INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

A PATH FOR HORIZING YOUR INNOVATIVE WORK

SPECIAL ISSUE FOR
INTERNATIONAL CONFERENCE ON
"INNOVATIONS IN SCIENCE & TECHNOLOGY: OPPORTUNITIES & CHALLENGES"

SHEAR WALLS ARE ADVANTAGEOUS IN CONSTRUCTION

MISS. KAVITA K. GHOGARE

B.E (Civil),M.E(Structure), Department of civil engineering, College of Engineering & Technology, Akola

Accepted Date: 07/09/2016; Published Date: 24/09/2016

Abstract: *Now a day's, Shear walls are mostly used in construction. Therefore, in this paper the study is done for shear walls are advantageous in construction. The walls, in a building, which resist lateral loads originating from wind or earthquakes, are known as shear walls. A large portion of the lateral load on a building, if not the whole amount, as well as the horizontal shear force resulting from the load, are often assigned to such structural elements made of RCC. These shear walls, may be added solely to resist horizontal force, or concrete walls enclosing stairways, elevated shafts and utility cores may serve as shear walls.*

Keywords: *Earthquake, Shear wall, Concrete structure, Steel structure, Lateral Load.*

Corresponding Author: MISS. KAVITA K. GHOGARE

Co Author:

Access Online On:

www.ijpret.com

How to Cite This Article:

Kavita K. Ghogare, IJPRET, 2016; Volume 5 (2): 527-537

PAPER-QR CODE

INTRODUCTION

Literature Review:

1. Shear walls – A review

Venkata Sairam Kumar.N1, Surendra Babu.R2, Usha Kranti.J3

In this paper the study is done for Shear walls- a review. Shear walls are structural systems which provide stability to structures from lateral loads like wind, seismic loads. These structural systems are constructed by reinforced concrete, plywood/timber unreinforced masonry, reinforced masonry at which these systems are sub divided into coupled shear walls, shear wall frames, shear panels and staggered walls. The present paper work was made in the interest of studying various research works involved in enhancement of shear walls and their behaviour towards lateral loads. As shear walls resists major portions of lateral loads in the lower portion of the buildings and the frame supports the lateral loads in the upper portions of building which is suited for soft storey high rise building, building which are similar in nature constructed in India, As in India base floors are used for parking and garages or officers and upper floors are used for residential purposes.

2. Recent Advancements In Retrofit of RC Shear Walls

K. Galal1 and H. El-Sokkary2

This paper describes in detailed as recent advancements in retrofit of RC shear walls. Reinforced concrete (RC) shear walls are widely used in medium- to high-rise buildings to provide the lateral strength, stiffness and energy dissipation capacity required to resist lateral loads arising from wind or earthquakes. In the past few decades, there has been considerable advancement in the design of RC walls for new construction. The newly adopted performance evaluation methodology and capacity design principles are examples of these important advancements in seismic engineering. Therefore, there is an essential need to upgrade the seismic performance of existing RC shear walls so that they can meet the requirements of the new performance-based seismic design techniques. Several retrofit techniques using different materials are reported in the literature. These ranged from using steel, concrete, fiber-reinforced polymers, and shape memory alloys as retrofitting materials used in different methods of application. This paper presents different retrofit techniques that were used to increase the seismic resistance of existing RC shear walls. The paper discusses the advantages and disadvantages of each retrofit technique and the corresponding characteristic enhancements. The objective of this paper is to provide a state-of-the-art on the recent advancements and challenges in the area of retrofit of RC shear walls.

3. Steel Plate Shear Walls: Practical Design And Construction

Ignasius F. Seilie, P.E., John D. Hooper, P.E.

In this paper the study is done for shear plate shear walls: practical design and construction. Steel plate shear walls (SPSW) have been used, to a limited extent, as the primary lateral-force-resisting system in buildings for more than three decades. Their recent good performance in major earthquakes, their robust performance in the laboratory, and their recent inclusion in codes and standards make SPSW a good choice for a variety of building applications. Selecting SPSW for the primary lateral-force-resisting system requires a thorough understanding of the advantages and disadvantages of the SPSW system relative to other competitive systems as well as the configuration issues, analytical modelling techniques, and construction consideration associated with the system. This paper summarizes these issues and provides practical rules-of-thumb for engineers who are considering using SPSW on a project.

4. Shear Walls

Timothy P. McCormick, P.E.

This study provides an introduction to shear walls and how they resist earthquake and wind forces. This study also shows how to properly construct the shear walls and the parts that make them up. With this knowledge, contractors can build proper shear walls and inspectors can recognize the errors untrained contractors make.

5. Comparing Effects of Openings In Concrete Shear Walls Under Near-Fault Ground Motions

Seyed M. Khatami, Alireza Mortezaei, Rui C. Barros

This paper describes in detailed- comparing effects of openings in concrete shear walls under near –fault ground motions. The results of a time history study for tall concrete buildings are presented, addressing the effects of openings in concrete shear walls under near fault earthquake ground motions. For this challenge, two near-fault earthquakes were selected from different records of past earthquakes: Loma Prieta and Taiwan. A ten-story building was modelled with three different types of lateral resisting systems: complete shear walls, shear walls with square opening in the centre and shear wall with opening at right end side. Studied models were analyzed with nonlinear software under the two mentioned records. The results evaluated were time history of displacements and basal shears of the investigated models. Results of the analyses showed a substantial decrease in terms of strength of the wall for shear walls with openings. In the model with opening at centre of the wall, maximum lateral

displacement was up to 8% less than maximum lateral displacement of the model with opening at the right end side; while for the complete shear wall that decrease was up to 17% less. The investigated building shows a specific behaviour of the openings, when compared with the complete wall case, which causes an increase in the time history of displacements. Finite element analyses of a panel with opening, showed a dramatic decline in ultimate force up to 54%. This study verified large lateral displacements and ductility for shear walls with openings in comparison with complete shear wall.

6. Concrete Shear Wall Construction

M. Ofelia Moroni

This paper gives detailed explanation about concrete shear wall construction. Buildings with cast-in-situ reinforced concrete shear walls are widespread in many earthquake-prone countries and regions, such as Canada, Chile, Romania, Turkey, Colombia, the republics of the former Soviet Union, etc. This type of construction has been practiced since the 1960s in urban regions for medium- to high-rise buildings (4 to 35 stories high). Shear wall buildings are usually regular in plan and in elevation. However, in some buildings, lower floors are used for commercial purposes and the buildings are characterized with larger plan dimensions at those floors. In other cases, there are setbacks at higher floor levels. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 inhabitants per building. This type of construction has been described in the WHE reports from Chile (Report 4), Kyrgyzstan (Report 40), Canada (Report 79), Romania (Reports 78 and 87), Turkey (Report 101), and Colombia (Report 109).

1. Introduction:

Reinforced concrete (RC) buildings often have vertical plate-like RC Walls are known as shear walls in addition to the slabs, beams and columns. Shear walls are structural systems which provide stability to structures from lateral loads likes winds, seismic loads. Shear walls are generally starts at foundation. Shear walls goes through full height of building. Shear walls made up from concrete, steel, timber and many others. The walls, in a building, which resist lateral loads originating from wind or earthquakes, are known as shear walls. Shear walls also called as structural walls. A large portion of the lateral load on a building, if not the whole amount, as well as the horizontal shear force resulting from the load, are often assigned to such structural elements made of RCC. These shear walls, may be added solely to resist horizontal force, or concrete walls enclosing stairways, elevated shafts and utility cores may serve as shear walls. Shear walls not only have a very large in-plane stiffness and therefore resist lateral load and control deflection very efficiently, but may also help to ensure development of all available

plastic hinge locations throughout the structure prior to failure. The other way to resist such loads may be to have the rigid frame augmented by the combination of masonry walls. The thickness of shear wall can be as low as 150 mm, or as high as 400 mm in high rise buildings. Shear walls are usually provided along both directions i.e, along the length and width of the building.

The use of shear walls or their equivalent becomes imperative in certain high rise buildings, if inter-storey deflections caused by lateral loadings are to be controlled. Well designed shear walls not only provide adequate safety, but also give a great measure of protection against costly non-structural damage during moderate seismic disturbances.

The term shear wall is actually a misnomer as far as high rise buildings are concerned, since a slender shear wall when subjected to lateral force has predominantly moment deflections and very insignificant shear distortions. High rise structures have become taller and more slender, and with this trend the analysis of shear walls may emerge as a critical design element. More often than-not, shear walls are pierced by numerous openings. Such shear walls are called coupled shear walls. The walls of both sides of openings are interconnected by short, often deep, beams forming part of the wall, or floor slab, or both of these. The structural engineer is fortunate if these walls are arranged in a systematic pattern.

The shear walls are subjected to the following loads:

1. A variable shear which reaches a maximum at the base.
2. A bending moment which tends to cause vertical tension near the loaded edge and compression at the far edge.
3. A vertical compression due to ordinary gravity loading from the structure.

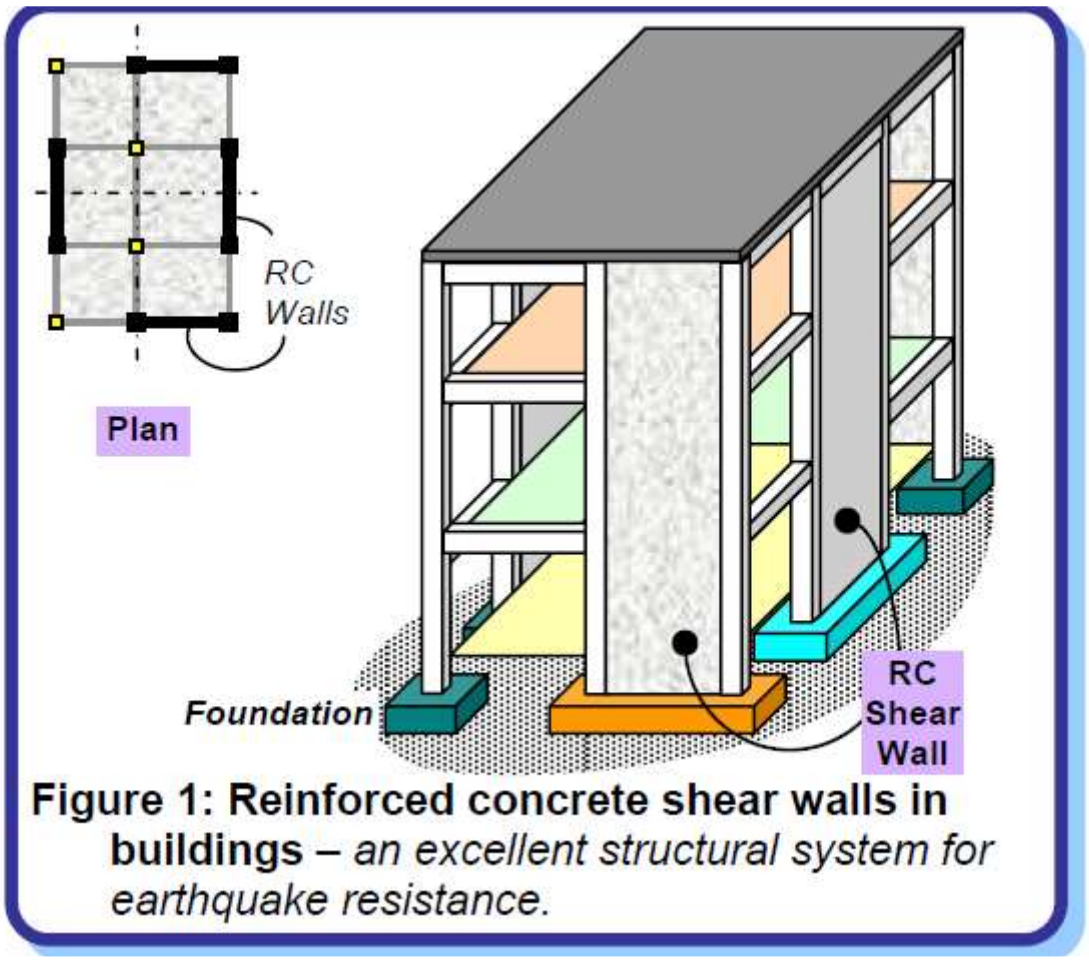

Figure1.1: Reinforced concrete shear walls in buildings.

2. Behaviour of shear walls:

The behaviour of shear walls, with particular reference to their typical mode of failure is, as in the case of beams, influenced by their proportions as well as their support conditions. Low shear walls also known as squat walls, characterized by relatively small height-to-length ratios, may be expected to fail in shear just like deep beams. Shear walls occurring in high-rise-buildings, on the other hand, generally behave as vertical cantilever beams with their strength controlled by flexure rather than by shear.

RC walls are classified as bearing walls, non-bearing walls, shear walls, flexural shear walls and squat shear walls. Shear walls are part of the lateral force resisting system that carry vertical loads, bending moments about the wall strong axis and shear forces parallel to the wall length. Shear wall system is one of the most common and effective lateral load resisting systems that is widely used in medium to high rise buildings. It can provide the adequate

strength and stiffness needed for the building to resist wind and earthquake loadings, provided that a proper design is considered, that cares for both wall strength and ductility. Many of the existing RC buildings with shear wall system that are located in seismically active zones are designed according to older design codes, in which the ductility requirements were not enforced. These buildings are seismically deficient according to the new codes due to lack of strength and/or ductility. Therefore, retrofitting of such buildings becomes a necessity and cannot be overlooked. Performance-based (PB) seismic engineering is the modern approach to earthquake resistant design. Figure shows the typical seismic performance of existing structures versus structures designed according to performance-based seismic engineering. Seismic performance is described by designating the maximum allowable damage state for an identified seismic hazard. Performance level describe the state of a structure after being subjected to a certain hazard level as : Fully operational, operational, life safe, near collapse or collapse(FEMA 1997;SEAOC 1995). Overall lateral deflection, ductility demand and inter-storey drift are the most commonly used damage parameters.

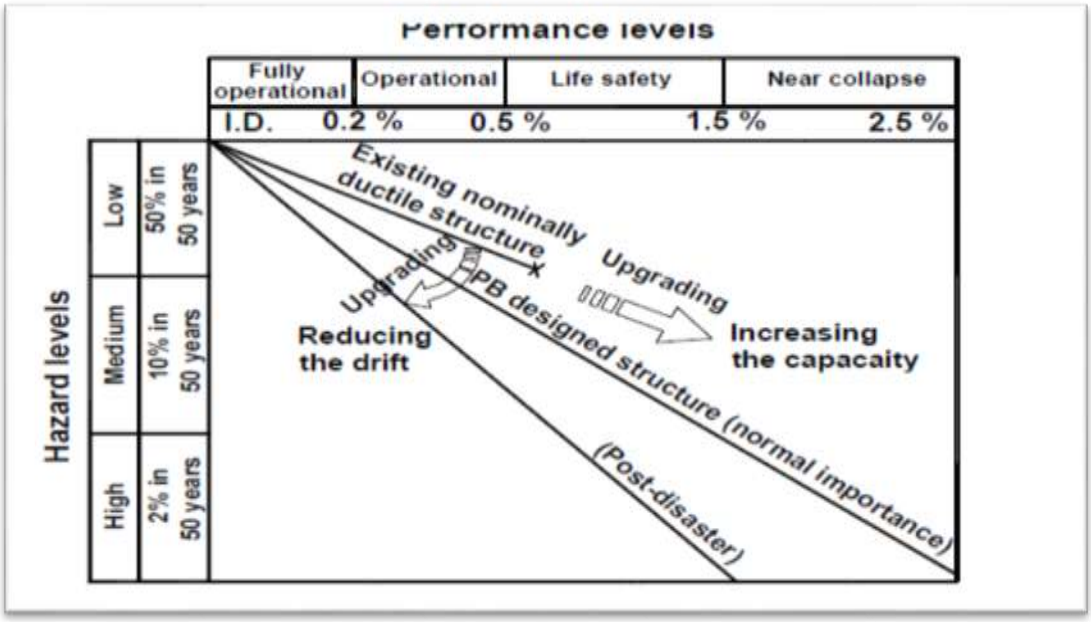

Figure 2.1: Performance levels.

3. Principals and Architectural Aspects of Shear walls:

Shear wall – analysis and design depend on the following principals:-

- Large strength
- High stiffness
- Ductility

Shear wall can be detailed to have large ductility.

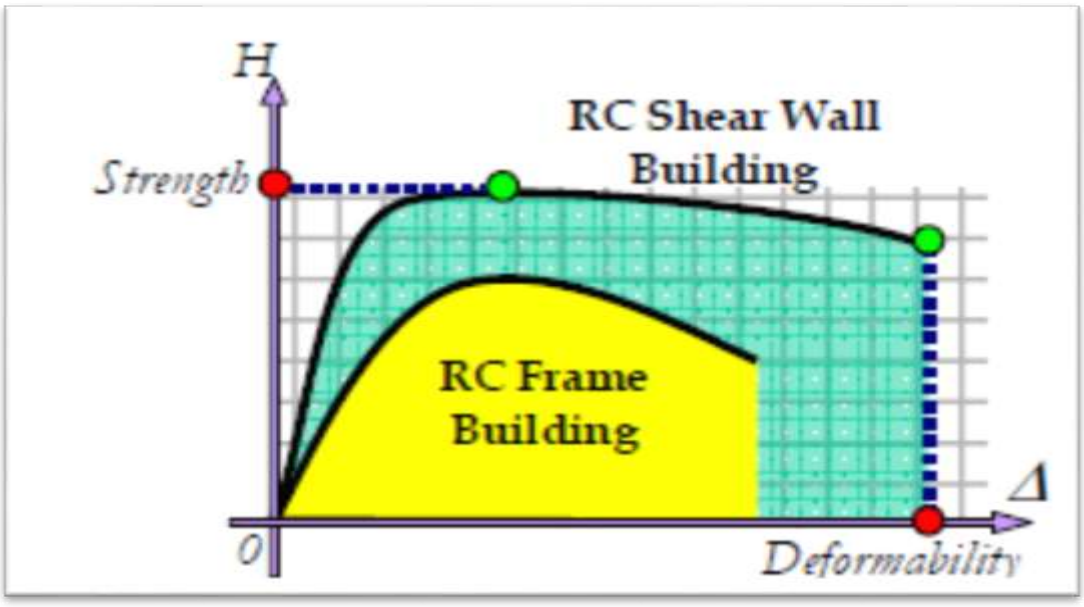

Figure.3.1: Strength of shear wall.

Architectural Aspects:

- Walls must be preferably in both directions.
- If provided only in one direction, a proper moment resisting frame must be provided in other direction.
- Shear wall can extend over the full width of building, or even over partial width.
- Walls should be throughout height.
- Walls should be along perimeter of the building.
- Walls must be symmetrically placed in plan.
- Shear wall building should not be narrow.
- Opening in the walls must be few, small and symmetric.

4. Role of shear wall:

Role of shear wall:

- Transferring seismic forces very smoothly.
- Vertically oriented wide beams.

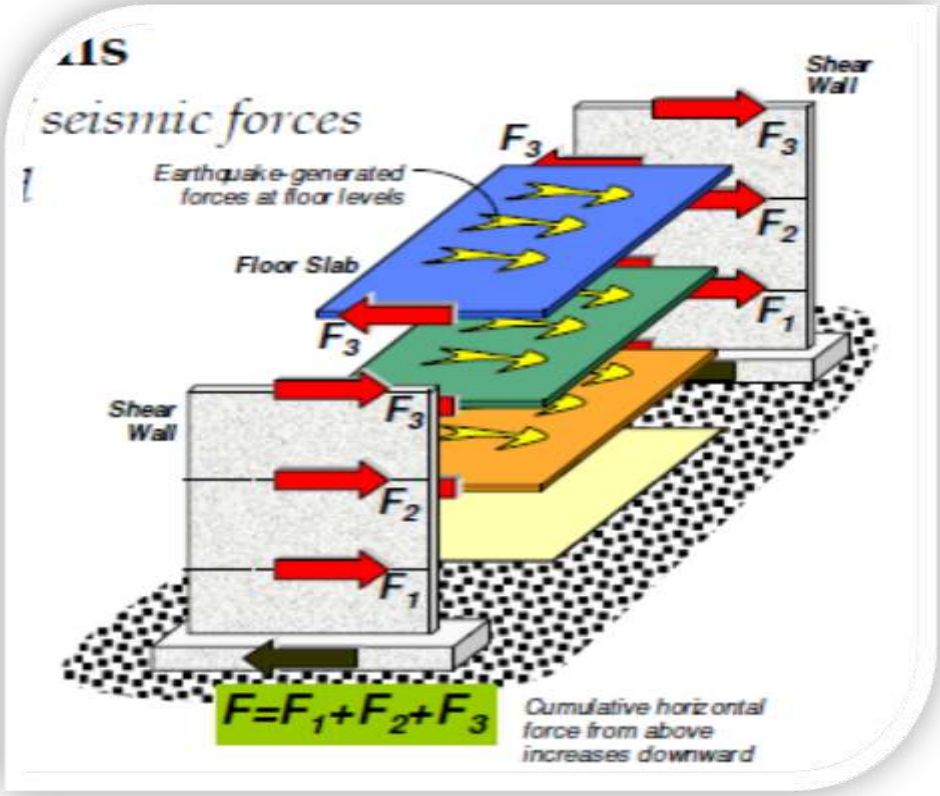

Figure.4.1: Lateral forces acting on building.

5. Methods of analysis and design:

Following are the methods for analysis and design-

1. Static analysis method
2. Response spectrum analysis method
3. IS Code method for design

By using these methods, analysed and designed shear wall. All provisions of design are given in the IS Code IS:13920:1993 and IS:1893:2002. For analysis purpose, use static analysis method, response spectrum analysis method, time history method and many more.

6. Ductile Design of Shear Walls:

Just like reinforced concrete (RC) beams and columns, RC shear walls also perform much better if designed to be ductile. Overall geometric proportions of the wall, types and amount of reinforcement, and connection with remaining elements in the building help in improving the ductility of walls. The Indian Standard Ductile Detailing Code for RC members (IS:13920:1993) provides special design guidelines for ductile detailing of shear walls.

.

Overall Geometry of Walls:

Shear walls are oblong in cross-section is much larger than the other. While rectangular cross-section is common, L- and U-Shaped sections are also used. Thin-walled hollow RC shafts around the elevator core of buildings also act as shear walls, and should be taken advantage of to resist earthquake forces.

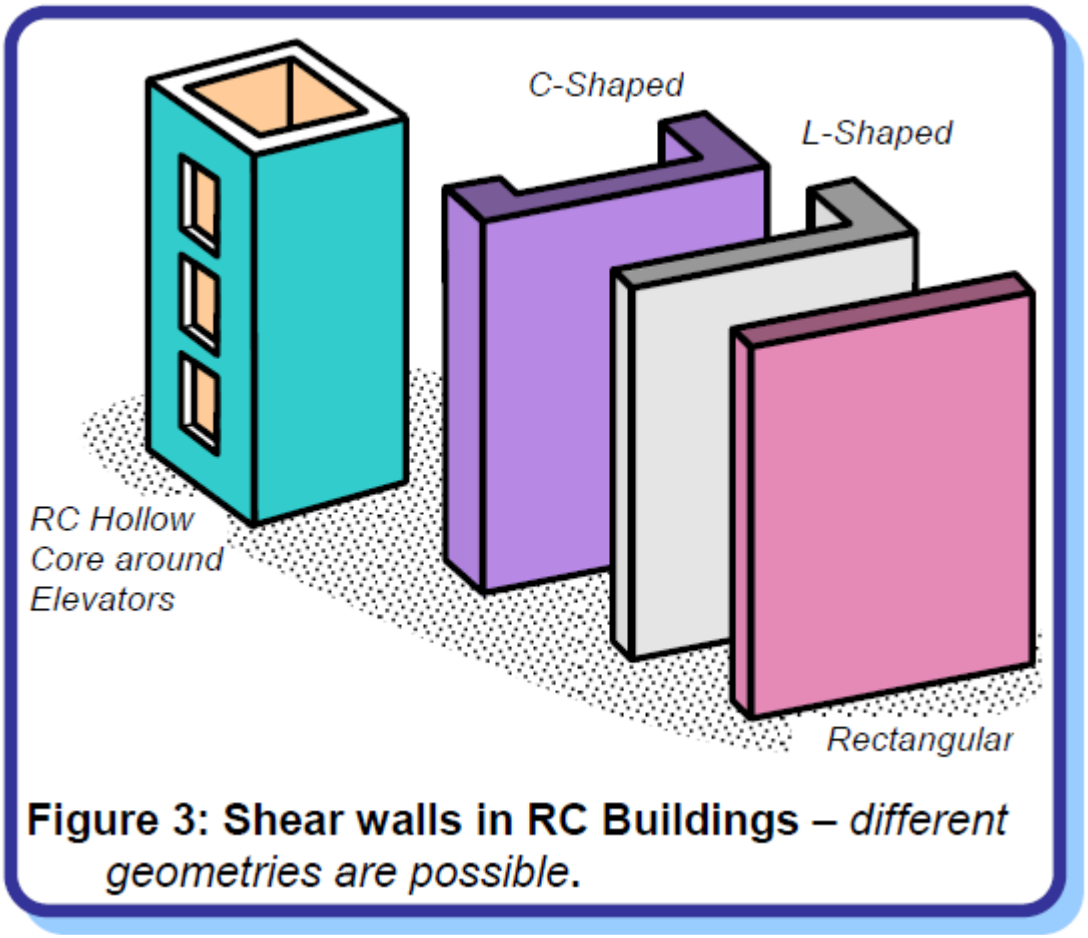

Figure.5.1: Shear walls in RC buildings with different shapes.

7. Conclusion:

From the detailed and final study-

- Shear walls resist the lateral forces due to earthquake and wind.
- Transferring the load very smoothly

- Time saving
- Economical
- High strength, large stiffness and more ductile
- Lesser lateral displacement than frames
- Lesser damage to structural and non-structural elements

8. References:

1. Venkata Sairam Kumar.N1, Surendra Babu.R2, Usha Kranti.J3,"Shear walls – A review", Vol. 3, Issue 2, February 2014,IJIRSET.
2. K. Galal1 and H. El-Sokkary2, "Recent Advancements In Retrofit of RC Shear Walls".
3. Ignasius F. Seilie, P.E., John D. Hooper, P.E.,"Steel Plate Shear Walls: Practical Design and Construction".
4. Timothy P. McCormick, P.E,"Shear Walls".
5. Seyed M. Khatami, Alireza Mortezaei, Rui C. Barros ,"Comparing Effects of Openings In Concrete Shear Walls Under Near-Fault Ground Motions".
6. M. Ofelia Moroni ,"Concrete Shear Wall Construction".
7. IS:13920:1993,"Ductile Detailing".
8. www.google.com
9. Agarwal, P. and Shrikhande, M., 2006, Earthquake Resistant Design of Structures, 2nd Edition, Prentice-Hall of India Private Limited, New Delhi.
10. S.K.Duggal,2007, Earthquake Resistant Design of Stuctures, First Edition, Oxford University Press, New Delhi, India.
11. IS:1893 (Part 1):2002 , ˝ Criteria for Earthquake Resistant Design of Structures ˝.