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A Review on Comparative Study of Structural RC Frame System and RC Shear Wall System

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ABSTRACT
High rise building has become need of today's era. High rise building is a structure vertically cantilevered from the ground level subjected to axial loading and lateral forces. Lateral forces generated either due to wind blowing against the building or due to the inertia forces induced by ground shaking which tend to snap the building in shear and push it over in bending. Imparting sufficient strength and stability in counter to the lateral loads is one of the major challenges faced by every designer. Shear walls can be placed around the building as periphery walls, around the lift and beside the staircase. In present study Parameters like Lateral Displacement, Story Drift, Base Shear are observed.

***Keywords* - Base Shear, Reinforced Concrete, Tall Building, Seismic Performance, Shear Wall.**

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I. INTRODUCTION

I. Rapid growth of urban population in India demands vertical growth of RC multi storied buildings. Irrespective of the location and geographical conditions of buildings, the combination of gravity and lateral forces due to seismic and wind intensity, seriously influence the structural performance of high raised buildings. In this context the recent advancements in high raised constructions promotes the use of RC shear wall flat slab system and discourage the routine practice of RC beam column slab framed system. The relevant studies made in the past also emphasized the significance of shear wall system for efficient performance of multi storied buildings against lateral forces. But due to lack of economic studies, much awareness is not promoted to adopt shear wall system in multi storied buildings. Most of the builders are in wrong inception that shear wall system is more cost than beam column framed system. They act as vertical cantilevers in the form of separate planner walls, and as nonplanar assemblies of connected walls around elevator, stair, and service shafts. Because they are much stiffer horizontally than rigid frames, shear wall structures can be economical up to about 35 stories.[13]

If, in low- to medium-rise buildings, shear walls are combined with frames, it is reasonable to assume that the shear walls attract all the lateral loading so that the frame may be designed for only gravity loading. It is especially important in shear wall structures to try to plan the wall allows them to be designed to have only the minimum reinforcement. Shear wall structure have been shown to perform well in earthquakes, for which case ductility becomes an important consideration in their design. The shear wall frame action is shown in Figure[14]

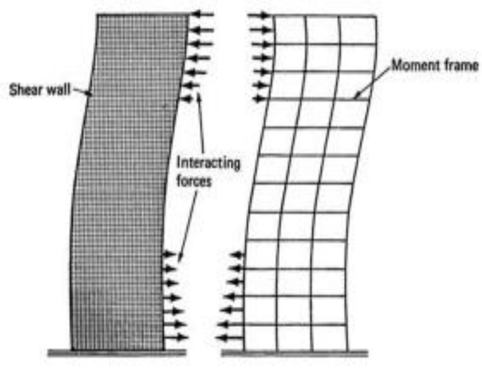

Figure 1 Shear Wall-Frame Interactions

(A) Moment Frame Systems
Moment frames consist of a grid of vertical (i.e., columns) and horizontal (i.e., beams) members. They resist lateral loads through axial forces, bending moment and shear force generated in both beams and columns.

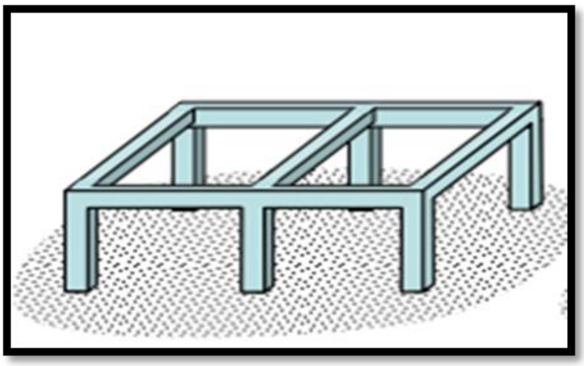

Figure 2 Common structural systems employed in buildings: Moment frames

Beam and column sections should be designed as under-reinforced sections, and thereby, can be expected to undergo ductile behavior; brittle shear failure must be prevented through capacity design procedures. While deciding the structural configuration of the building, predominant flexural behavior in beams and columns should be facilitated. This can be achieved by using relatively long frame members; short beams and columns attract large forces and are susceptible to fail in a brittle manner.[14]

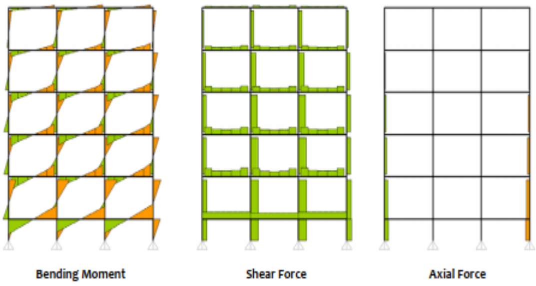

Figure 3 Behaviour of moment frames: Bending moment, shear force and axial force diagrams

(B) Structural Wall-Frame Systems

Earthquake resistant buildings should possess, at least a minimum lateral stiffness, so that they do no swing too much during small levels of shaking. Moment frame buildings may not be able to offer this always. When lateral displacement is large in a building with moment frames only, structural walls, often commonly called shear walls, can be introduced to help reduce overall displacement of buildings, because these vertical plate-like structural elements have large in-plane stiffness and strength.[14]

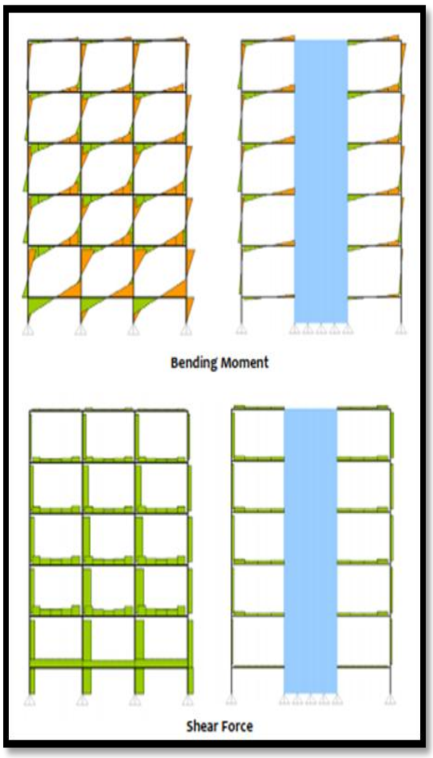

Figure 4 Demands on beams & columns are significantly reduced in building with structural walls.

II. LITERATURE REVIEW

Reshma K Bagawan et.al analyzed RC Framed G+5 and G+10 buildings models in ETABS having different consideration of diaphragm discontinuity and conclude that From time history analysis concentric models, eccentric models and mass irregular models have mare joint displacement compared to regular model, Provision of diaphragm discontinuity in structure reduces the stiffness of the structure which effect on performance of the building and provision of diaphragm openings reduces the performance of structure during earthquakes also it is observed that the storey shear, story drift, displacement and time period are depending on the lateral storey stiffness distribution.[1]

Sudip Karanjit et.al Considered five RC frame buildings of different storey numbers have been analysed using different column overdesign factors and check effectiveness of various Strong Column Weak Beam (SCWB) factors to enhance seismic performance is assessed for Reinforced Concrete (RC) frame building structures and analyzed that Failure of present RC structures is initiated with the collapse level hinge formation at the bottom level columns. Failure mechanism moves fro column failure mechanism to beam failure mechanism with increase in SCWB factor and conclude that with current SCWB provision very high value of factor (SCWB > 1.5) is required for the complete elimination of column hinging in RC building at performance point. To determine the optimum value of SCWB factor, the study can be further extended with the narrow variation in factors for low to high rise building as well. Proposed MSCWB shows better performance over current SCWB factor even for lower value of MSCWB (Performance of MSCWB 1.2 is very similar or better in all the cases than SCWB 1.5) indicating the effective balance between economy as well as performance.[2]

Vihar S. Desai et.al consider a building with soft storey (G+14) at different level along with ground level and investigate performance of a building and reduction of soft storey effect on seismic response of building after adding of shear wall to structures and conducted nonlinear response spectrum analysis and time history analysis were carried out and the results obtained from models were compared in terms of storey displacement, storey drift, storey shear, time period and best alternative for construction in earthquake-prone area was selected. From the study it was conclude that 1) Deflection and displacement of storey are always maximum at soft storey level and The lower level soft storey columns require more percentage of reinforcement it is advisable to provide soft storey at higher levels. 2) Large opening on lowest floor causes relatively low stiffness compared to stiffness of above storey and Infill walls increases the stability of the structure. 3) The drift and the strength demands in the first storey columns are very large for buildings with soft ground storey and shear forces and bending moments are always maximum at soft storey level.[3]

Axay Thapa et.al In this paper the main focus is to compare the dynamic responses of frame structure with and without shear wall. Three models are generated with varying height with and without shear wall. G+5, G+10 and G+15 RC frame models with and without shear walls are generated with varying structural member dimensions according to height. The models are analyzed by Static Method and Response Spectrum Method considering seismic zone V in STAAD. Pro V8i.Parameters like lateral displacement, story drift, base shear and mode shapes are determined for all the models (with and without shear walls) by the three methods and are compared and the effectiveness of shear walls is enumerated and found that structure with shear wall is more important while considering lateral displacement, story drift, base shear and mode shapes.[4]

Dr.B.Kameshwari et.al analyzed the influence of drift and inter storey drift of the structure on various configuration of shear wall panels on high rise structures. The bare frame was compared with various configurations like i) Conventional shear wall ii) Alternate arrangement of shear wall iii) Diagonal arrangement of shear wall iv) Zig Zag arrangement of shear wall v) Influence of lift core shear wall. From the study it was found that Zig Zag shear wall enhanced the strength and stiffness of structure compared to other types. In earthquake prone areas diagonal shear wall was found to be effective for structures.[5]

Nanjma Nainan et.al conducted analytical study on dynamic response of seismo resistant building frames. The effects of change in height of shear wall on storey displacement in the dynamic response of building frames were obtained. From the study it was concluded that it is sufficient to raise the shear wall up to mid height of building frames instead of raising up to entire height of the building.[6]

Shahzad Jamil Sardar et.al modeled a 25 storey building zone V and analysed by changing the location of shear wall to determine various parameters like storey drift, storey shear and displacement using ETABS. Both static and dynamic analysis was done to determine and compare the base shear. Compared to other models, when shear wall placed at centre and four shear wall placed at outer edge parallel to X and Y direction model showed lesser displacement and inter storey drift with maximum base shear in addition strength and stiffness of the structure has been increased.[7]

Mr.K.LovaRaju et.al conducted nonlinear analysis of frames to identify effective position of shear wall in multi storey building. An earthquake load was applied to a eight storey structure of four models with shear wall at different location in all seismic zones using ETABS. Push over curves were developed and has been found the structure with shear wall at appropriate location is more important while considering displacement and base shear.[8]

Varsha.R.Harne et.al considered a six storey RCC building which is subjected to Earthquake loading in zone II to determine the strength of RC wall by changing the location of shear wall using STAAD.Pro. Seismic coefficient method is used to calculate the earthquake load as per IS 1893 – 2002 (Part I). Four different models like structure without shear wall, structure with L type shear wall, structure with shear wall along periphery, structure with cross type shear wall were modeled for analysis. Compared to other models the shear force and bending moment, for structure with shear wall along the periphery is found to be maximum at the ground level and roof level respectively. Hence the shear wall provided along the periphery of the structure is found to be more efficient than all other types of shear wall.[9]

Anuj Chandiwala et.al studied a 10 storey RC building located in seismic zone III which is on medium soil. The different building configurations were i) Shear wall at end of L section ii) L Shear wall at junction of 2 flange portion iii) Two parallel L shear wall at junction of 2 flange portion iv) Tube type shear wall at junction of 2 flange portion v) Two parallel shear wall at end of flange portion. From the analysis, it was observed that compared to other models shear wall placed at end of L section is best suited for base shear since end portion of the flange always oscillate more during earthquake.[10]

Wen-I Liao et al. conducted an experimental investigation on high seismic performance shear wall. The test results of four large-scale shear walls, (two shear walls under shake table tests and two shear walls under reversed cyclic loading) were presented. The response time histories for accelerations and displacements as well as the hysteretic loops were presented for the shear walls under dynamic loading induced by shake table. The force-displacement hysteretic loops were presented for the shear walls under reversed cyclic loading. From the experimental results, it was found that the tested high performance shear walls have better ductility than that of conventional shear walls.[11]

K Venkatesh (et.al) In this paper the analytical study on the lateral behaviour of the structure is mainly concentrated and how it is varying in the different zones of zone II and zone III with different storey heights of a 6storey, 11storey, and 16storey structure. The study also involves the orientation of shear wall. Methodology taken by his The (OMRF &SMRF) structures of G+5, G+10, G+15. The seismic analysis of building is done by Seismic Coefficient with given above procedures for Zone II and III. The obtained results of both structures are compared with each other and conclude that variation of storey drift between OMRF & SMRF structure are as follow.[12]

	ZONE 2	ZONE 3
G+ 5	0.04%	0.15%
G+10	0.21%	0.42%
G+15	0.41%	0.66%

III. CONCLUSION

From the study of above literature it can be conclude that,

- In multi-storey buildings, provision of shear walls is found to be effective in increasing the overall seismic response and characteristics of the structure.
- Shear wall ultimately increases the stiffness and strength of the structure and affect the seismic behavior of the structure.
- The considerable reduction in lateral displacement is observed in the structures having shear wall as compare to structure without shear wall. The reduction of displacement of storey is due to increase in stiffness of structure.
- For better seismic performance, a building should have proper lateral stiffness. Low lateral stiffness leads to large deformation and strains, damage to non structural elements.
- The displacement values will depend upon frequency of earthquake and natural frequency of the structure and building with short time period tends to suffer higher accelerations but smaller displacement.
- Structure with shear wall a appropriate location is more important while considering displacement and base shear.
- Shear walls with openings experienced a decrease in terms of Strength.
- Diagonal shear wall was found to be effective for structures located in earthquake prone areas.
- Raising of shear wall up to the entire height of building is not necessary and it is sufficient to raise the shear wall up to mid height of building.
- Shear wall –Flat slab system is more adoptable than framed system in the construction of RC high raised structures.

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