# Comparative Study and Modeling of Framed Structure with Shear Wall & without ShearWall by using Etabs

**Vivek Suwalka[1], Mr. Nandeshwar Laata[2], Dr. Bharat Nagar[3]**

*[1]M.tech (Structure) Scholar, Dept. Civil Engineering Jagannath University, Jaipur, Rajasthan, India*
*[2]Asst. professor, Dept. of Civil Engineering, Jagannath Gupta Institute of Engineering And Technology, Jaipur, Rajasthan, India*
*[3]Professors, Dept. of Civil Engineering, Jagannath Gupta Institute of Engineering and Technology, Jaipur, Rajasthan, India*

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**ABSTRACT:-** *The purpose of this study is to find the prime location of shear wall and then investigate the effectiveness of best shear wall in bare frame system. The structure is analyzed for earthquake in the types of structural system i.e bare frame system. Shear wall is the best structural element which is used for resisting lateral load in multi-storey reinforced concrete structures. Wall which is mainly designed to resist lateral forces in its own plane is called shear wall. Shear walls are generally provided in high rise buildings to avoid failure of building under lateral forces. Shear walls are mainly flexural members which are specially designed to resist lateral forces which are caused by seismic forces and others forces. Shear wall an efficient bracing system and also offer great resistance to horizontal forces. Shear walls start from the foundation level and should be continuous throughout the height of the building. Study of G+15 building presented with some investigations which are analyzed in both the structural system i.e shear wall frame structure and without shear wall structure. The building is located in Zone-IV according to IS 1893: 2002. Analysis of 3 D building model is done by linear static method, response spectrum and surface messing is done to model shear wall. In this study Etabs software is used. Comparison of these models for different parameters like Lateral displacement in X & Y Direction, storey drift and axial force in columns carried out.*

***Key words****: Shear wall, lateral load, Static method .Response spectrum method.*

## 1. INTRODUCTION

As mass increases we have to go for even heavier sections to counter these seismic forces which in turn again will increase the mass of the structure leading to more seismic forces. In order to deal with this, structures are made ductile so that it can dissipate seismic forces by yielding. Ductility can be provided easily in a framed structure by proper detailing of reinforcement but as it crosses certain heights it practically becomes unfeasible due to large sizes of sections being required to counter forces. In order to deal with this phenomenon shear walls are introduced. Shear walls provide desired stiffness to the building frame through in plane bending but its more use in a particular structure makes the structure stiffer. Thus, a balance should be maintained between amount of Shear walls & Frame elements in a structure for safe and economic design of high rise structures. Shear wall construction is an economical method of bracing buildings to limit damage. For good performance of well-designed shear walls, the shear wall structures should be designed for greater strength against lateral loads than ductile reinforced concrete frames with similar characteristics; shear wall are inherently less ductile and perhaps the dominant mode of failure is shear. However exceptions to the excellent performance of shear wall occur when the height-to-length ratio becomes great enough to make overturning a problem and when there are excessive openings in shear walls.

## 2. LITERATURE REVIEW

**[Greifenhagen and Lestuzzi, 2005]** presented the strength and deformation capacity of squat reinforced shear wall which are not designed for seismic excitation. For this study the test conducted on four lightly reinforced concrete shear wall of size 400 mm x 400 m and height 3.5m with 1:3 scale for which horizontal reinforcement, axial force ratio and concrete compressive strength varied. In this study it is reported that the series of static cyclic tests that were explicitly designed to investigate deformation capacity of lightly reinforced concrete shear wall of existing building. The main objective of this study is to investigate a more realistic seismic evaluation of existing shear wall prior to earthquake resistant design recommendations but failure mode occur due to different parameters of type of cross section, reinforcement detailing and quantities, property of reinforcing steel and boundary conditions. From the test results found that drift capacity of all four specimens of shear wall were found more than 0.8% and indicate that drift capacity reduced at higher Axial Load Ratio.

**[Elwood, et-al., 2006]** discussed in this study a beam –pillar frame structure ability of earthquake resistant building. For this study in order to reinforce building against earthquake load, the compression braces & tension braces should be provided diagonally to a beam pillar structure of a building. For this study loading test is conducted to tension braces of thickness 200 mm, which are screwed with connectors and tap bolts i.e. tap bolts at two perpendicular sides of connectors on pillar -beam element. In such arrangements, the compression braces of same thickness are also tested and found useful as it can readily be used and is very effective in increasing seismicity. The main object of this study was to avoid the inconvenience which might be caused when the building is pulled down and rebuilt again for reinforcement. Results obtained from this study concluded that, if tensile braces are installed on all or necessary beam-pillar framed structures of an existing building to apply a pre-tensile stress, the ratio of out-of-plane/in-plane stiffness is observed more than 0.2 to achieve post buckling strength.

**[Su & Wong, et-al., 2007]** studied the effect and confinement of earthquake load on Reinforced Concrete (RC) wall. In this study test is performed on three fabricated specimen of slender cantilever wall with different Axial Load Ratio [ALR] between 2.5 – 0.5 and aspect ratio 4. This Study is based on the ALR parameter for consideration of seismic performance assessment of RC shear wall. The seismic performance of shear wall is uncertain as the ALR is relatively high in medium and high rise R.C. structures. The specimen was critically examined to check ductility capacity, strength degradation, axial load capacity and effect of ALR in confinement of failure mode. The results found that for residential building, the higher values of ALR from 0.3 in shear wall structure increased ultimate load conditions, deformability and failure mode of specimen due to maximum ductility ratio also decreases. As ALR increases from 0.25 to 0.5, first specimen collapse at 2.2% drift but other two at 1.1% and 1.3% i.e. on high ALR, the drift ratio at collapse reduces and accordingly collapse prevention and life safety performance level reduces.

**[Kitada, et-al., 2007]** described in this study the test results on multi axes loading on RC shear wall for 10 years project aiming at comprehension on earthquake response behavior for three dimensional. This test is proposed to study the elasto plastic behavior of shear wall which is subjected to orthogonally two dimensional loading. In this study to check the behavior load is applied statically on three specimens of different shapes for horizontal, vertical and diagonal loading. Results obtained from the study found that influence of dynamic vertical motion on the non linear behavior of specimen in horizontal direction is comparatively very small. The reason of smaller value is that the specimen of dynamic loading test has damages due to cracks. All the three specimens were reached the deformation angle of 6/1000 rad/s and value reached earlier in cylindrical type shear wall. The outcomes from result are helpful in evaluating seismic margins of important structures in Nuclear Power Plant.

**[Park, et-al., 2008]** proposed in this paper the use of friction joints devised to dissipate energy during severe seismic excitations and non linear time history that was used to obtain such relation. In this study the author reported that if the input energy can be controlled, the level of distress can be significantly reduce by adding any mechanism. LSB joints which act in effect both as safety valve and structural dampers, are incorporated in tall cast-in-place shear walls of size 450 mm x 600 mm provided at full height of building. For testing purpose mechanism is attached to control loading and show the level of maximum energy dissipation capacity. Results obtained from this experiment is that, friction joint dissipate energy by 56.5% under severe seismic excitation, just the joint of sufficient strength with maximum energy dissipation capacity are required to be placed in shear wall.

**[Wang, et-al., 2015]** studied the seismic behavior of unstiffened steel plate shear wall specimen with 1:3 ratio under cyclic load. In this study the test is carried out on four-three storey unstiffened steel plate shear wall which exhibited high strength, good energy dissipation capacity and good ductility with no more than 5% strength degradation. For the experimental approach the span to height ratio is put L/h=1.5 to 2.0 and steel plate shear wall specimen with 1:3 ratio is designed. During loading at inter-drift angle 1/50 of specimen, the strength degradation is no more than 5% which indicate that the structure is good in seismic behavior. Results of this study found column stiffness ratio more than 0.2, which is the best for post buckling strength of steel plate shear wall and stiffness of edge column provides great lateral load capacity of shear wall. As ratio increases the specimen shows good ductility i.e. ductility coefficient reached more than 3.0 of first specimen which span to height ratio is 1.5. The experimental studies also indicate that residual stresses had little effect on behaviors of steel plate shear wall which cannot be considered for numerical analysis.

**[Vetr, et-al., 2016]**Proposed in this study the work on the construction behavior at the interface of composite column, shear wall elements and concrete wall. For analysis of this study ten test specimens named HSW 1 to HSW 10 varying in interface connection were tested to investigate the force-slip behavior between Concrete Filled Steel Tubular (CFST) columns and Reinforced Concrete (RC) Shear Wall. During testing it is found that the expansion of cracks at IFC region restrained and failure occurred at central region of RC panel when specimen were layout diagonally. In order to develop force-slip relationship at IFC, the experimental force-displacement curves were normalized at load FR and slip SR to evaluate non linear static and dynamic response of Hybrid Shear Wall (HSW) under lateral loading. Results assessed the efficiency of different interface and found that response of straight anchor bars is less effective than those with diagonal bars. Best interface solution from result is found of HSW10 which is arranged diagonally with 6mm anchoring bars spaced at 50 mm from penetration of CFST. The result of force-slip clearly shows that straight anchorage bars exhibited considerable slippage along the column-wall interface.

## 3. METHODOLOGY

Earthquake motion causes vibration of the structure leading to inertia forces. Thus a structure must be able to safely transmit the horizontal and the vertical inertia forces generated in the super structure through the foundation to the ground. Hence, for most of the ordinary structures, earthquake-resistant design requires ensuring that the structure has adequate lateral load carrying capacity. Seismic codes will guide a designer to safely design the structure for its intended purpose. Quite a few methods are available for the earthquake analysis of buildings; two of them are presented here. Modeling of Shear wall can be done by following methods:-

1- Equivalent frame method, 2- Braced frame method, 3- Finite element method modeling of the shear wall is done by using Finite Element Method in ETAB, using by Surface Meshing.

## 4. NUMERICAL STUDY

### 4.1 Description of the building

For the present study, a Reinforced Concrete Structure is selected. It has symmetrical layout and consists of fifteen stories with each storey height of 3 m. Floor plan of all stories is rectangular with length of 24 m in x-direction and length of

36 m in y-direction. The number of bays in x-direction is 5 and number of bays in y-direction is 3. The width of each bay is 5 m in both x-direction and y-direction. All the columns of the building are located at the axes intersections. Building details are as follows:

| |
|---|
| 1. Building frame type is Special Moment Resisting Frame (SMRF). |
| 2. Building is located in Seismic Zone IV. |
| 3. Number of storey is G+15. |
| 4. Spacing between frames are 6 m along x and 4.5 m y-directions. |
| 5. Number of bays in x and y-directions are 4 and 8 respectively. |
| 6. Grade of concrete used is M 25 and grade of steel used is Fe 500. |
| 7. Floor to floor height is 3 m. |
| 8. Parapet wall height is 1 m. |
| 9. Parapet wall thickness is 230 mm. |
| 10. Slab depth is 125 mm. |
| 11. Thickness of external wall & internal wall is 230 mm and 115 mm resp. |
| 12. Size of column is 300 mm × 750 mm. |
| 13. Size of beams is 300 mm × 450 mm. |
| 14. Live load on 2.0 kN/m2 [typical floor] |
| 15. Live load on terrace is 1.5 KN/m2. |
| 16. Floor finish load is 1.5 KN/m2. |
| 17. Terrace finish load is 1.5 KN/m2. |
| 18. Building is resting on medium soil. |
| 19. Importance factor is taken as 1.2. |
| 20. Unit weight of RCC is 25 KN/m3. |
| 21. Unit weight of masonry wall is taken as 20 KN/m3. |
| 22. Thickness of Shear walls is 300 mm. |
| 23. Elastic modulus of brick masonry wall is 22360 MPa. |
| 24. Elastic modulus of concrete is 25000 MPa. |
| 25. Response Spectra is taken as per IS 1893 (Part-1): 2002. |
| 26. Damping of structure is taken as 5 percent. |
| Following load combinations are used in this thesis are per IS 1893 (Part-1): 2002. |

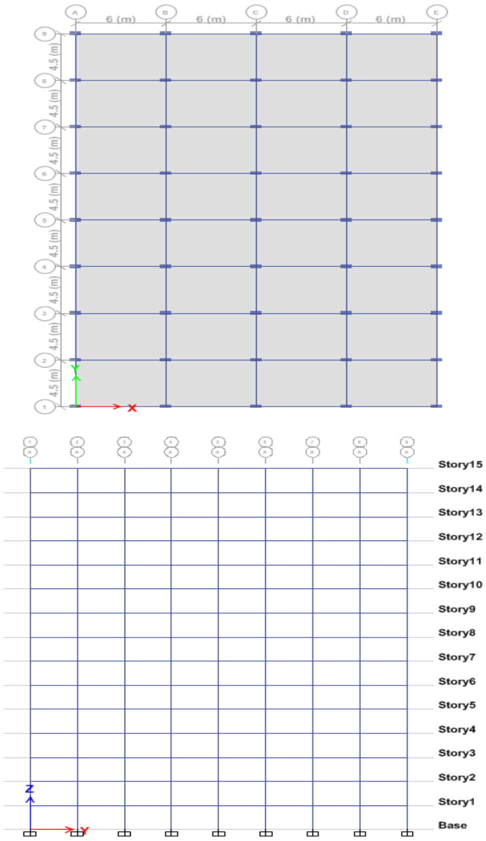



**Fig-1:** Plan and Elevation view of sample structure

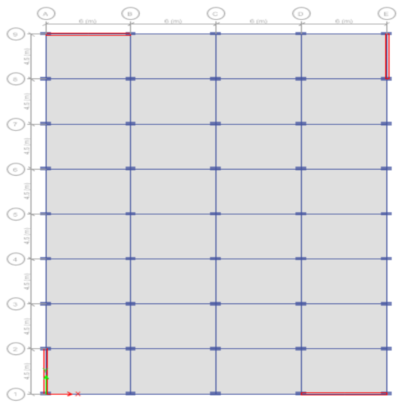


**Fig-2:** Model

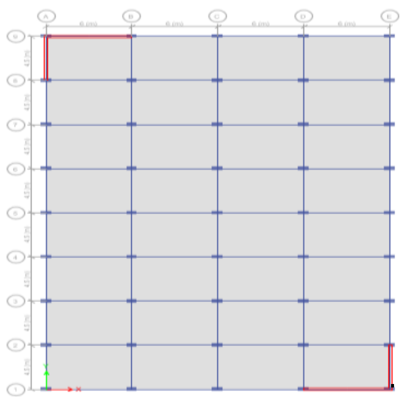


**Fig-3:** Model -2

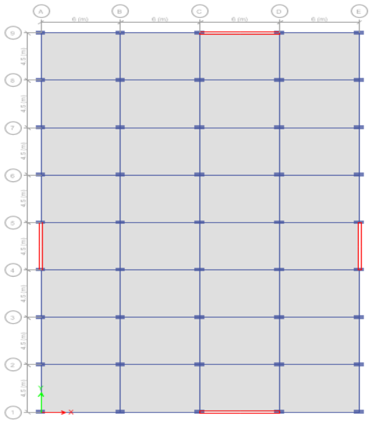


**Fig-4:** Model -3

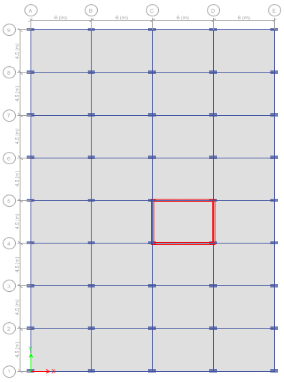


**Fig-5:** Model -4

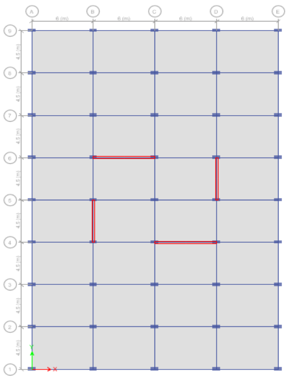


**Fig-6:** Model -5

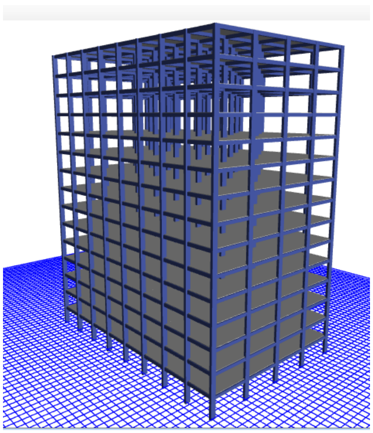


**Fig-7:** 3 D Views

| TABLE:1 Load Combinations | | |
|---|---|---|
| Name | Load Case/ Combo | Scale Factor |
| 1=(1.5Dead+1.5Live) | Dead | 1.5 |
| 1=(1.5Dead+1.5Live) | Live | 1.5 |
| 2=(1.2Dead+1.2Live+1.2DEQX+) | Dead | 1.2 |
| 2=(1.2Dead+1.2Live+1.2DEQX+) | Live | 1.2 |
| 2=(1.2Dead+1.2Live+1.2DEQX+) | DEQX+ | 1.2 |
| 3=(1.2Dead+1.2Live-1.2DEQX+) | Dead | 1.2 |
| 3=(1.2Dead+1.2Live-1.2DEQX+) | Live | 1.2 |
| 3=(1.2Dead+1.2Live-1.2DEQX+) | DEQX+ | -1.2 |
| 4=(1.2Dead+1.2Live+1.2DEQX-) | Dead | 1.2 |
| 4=(1.2Dead+1.2Live+1.2DEQX-) | Live | 1.2 |
| 4=(1.2Dead+1.2Live+1.2DEQX-) | DEQX- | 1.2 |
| 5=(1.2Dead+1.2Live-1.2DEQX-) | Dead | 1.2 |
| 5=(1.2Dead+1.2Live-1.2DEQX-) | Live | 1.2 |
| 5=(1.2Dead+1.2Live-1.2DEQX-) | DEQX- | -1.2 |
| 6=(1.2Dead+1.2Live+1.2DEQY+) | Dead | 1.2 |
| 6=(1.2Dead+1.2Live+1.2DEQY+) | Live | 1.2 |
| 6=(1.2Dead+1.2Live+1.2DEQY+) | DEQY+ | 1.2 |
| 7=(1.2Dead+1.2Live-1.2DEQY+) | Dead | 1.2 |
| 7=(1.2Dead+1.2Live-1.2DEQY+) | Live | 1.2 |
| 7=(1.2Dead+1.2Live-1.2DEQY+) | DEQY+ | -1.2 |
| 8=(1.2Dead+1.2Live+1.2DEQY-) | Dead | 1.2 |
| 8=(1.2Dead+1.2Live+1.2DEQY-) | Live | 1.2 |
| 8=(1.2Dead+1.2Live+1.2DEQY-) | DEQY- | 1.2 |
| 9=(1.2Dead+1.2Live-1.2DEQY-) | Dead | 1.2 |
| 9=(1.2Dead+1.2Live-1.2DEQY-) | Live | 1.2 |
| 9=(1.2Dead+1.2Live-1.2DEQY-) | DEQY- | -1.2 |
| 10=(1.5Dead+1.5DEQX+) | Dead | 1.5 |
| 10=(1.5Dead+1.5DEQX+) | DEQX+ | 1.5 |
| 11=(1.5Dead-1.5DEQX+) | Dead | 1.5 |
| 11=(1.5Dead-1.5DEQX+) | DEQX+ | -1.5 |
| 12=(1.5Dead+1.5DEQX-) | Dead | 1.5 |
| 12=(1.5Dead+1.5DEQX-) | DEQX- | 1.5 |
| 13=(1.5Dead-1.5DEQX-) | Dead | 1.5 |
| 13=(1.5Dead-1.5DEQX-) | DEQX- | -1.5 |
| 14=(1.5Dead+1.5DEQY+) | Dead | 1.5 |
| 14=(1.5Dead+1.5DEQY+) | DEQY+ | 1.5 |
| 15=(1.5Dead-1.5DEQY+) | Dead | 1.5 |
| 15=(1.5Dead-1.5DEQY+) | DEQY+ | -1.5 |
| 16=(1.5Dead+1.5DEQY-) | Dead | 1.5 |
| 16=(1.5Dead+1.5DEQY-) | DEQY- | 1.5 |
| 17=(1.5Dead-1.5DEQY-) | Dead | 1.5 |
| 17=(1.5Dead-1.5DEQY-) | DEQY- | -1.5 |
| 18=(0.9Dead+1.5DEQX+) | Dead | 0.9 |
| 18=(0.9Dead+1.5DEQX+) | DEQX+ | 1.5 |
| 19=(0.9Dead-1.5DEQX+) | Dead | 0.9 |

| | | |
|---|---|---|
| 19=(0.9Dead-1.5DEQX+) | DEQX+ | -1.5 |
| 20=(0.9Dead+1.5DEQX-) | Dead | 0.9 |
| 20=(0.9Dead+1.5DEQX-) | DEQX- | 1.5 |
| 21=(0.9Dead-1.5DEQX-) | Dead | 0.9 |
| 21=(0.9Dead-1.5DEQX-) | DEQX- | -1.5 |
| 22=(0.9Dead+1.5DEQY+) | Dead | 0.9 |
| 22=(0.9Dead+1.5DEQY+) | DEQY+ | 1.5 |
| 23=(0.9Dead-1.5DEQY+) | Dead | 0.9 |
| 23=(0.9Dead-1.5DEQY+) | DEQY+ | -1.5 |
| 24=(0.9Dead+1.5DEQY-) | Dead | 0.9 |
| 24=(0.9Dead+1.5DEQY-) | DEQY- | 1.5 |
| 25=(0.9Dead-1.5DEQY-) | Dead | 0.9 |

Where DL= Dead Load, LL= Live Load, EL= Earthquake Load

### 4.2 Analysis and design of the model

Analysis of the model is performed for all the static load cases. Analysis of the model is to be done before it is designed. After analysis is performed, suitable design code (IS 456) is selected from the dropdown list for designing the concrete frame. All the load combinations are selected for the design. Etabs will design the frame members (i.e beams and columns) for most critical load combination.

**Table 2:** Comparison Table of Maximum Displacement in X direction with & without Shear Wall

| NO OF STOREY | WITHOUT SHEAR WALL | MODELS WITH SHEAR WALL | | | | |
|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 |
| 1 | 2.3 | 1.45 | 2.3 | 0.76 | 1.91 | ` |
| 3 | 12.3 | 5.79 | 12.3 | 4.25 | 7.99 | 6.491 |
| 5 | 23.5 | 11.27 | 23.5 | 9.5 | 14.56 | 12.065 |
| 7 | 34.7 | 17.33 | 34.7 | 15.67 | 21.35 | 18.081 |
| 9 | 44.9 | 23.51 | 44.9 | 22.09 | 28.03 | 24.262 |
| 11 | 53.4 | 29.46 | 53.4 | 28.33 | 34.12 | 30.123 |
| 13 | 59.5 | 34.92 | 59.5 | 34.17 | 38.92 | 34.931 |
| 15 | 62.8 | 39.61 | 62.8 | 39.37 | 41.66 | 37.754 |

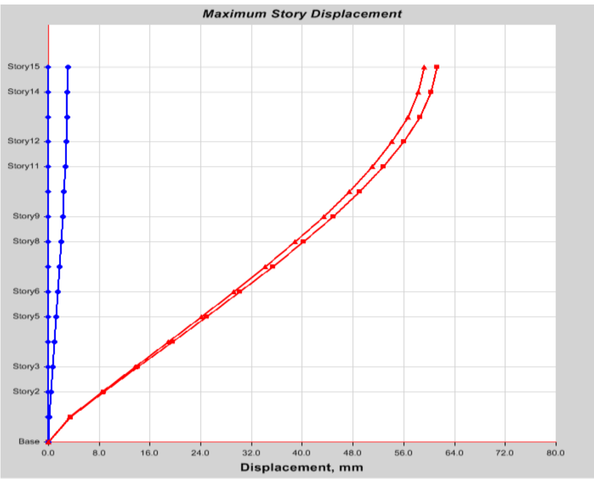



**Fig-8:** Model-0 Lateral Displacement in X & Z Direction (Without Shear Wall)

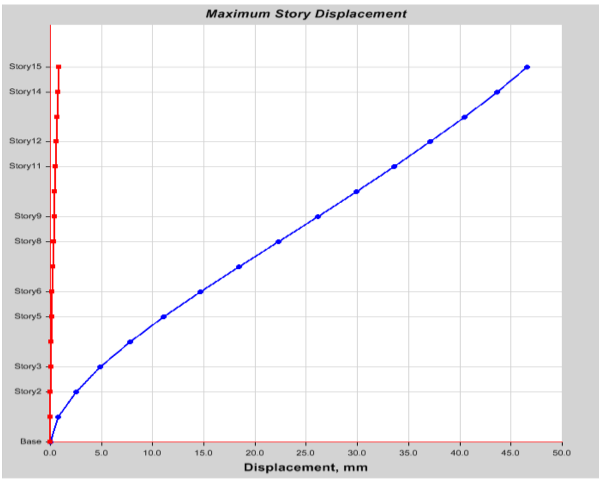



**Fig-9:** Model-5 Lateral Displacement in X & Z Direction (Shear Wall-5)

**Maximum Bending Moment MZ value of with and without shear wall structure.**

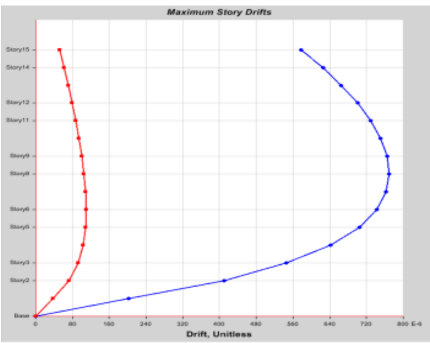
**Table 3**

| MODEL NO | WITHOUT SHEAR WALL | SHEAR WALL 1 | SHEAR WALL 2 | SHEAR WALL 3 | SHEAR WALL 4 | SHEAR WALL 5 |
|---|---|---|---|---|---|---|
| MAX BENDING MOMENT MZ KN-M | 146.7 | 135.7 | 140.5 | 125.5 | 114.5 | 111.12 |

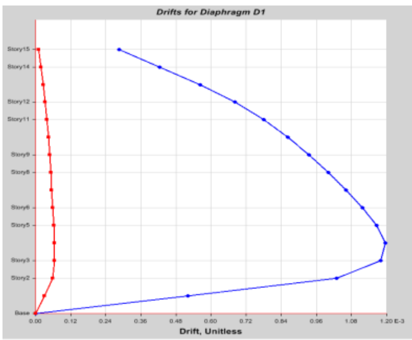
**Story Response – Story Drifts and Story Shear for Diaphragm Model-0 & Model -5 max. Story drift in X & Y Direction (With & without Shear Wall)**

**Table 4**

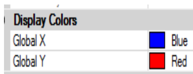
| Story | Elevation | Location | Model-0 X-Dir | Model-0-Dir | Model-5 X-Dir | Model-5 Y-Dir | Model-0 X-Dir | Model-0-Dir | Model-5 X-Dir | Model-5 Y-Dir |
|---|---|---|---|---|---|---|---|---|---|---|
| | m | | Max. story drift Without Shear Wall | | Max. story drift Shear Wall-5 | | Max. story Shears Without Shear Wall | | Max. story Shears Shear Wall-5 | |
| Story15 | 45 | Top | 0.000286 | 0.000011 | 0.000578 | 0.000052 | 283.0858 | 0.0082 | 457.3512 | 14.1431 |
| Story14 | 42 | Top | 0.000424 | 0.000019 | 0.000626 | 0.000061 | 610.6264 | 0.0065 | 1002.6606 | 35.2888 |
| Story13 | 39 | Top | 0.000563 | 0.000026 | 0.000664 | 0.00007 | 847.5698 | 0.0051 | 1364.3359 | 53.679 |
| Story12 | 36 | Top | 0.000681 | 0.000033 | 0.000701 | 0.000079 | 1022.7125 | 0.0053 | 1601.9878 | 69.4256 |
| Story11 | 33 | Top | 0.000779 | 0.000039 | 0.000729 | 0.000087 | 1160.4886 | 0.0073 | 1763.2956 | 82.8347 |
| Story10 | 30 | Top | 0.000862 | 0.000043 | 0.000751 | 0.000094 | 1278.2372 | 0.0075 | 1883.725 | 94.3658 |
| Story9 | 27 | Top | 0.000935 | 0.000047 | 0.000765 | 0.0001 | 1385.7918 | 0.0067 | 1992.9467 | 104.532 |
| Story8 | 24 | Top | 0.001002 | 0.000051 | 0.000769 | 0.000105 | 1486.1048 | 0.0052 | 2114.9215 | 113.7725 |
| Story7 | 21 | Top | 0.001062 | 0.000055 | 0.000763 | 0.000109 | 1580.0417 | 0.0044 | 2263.2592 | 122.3405 |
| Story6 | 18 | Top | 0.001117 | 0.000058 | 0.000743 | 0.00011 | 1669.4275 | 0.0043 | 2438.3794 | 130.2468 |
| Story5 | 15 | Top | 0.001165 | 0.000061 | 0.000704 | 0.000109 | 1759.0311 | 0.0034 | 2629.5988 | 137.2766 |
| Story4 | 12 | Top | 0.001196 | 0.000064 | 0.000641 | 0.000104 | 1852.8912 | 0.0032 | 2820.2711 | 143.0803 |
| Story3 | 9 | Top | 0.00118 | 0.000064 | 0.000546 | 0.000092 | 1949.4562 | 0.0034 | 2991.533 | 147.316 |
| Story2 | 6 | Top | 0.00103 | 0.000058 | 0.00041 | 0.000073 | 2034.8363 | 0.0029 | 3121.9493 | 149.8149 |
| Story1 | 3 | Top | 0.000521 | 0.000031 | 0.000203 | 0.000037 | 2084.538 | 0.0038 | 3187.4161 | 150.7386 |
| Base | 0 | Top | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

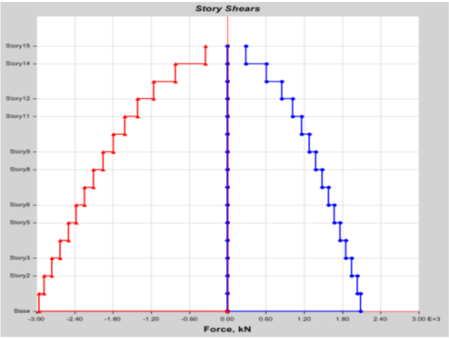



Model-0 max. Story drift in X & Y Direction (Without Shear Wall)

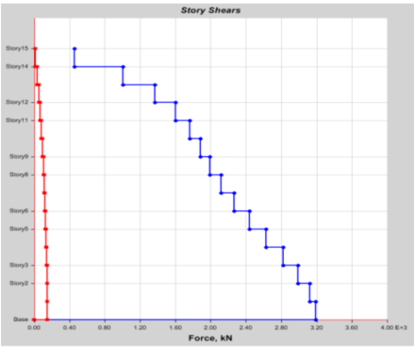



Model-5 max. Story drift in X & Y Direction (Shear Wall-5)






Model-0 max. Story Shear in X & Y Direction (Without Shear Wall)




Model-5 max. Story Shear in X & Y Direction (Shear Wall-5)

## 5. Result Analysis

Displacement of each storey in X & Z direction with different location of shear wall and configuration of shear wall in a building under earthquake force is shown in 4.2.1 & 4.2.2. From the graph and tables following inferences can be drawn;

- The displacements are increasing when the storey height increases and that is evident from all models.
- Shear wall foot print plays major role in reduction in lateral displacements and same can be observed if comparison is made between models-4 &5 and between models-1-2. Thought the numbers of shear walls provided are same in X and Z directions but the walls placed on the outer edges are more effective than those placed in the central core.
- Increasing the number of shear wall at corner as per model-2 have no improvement in lateral displacement than in model -1 & 3 (where in there are only 8 shear walls). This indicates about proper foot print of shear wall is more important than the number of shear walls. Thus with lesser number of shear wall and their appropriate placement can reduce the lateral displacements more effectively than the arbitrary placements of shear walls.
- Comparison of lateral displacement at each storey Model -4 and Model -5 give least lateral displacement in X and Z directions.
- The frame structure with shear wall observed reduction upto 38.35%, 38.83% & 49.22% in displacement when the shear wall is provided as per Model-1 & 4 (foot print of 8 shear wall) and Locations as per Model-5 (foot print of 10 shear walls) in X direction when seismic force is applied in the same direction.
- Table-5. indicates that frame structure with shear wall observed reduction almost from 34.41% to 36% in displacement when the shear wall is provided in Location as per Model -1,2,3,4 & 5 (foot print of 8 shear wall) in Z direction when seismic force is applied in same direction
- Table-5.18 shows the results, indicating that RCC frame structure in foot print of 10 shear wall (Model-5) reduces bending moment upto 24.38% than bending moment of bare frame.

## 6. CONCLUSIONS

- One of the models is bare frame and other five models are with different shear wall location and configuration in their foot print having total shear wall panel.
- Provision of a shear wall Model in Location 1 & 5 influences the seismic performance of the structure with reference to lateral displacement and results indicates that this configuration give least lateral displacement under seismic loads.
- Shear wall located in Model Location 1-2 performs better when compared to the frame without shear wall for most of the storeys except near top storey.
- The provision of shear wall with appropriate location is advantageous and the structure performs better if optimum configuration and its foot print are identified before the design of the entire structure.

## REFERENCES

[1] Choi, I. R., & Park, H. G. “Ductility and energy dissipation capacity of Friction joint-dominated steel plate walls”. Journal of structural engineering, vol no.134, No.9, pp 1495-1507, 2008

[2] Greifenhagen, C., & Lestuzzi, P. “Static cyclic tests on lightly reinforced concrete shear walls”. Engineering Structures, vol no.27, No.11, pp 1703-1712, June 2005] Kitada, Y., Nishikawa, T., Takiguchi, K., & Maekawa, K. “Ultimate strength of reinforce concrete shear walls under multi-axes seismic loads”. Nuclear engineering and design, vol.no.237, no.12, pp 1307-1314, October 2007

[3] Matamoros, A. B., & Elwood, K. (Eds.). (2006). “Beam-Pillar structure capacity and shear strength of reinforced concrete members under cyclic loading”. San Francisco, California. American Concrete Institute. vol.no.9, No.2, pp 24-28, October 2004

[4] Su, R. K. L., & Wong, S. M. “Seismic behaviour of slender reinforced concrete shear walls under high axial load ratio”. Engineering Structures, vol.no.29, No.8, pp 1957-1965, Feburary 2007

[5] Vetr, M. G., Shirali, N. M., & Ghamari, A. “Seismic resistance of hybrid shear wall (HSW) systems”. Journal of Constructional Steel Research, vol.no.116, No. 2, pp 247-270, January 2016

[6] Wang, M., Shi, Y., Xu, J., Yang, W., & Li, Y. "Experimental and numerical study of unstiffened steel plate shear wall structures". Journal of Constructional Steel Research, vol.no.112, No.1, pp 373-386, June 2015