.2 Shear walls section types

3. Positioning of Shear Walls

Structurally, the best position for the shear walls is in the center of each half of the building but this is rarely practical [Fig.3].

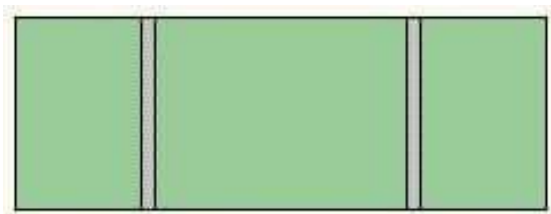


Fig.3 Positioning of shear walls

4. Concrete shear walls

Concrete shear walls are one of the most assured types of shear walls. Buildings with cast-in-place reinforced concrete shear walls are widespread in many earthquake-prone countries and regions [3]. This type of construction has been practiced since the 1960s in urban regions for medium to high-rise buildings (4 to 35 stories high).

4.1. Structure of a concrete shear wall

A concrete shear wall consists of reinforcements and concrete. Which can be built in two ways: 1. pre-cast [Fig.4], 2. Cast in place [Fig.5]. But both of them are almost similar in their reinforcements [Fig.6] [4].



Fig.4 Pre-cast shear wall

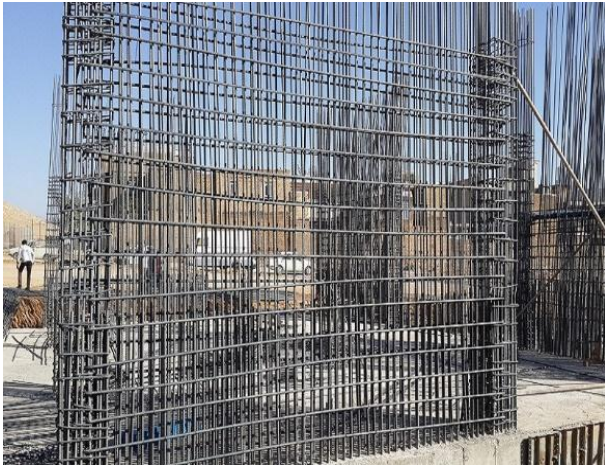


Fig.5 A cast in place shear wall

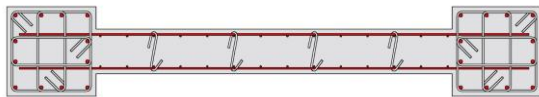


Fig.6 Reinforcement of shear walls

4.2. Construction of a concrete shear wall

After foundation reinforcement finished and before pouring its concrete, shear wall starter bars should be placed into foundation reinforcement [Fig.7]. Then, after concrete pouring of foundation, formworks should be installed [Fig.8]. Please note that if there is not enough space through the wall to install the reinforcements, form works should be installed after reinforcement works [Fig.9]. The next phase is pouring concrete into the forms. Forms can be removed after a proper time when concrete has reached a sufficient resistance (As mentioned in valid codes).



Fig.7 Shear wall's starter bars placing



Fig.8 formworks installation



Fig.9 formworks installation and concrete pouring

5. Steel Shear walls

A steel plate shear wall (SPSW) consists of steel infill plates bounded by boundary elements. They constitute an SPSW. Its behavior is analogous to a vertical plate girder cantilevered from its base [5]. Similar to plate girders, the SPSW system optimizes component performance by taking advantage of the post-buckling behavior of the steel infill panels. An SPSW frame can be idealized as a vertical cantilever plate girder, in which the steel plates act as the web, the columns act as flanges and the cross beams represent the transverse stiffeners [6].

5.1. Construction of a steel shear walls

After foundation reinforcement finished and before pouring its concrete, shear wall Anker bolts should be placed into foundation reinforcement [Fig.10].



Fig.10 shear wall's Anker bolts

Then column plates should be installed and leveled by grout. Afterwards like all other steel frame buildings, columns and beams can be installed [Fig.11].



Fig.11 column plates installation

Then steel plates are carried to the place by crane and installed to columns and beams by bolts or welding [Figs.12-14] [7].



Fig.12 Carriage and installation of steel shear walls

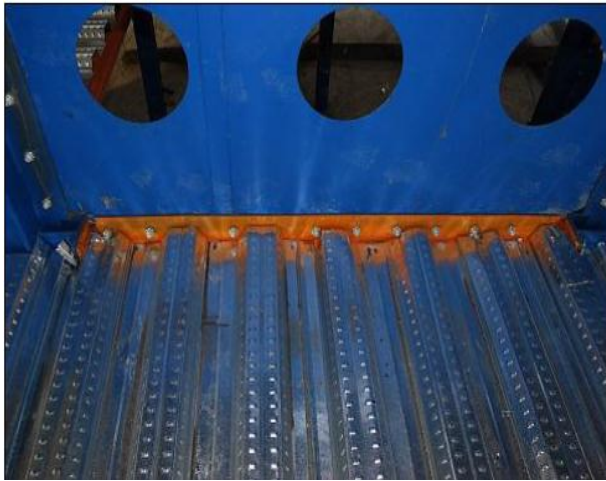


Fig.13 Steel shear walls installed by bolts



Fig.14 Steel shear walls installed by welding

6. Conclusion

With buildings rising in stories, engineers are trying to find new systems for designing and constructing structures with better performance and functionality. Shear walls are one of the best solutions for resisting lateral loads, which can be constructed by reinforced concrete or steel plates and can be used in both concrete and steel framed structures. Shear walls are either plane or flanged in section and best position for them is in the center of each half of the building. They are easy to construct and make the structure more ductile and safe against earthquake and wind forces.

References

- [1] www.abag.ca.gov
- [2] Venkata Sairam Kumar.N, Surendra Babu.R, Usha Kranti.J, "Shear walls – A review" International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 2, February 2014
- [3] M. Ofelia Moroni," CONCRETE SHEAR WALL CONSTRUCTION" Edificios Chilenos de Hormigón Armado, 2002. Ed. ICH, Chile.
- [4] Murty CVR, Rai DC, Bajpai KK, Jain SK. "Effectiveness of reinforcement details in exterior reinforced concrete beam column joints for earthquake resistance, ACI Structural journal, 100, Pp.49-155,2003.
- [5] Max Guendel, Benno Hoffmeister, Markus Feldmann, "Experimental and numerical investigations on steel shear walls for seismic retrofitting". Proc of the 8th international conference on structural dynamics, Eurodyn, pp. 474-481,2011.
- [6] S.V.Venkatesh, H.Sharada Bai, "Effect of internal & External shear wall on performance of buildings frame subjected to lateral load", International journal of earth science and engineering, Vol.4, No.6, SPL, (Oct, 2011), pp 571-576,2011.
- [7] S.W.Nunnally, "Construction Methods and Management", 1980 by Prentice-Hall, Inc., Englewood Cliffs, N.J. 07632