# Design of shear wall in seismic region

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***Abstract*— This paper presents a review of relevant literature to bring out the background of shear wall. The research contribution which have a direct relevance are mentioned in greater detail. Some of the historical works which have contributed greatly to the understanding of the design of shear wall are also described. A brief review of design concept is presented and need of shear wall, effect of earthquake, design considerations ,architectural aspect are discussed. Literature on this subject has increased rapidly which are very helpful to understand the recent development in earthquake engineering.**

***Keywords*— Shear wall, seismic region, earthquake, boundary element, SFRS**

## I. INTRODUCTION

Earthquake can occur on land or sea, at any place on the surface of the earth where there is major fault. When earthquake occurs on land, it affects man-made structures around the place of its origin. Hence structures in such locations need to be suitably designed and detailed to ensure stability, strength and serviceability with acceptable levels of safety under seismic effects. Generally a concrete frame is design to resist gravity load and made stiff by providing brittle masonry filler wall within frame, hence there is greater possibility that because of its greater stiffness, it will attract more of the earthquake forces and fail in shear due to failure of brittle masonry. Hence construction of shear wall in building which comes under seismic region avoid collapse. By enhancing ductility and energy dissipation capacity in the structure, the induced seismic forces can be reduced, and a more economical structure obtained, or alternatively, the probability of collapse reduced. Hence building with lateral load resisting system comprising a dual system consisting of ductile moment resisting space frame and ductile flexural(shear) wall qualify for very low seismic induced forces.

## II.SHEAR WALL

Shear walls are specially designed structural walls incorporated in buildings to resist lateral forces that are produced in the plane of wall due to wind and earthquake.

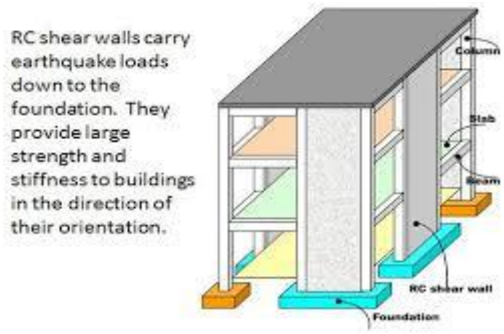


Fig.1 Shear wall

*A. Types of shear wall*:
1)Simply rectangular type and the flange walls
2)Coupled shear wall
3)Rigid frame shear wall
4)Column supported shear wall
5)Column supported shear wall
6)Core type shear wall

*B .Importance of shear wall*

*C. Loads in shear wall*

Shear walls are vertical members cantilevering vertically from the foundation, designed to resist lateral forces in its own plane, and are subjected to bending moment, shear and axial load.

## III. EFFECT OF EARTHQUAKE

During earthquake , under horizontal shaking of the ground ,horizontal inertia forces are generated at level of mass of structure(usually situated at floor level).The transfer of these forces from slab to column/wall to the foundation and finally to the soil system underneath has to be done safely.

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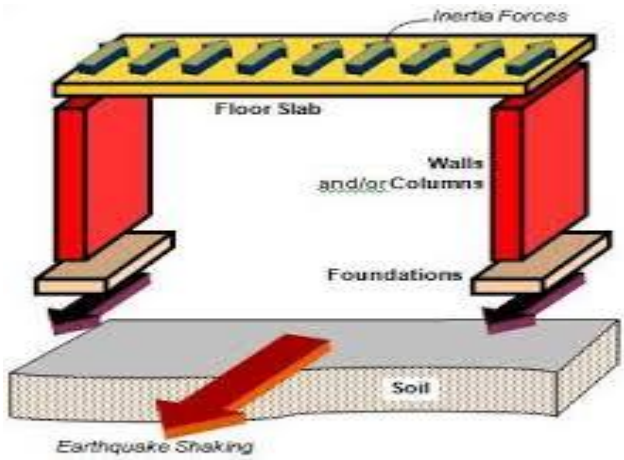

Fig.2 Flow of forces

## IV. ARCHITECTURAL ASPECT AND DESIGN CONSIDERATIONS

*A. Thickness*

As per IS1893 and IS13920 shear walls generally starts at foundation level and are continuous throughout height. Its thickness varies from 150mm to 400mm.They are located symmetrically to reduce ill-effects of twist.

*B .Reinforcement and spacing*

The vertical and horizontal reinforcement in the wall can be placed in one or two parallel layers called curtains. Minimum area of reinforced steel should be 0.0025 of the gross section in each direction. Bar diameter should not be more than 1/10 of wall thickness and spacing should be smaller of the three values, either smaller than 1/5 of horizontal length of wall or smaller than thrice of wall thickness or less than 450mm.

*C. Boundary element*

End regions of wall with increased confinement are called boundary element and reinforcement provided is same as that of RC column. It is provided when extreme fiber compressive stress exceeds 0.2fck.and if wall is without boundary element then minimum 4-12mm diameter bars should be arranged in at least two layers near each end face of the wall.

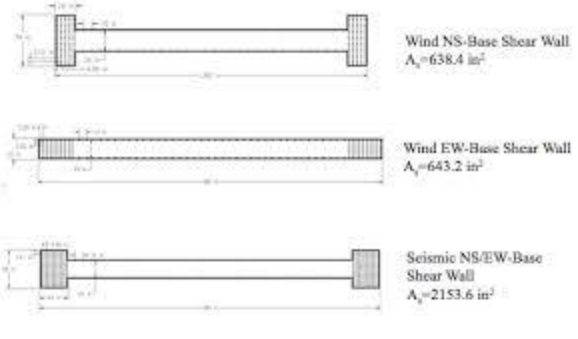

Fig.3 Boundary element

*D. Location*

As per code shear walls must be located symmetrically to reduce twisting however in case of as asymmetric shear wall building, where twist is invertible it might be difficult to developed the complete building's load displacement relationship unless the accurate floor twist angle, centre of rotation and strength are accurately quantified throughout the building loading history.

Paul et al., (2014)studied on asymmetric building with shear wall in which how the response of Reinforced masonry (RM)system differ from response of individual RM SFRS(seismic force resisting system)component with load displacement relationship, floor twist angle and centre of rotation and strength have analysed.

Himalee et al., (2013) have analysed G+5 storey building by changing various position of shear wall with different shapes and have determine parameter like axial load and moments for effective location of shear wall.

Paulay 2000 have described that the building response to earthquake excitation is more complex than the behaviour of its individual wall component.

*E. Rigidity of shear wall*

Computation of rigidity of shear wall with opening is more complex than that of solid shear wall. J.Kent Hsiao et al.(2014)suggested that computation of rigidity of shear wall using conventional method does not give exact value however using new procedure in which rotation on the top of the pier is consider and more accurate value of rigidity of shear wall is obtained.

*F. Shear wall-frame connection*

The junction between the shear wall and slab is a key force resisting element that is subjected to severe stress concentration. conventionally U-hooks are used for connection between shear wall and slab, S.Greeshma et al (2013) suggested that instead of U-hooks if slab bars bent 90 degree, it gives higher ultimate strength, no major cracks form at joint and slab region and joint remained intact throughout loading cycle, hence shear resisting capacity is more. Displacement ductility is enhanced.

*G. Space shear wall*

Bayat et al., (2013) introduced an innovative application of space frame system as Space shear wall, based on the double layer diagonal spatial structures with mero connections which gives advantages such as high stiffness, ductility, energy dissipation, lightness, low cost, fast fabrication etc. Developing this concept would be considered in future studies through optimization of material ,grid patterns, and connections.

## V. CONCLUSION

The available literature from books, codes and research papers gives proper designing, positioning and introducing the shear wall in building ,a building is made more strong to resist earthquake. Even though there are many methods for dissipating earthquake energy, shear walls are observed to be simple, efficient, economical and long lasting.

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