International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June-2018 www.irjet.net p-ISSN: 2395-0072

# Analysis of RC Structure With and Without Shear Wall and Optimum Location of Shear Wall

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**Abstract -** *As we know that in the present scenario buildings with shear walls are gaining more popularity than buildings without shear wall in earthquake prone areas due to its capability to the resistance during earthquake. In this paper 11 story RCC building is considered for the seismic analysis which is located in zone V is considered for the analysis. Three models are considered for the analysis out of which one is bare frame model and remaining two models are structures with shear wall at various positions is considered. The modelling and analysis is done using ETABS -2013 software package. An attempt is made to study and compare the parameters such as story displacement, story drift, story shear, natural period and base shear*

***Key Words*: *Shear Wall, ETABS, Base Shear, storey drift, natural period and storey displacement***

## 1. INTRODUCTION

The major criteria now-a-days in designing RCC structures in seismic zones is control of lateral displacement resulting from lateral forces. In this thesis effort has been made to investigate the effect of Shear Wall position on lateral displacement and Storey Drift in RCC Frames. Three types of G + 10 structures are considered, out of which one is bare frame model i.e. without shear wall and for remaining two models shear wall is considered at centre and at corners . All the 3 models are analyzed. And after the analysis, obtained results are compared with respect to storey displacement, storey shear, base shear, and natural period for all the three models and then by comparing the results optimum location of shear wall is determined**.**

### 1.1 Objectives

1. To analyze the multi-storey building with shear wall using ETABS Software.

2. To study behavior of the structure under different location of shear wall.

3. To study and compare the parameters such as Natural Period, storey shear, storey displacement and storey drift.

4. To determine the optimum location of the structure.

### 1.2 Methodology

- Modelling and analysis of multi-storeyed building without and with shear wall at centre and corners for seismic loads.
- Comparison of results and graph of all models for the parameters storey displacement, storey drift, Storey stiffness, base shear and natural period.
- Seismic zone considered in this project is Zone V.
- Optimum location of shear wall is found out.

## 2. MODELING AND ANALYSIS

For this study, an 11-story building with each story height as 3 meters is considered and modelled using ETABS. The buildings are assumed to be fixed at the base. Three different models were considered, out of which one is bare frame model and other two models consist shear wall at center and corners. Models are studied in zone V comparing lateral displacement, story drift, story stiffness, base shear and natural period for all models**.**

### 2.1 MODELING

In the present study, four different types infill materials viz, conventional brick, cement concrete block, hollow block and light weight brick is taken into consideration. The building models with different types infill materials is modeled and analyzed using the computer software ETABS-2009 and the results are compared.

**Table -2.1: Analysis Data**

| | |
|---|---|
| Plan Size | 25m X 25m |
| No. Of Storeys | 11 No |
| Storey Height | 3m |
| Thickness Of Slab | 0.12m |
| Wall Thickness | 0.23m |
| Column Size | 0.6m X 0.6m |
| Beam Size | 0.23m X 0.45m |
| Grade Of Steel | Fe 415 |
| Grade Of Concrete for | M 25 |

| | |
|---|---|
| Beam | |
| Grade Of Concrete for Column | M 30 |
| Floor Finish | 1kN/m² |
| Live Load on Floor | 3kN/m² |
| Live Load on Roof | 1kN/m² |
| Response Reduction Factor | 5 |
| Importance Factor | 1 |
| Soil Condition | Medium |
| Type | II |
| Zone | V |
| Zone Factor | 0.36 |

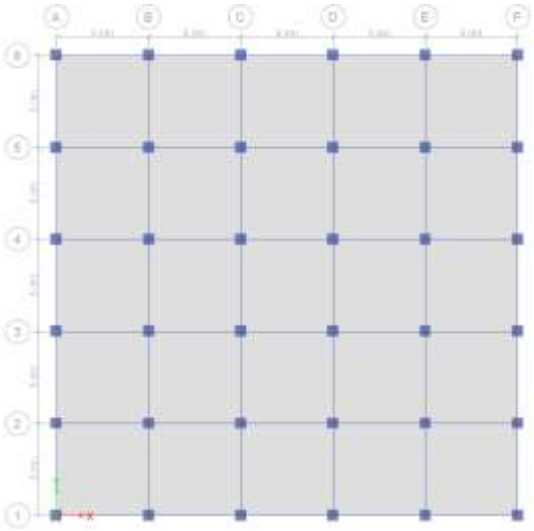

**Fig-2.1 Plan of Structure without Shear Wall (Model 1)**

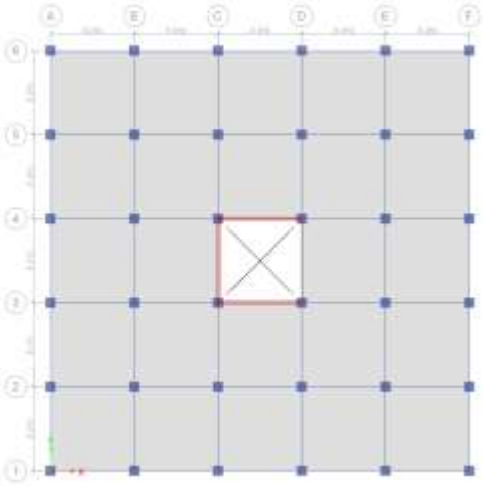

**Fig2.2 Plan of Structure with Shear Wall at Middle (Model 2)**

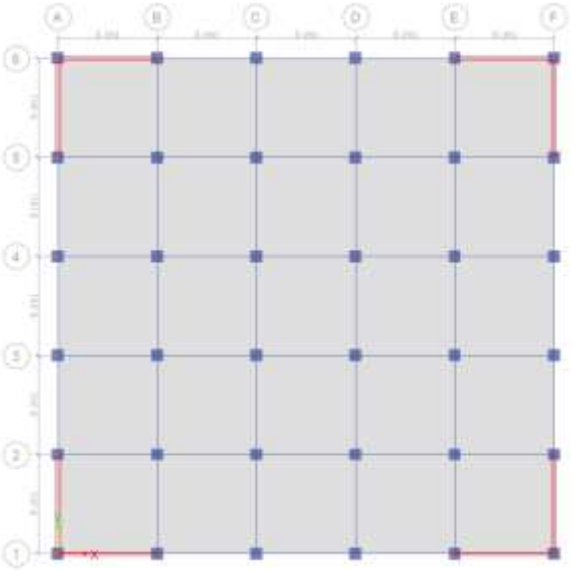

**Fig-2.3 Plan of Structure with Shear Wall at all four Corners (Model 3)**

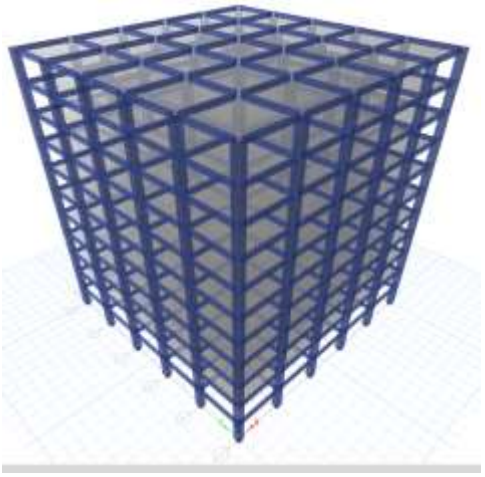

**Fig-2.4 3D View of Structure without Shear Wall (Model1)**

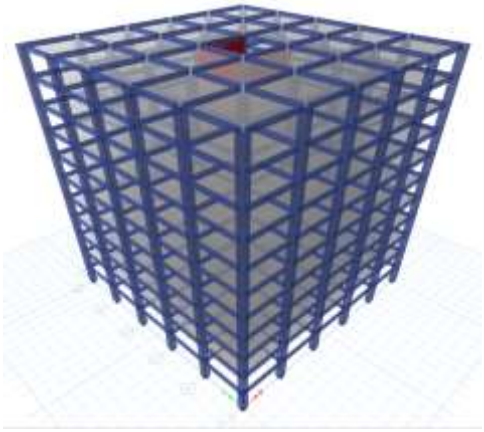

**Fig-2.5 3D View of Structure with Shear Wall (Model2)**

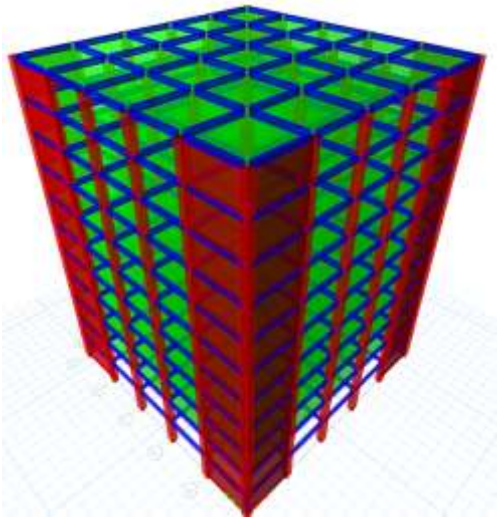

**Fig-2.6 3D View of Structure with Shear Wall (Model3)**

## 3. RESULTS AND DISCUSSION

Results from the analysis are base Shear, storey displacement, story drift, Natural period and story shear which is obtained for all models along both lateral direction i.e. along X and Y direction. Results are obtained and graphs are developed for multistoried building of bare frame model for models at various position of shear wall.

### 3.1BASE SHEAR FOR THREE MODELS

**Table-3.1 Base Shear (kN)**

| Model | Base Shear |
|---|---|
| Model 1 | 1241.01 |
| Model 2 | 3020.701 |
| Model 3 | 4586.57 |

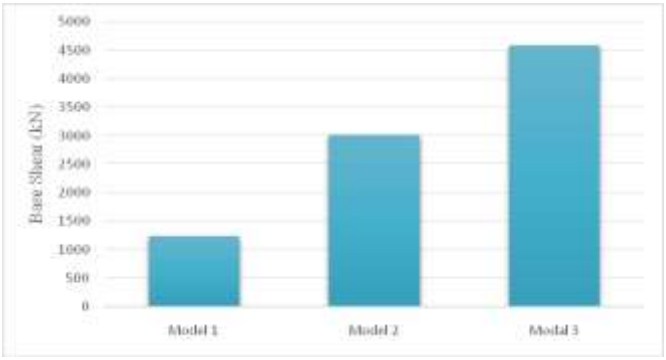


**Fig-3.1 Comparison of Base Shear**

Table-3.1 shows base shear for all the three models i.e. structure without shear wall, structure with shear wall at centre and structure with shear wall at corners. Fig-3.1 shows the variation of base shear. From the above table we can say that the base shear is more for structure with shear wall at corners as compared to that for structure with no shear wall. From the above table we can say that the structure with shear wall at corners gives higher value since its mass and stiffness are more. And the structure without shear wall gives lower value since its mass and stiffness are less.

### 3.2 NATURAL PERIOD FOR THREE MODELS

**Table-3.2Natural Period (S)**

| Model | Period |
|---|---|
| Model 1 | 3.217 |
| Model 2 | 2.708 |
| Model 3 | 0.987 |

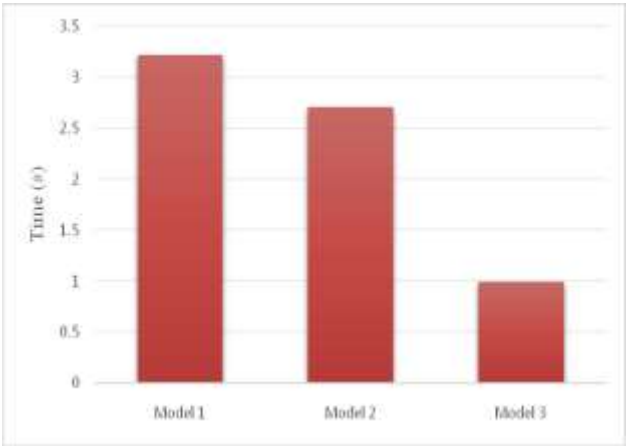


**Fig-3.2 Comparison of Natural Period**

Table-3.2 shows the natural period value for three models i.e. structure without shear wall, structure with shear wall at centre and structure with shear wall at corners. From the above results the natural period for the structure with shear wall at corners is less than that compared to the other two structures. From the above results we can conclude that, structure with shear wall at corners is stiffer than that compared to the structure with no shear walls.

### 3.3 STOREY DISPLACEMENT FOR THREE MODELS

**Table-3.3 Storey Displacement (mm)**

| Storey No | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Storey11 | 71.9 | 36.9 | 28.1 |
| Storey10 | 68.6 | 32.8 | 25 |
| Storey9 | 64.3 | 28.6 | 21.7 |
| Storey8 | 58.7 | 24.3 | 18.4 |
| Storey 7 | 51.8 | 20 | 15.1 |
| Storey6 | 43.9 | 15.8 | 11.9 |
| Storey5 | 35.3 | 11.9 | 8.9 |
| Storey4 | 26.3 | 8.3 | 6.2 |
| Storey3 | 17.4 | 5.1 | 3.9 |
| Storey2 | 9.2 | 2.6 | 2 |
| Storey1 | 2.8 | 0.9 | 0.7 |
| Base | 0 | 0 | 0 |

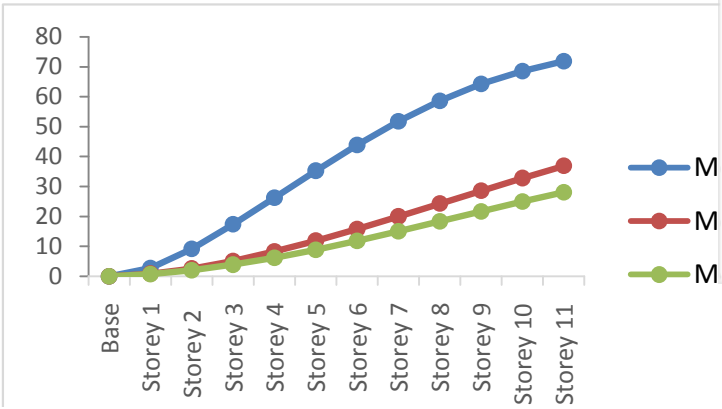


**Fig-3.3 Comparison of Storey Displacement**

Table-3.3 shows the displacement values of the three models i.e. structure without shear wall, structure with shear wall at centre, structure with shear wall at corners. And fig-3.3 gives the comparison plot between structures without shear wall, structure with shear wall at centre, structure with shear wall at corners. Here the structure without shear wall gives higher values as compared to the other two structures.

### 3.4 STOREY DRIFT FOR THREE MODELS

**Table-3.4 Storey Drift (m)**

| Storey No | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Storey11 | 0.001073 | 0.001381 | 0.001067 |
| Storey10 | 0.001446 | 0.001424 | 0.001099 |
| Storey9 | 0.001882 | 0.001439 | 0.001104 |
| Storey8 | 0.002291 | 0.001429 | 0.001092 |
| Storey7 | 0.002627 | 0.001391 | 0.001058 |
| Storey6 | 0.002867 | 0.001317 | 0.000997 |
| Storey5 | 0.002992 | 0.001202 | 0.000908 |
| Storey4 | 0.002968 | 0.001044 | 0.000788 |
| Storey3 | 0.00273 | 0.000845 | 0.000638 |
| Storey2 | 0.002145 | 0.000611 | 0.000462 |
| Storey1 | 0.000939 | 0.000284 | 0.000222 |
| Base | 0 | 0 | 0 |

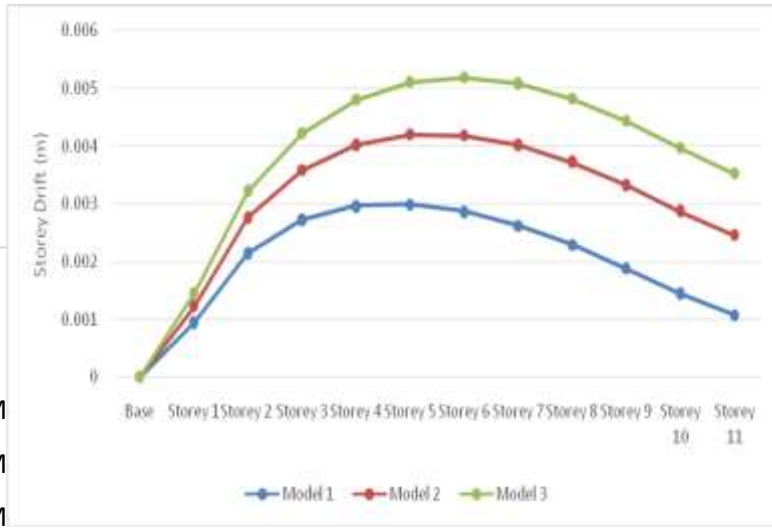


**Fig-3.4 Comparison of Storey Drift**

Table-3.4 shows the Storey Drift values of the three models i.e. structure without shear wall, structure with shear wall at centre, structure with shear wall at corners. And Fig-3.4 gives the comparison plot between structures without shear wall, structure with shear wall at centre, structure with shear wall at corners. Here the structure with shear wall at corners gives higher values as compared to the other two structures.

### 3.5 STOREY SHEAR FOR THREE MODELS

**Table-3.5 Storey Shear (kN)**

| Storey No. | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Storey 11 | 178.8791 | 430.9792 | 772.4396 |
| Storey 10 | 455.3334 | 1104.997 | 1764.019 |
| Storey 9 | 679.2614 | 1650.951 | 2567.198 |
| Storey 8 | 856.1922 | 2082.323 | 3201.809 |
| Storey 7 | 991.6548 | 2412.591 | 3687.683 |
| Storey 6 | 1091.178 | 2655.238 | 4044.651 |
| Storey 5 | 1160.292 | 2823.742 | 4292.546 |
| Storey 4 | 1204.525 | 2931.585 | 4451.199 |
| Storey 3 | 1229.406 | 2992.247 | 4540.441 |
| Storey 2 | 1240.464 | 3019.207 | 4580.104 |
| Storey 1 | 1241.01 | 3020.701 | 4586.57 |
| Base | 0 | 0 | 0 |

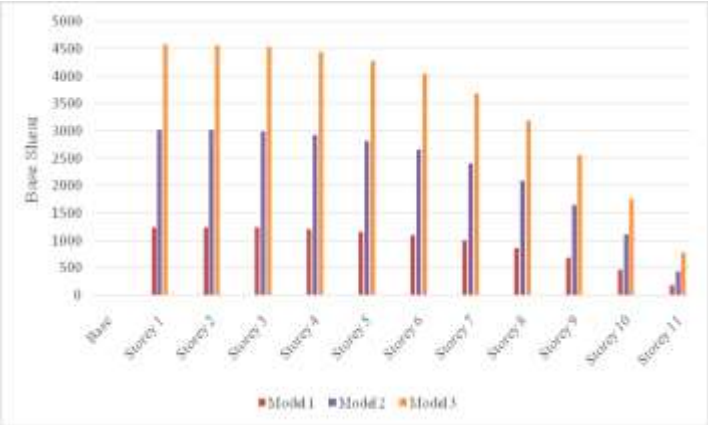


**Fig-3.5 Comparison of storey shear**

Table -3.5 shows the storey shear values of the three models i.e. structure without shear wall, structure with shear wall at centre, structure with shear wall at corners. And fig-3.5 gives the comparison plot between structures without shear wall, structure with shear wall at centre, structure with shear wall at corners. Here the structure with shear wall at corner gives higher values as compared to the other two structures, this is because structure with shear wall at corner have more shear resistance than that for the structure without shear wall.

### 4. CONCLUSIONS

The present study of analysis makes an effort to understand the effect of shear wall on the structure situated in the zone susceptible to earthquake. The analysis is been carried out, using ETABS. The results of the study lead to the following conclussions.

1. Base shear for structure with shear wall at corners is greater than the other two structures. Hence it is feasible to provide to shear wall at corners than at centre.

2. Natural period for structure with shear wall at corners is less i.e the structure displaces less in case of shear wall at corners than at centre. Hence it is feasible to provide shear wall at corners.

3. Storey displacement for structure with shear wall at corners is less as compared to that of structure with shear wall at centre and structure without shear wall. Hence it is feasible to priovid e shear wall at corners.

4. storey shear for structure with shear wall at corners gives higher values as compared to that with centre. Hence it is feasible to provide shear wall at corners.

5. From the above conclusions it is observed that structure with shear wall at corners gives better results as in case of the other two structures.

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