*International Journal of Engineering Applied Sciences and Technology, 2016*
**Vol. 1, Issue 8, ISSN No. 2455-2143, Pages 79-82**
Published Online June - July 2016 in IJEAST (http://www.ijeast.com)

# ANALYSIS OF RCC BUILDING WITH AND WITHOUT SHEAR WALL - A COMPARATIVE STUDY

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*Abstract*— **The present study reports the comparative analysis of RCC buildings with and without shear walls to work out effective, economical and ideal location of shear walls. G+4 RCC building in zone IV is considered for the present study. Analysis of the building is conferred with some preliminary investigations, analyzed by varied position of shear wall by considering four models as without shear wall, with shear wall at sides, with shear wall at corners and with shear wall at Centre. Maximum shear wall moments and maximum deflections are calculated and analyzed for all considered cases. M30 grade of concrete is used with Fe415 steel is used for the present study. The design and analysis is done using the software package STAAD.Pro.**

*Keywords*— **Shear Walls; Staad.Pro; Lateral forces; Stiffness**

## I. INTRODUCTION

Shear walls are a sort of structural system that has lateral resistance to the building or structure. They are vertical components of the structure i.e. the horizontal force resisting system. They are made to counteract the result of lateral masses engaged on the structure. In residential construction, shear walls are straight external walls that usually provide all of the lateral support for the building. To perform correct analysis, a structural engineer should confirm some data like structural masses, pure mathematics of the structure, support conditions, and materials properties. The results of such an analysis usually substantiate support reactions, stresses and displacements. This data is then compared with the factors that indicate the conditions of failure. Advanced structural analysis could examine dynamic response, stability and non-linear behavior. The aim of the design is that the action of an appropriate likelihood that structures are being so designed can perform satisfactorily throughout their design life with an applicable degree of safety, they must be ready to sustain all deformations of traditional construction and usefulness and have enough sturdiness and adequate resistance to the result of seismic masses and wind loads. Account ought to be taken of accepted theories, experiments and skill. The conclusion of the design objectives needs compliance with clearly outlined standards for materials, production, attainment and additionally maintenance and use of structure in commission. The planning of the building depends upon the minimum necessities as prescribed within the Indian common place Codes. Accurate conformity to loading standards counselled during this code, won't solely make sure the structural safety of the buildings that are being designed. Reinforced concrete (RC) buildings usually have vertical plate-like RC walls referred to as Shear Walls in addition to slabs, beams and columns. These walls generally begin at foundation level. Their thickness is as low as 150mm, or as high as 400mm in high rise buildings. Shear walls are sometimes provided on each length and breadth of buildings.

Solution of shear wall in multi storey building was studied D. Bhumina, et al. [2], comparison between forces owing to Egyptian code for hundreds (EC-1994) and (ECP-201, 2012) by carrying it out on the multi-stories R.C. framed buildings that were the foremost common kind of existing buildings in Egypt was carried by S. A. El-Betar [3], the response in terms of displacement and shear storey as the response of any structure could be a function of its unstable properties, specifically its mass and stiffness was calculated by S. Setia and V. Sharma [11].

The minimum need pertaining to the structural safety of structures are being covered by way of laying down minimum design loads which have to be assumed for dead loads, live loads and other external loads or forces the structure would be required to withstand. Accurate conformity to loading standards recommended in this study and hoped, will ensure the structural safety of the buildings which are being designed. The present study reveals the comparative analysis of RCC (G+4) buildings with and without shear walls to work out effective, economical and ideal location of shear walls. Analysis of the building is conferred with some preliminary investigations, analyzed by varied position of shear wall by considering four models as without shear wall, with shear wall at sides, with shear wall at corners and with shear wall at Centre. Maximum shear wall moments and maximum deflections are calculated and analyzed for all considered cases. M30 grade of concrete is used with Fe415 steel is used for the present study. The design and analysis is done using the software package STAAD.Pro.

## II. METHODOLOGY

The principle objective of the study is to analyse a multi-story building with Basement + Ground Floor + 4 Upper Floors. Analysis is carried out using STAAD.Pro. The design involves manual calculation of loads and analysing the whole structure by STAAD.Pro. Complicated and tall structures are very time consuming in calculations using conventional manual methods. STAAD.Pro provides us a fast, efficient, easy to use and accurate platform for analysing and designing structures. Various Loads such as Dead load, Live load, Floor load, Earthquake loads and their suitable combinations have been taken from their respective Indian standard codes. Such as Dead loads has been taken as per IS 875- I, Live load as per IS 875 part-II and seismic loadings as per IS 1893-I (1984).

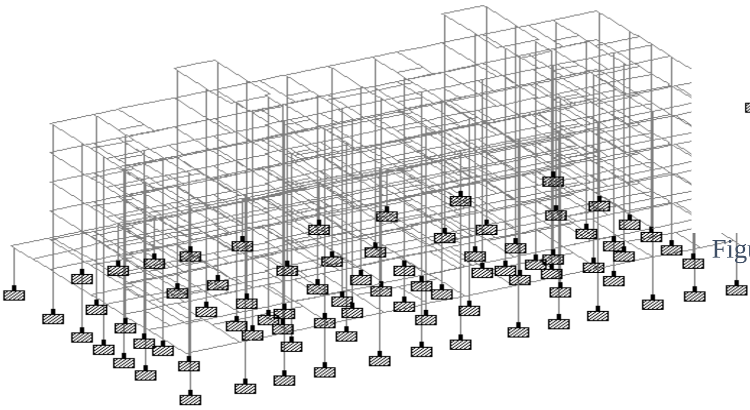

Figure 1. R.C.C. building Model

Given below is the design data that has been taken from IS Codes for doing the analysis:

### *A.* Design Data –

| | | |
|---|---|---|
| Type of Building | - | Residential |
| Live load | - | 3 kN/m$^2$ |
| Earthquake load | - | IS: 1893 (part 1)-1984 |
| Storey height (1$^{st}$ to 4$^{th}$ floor)- | | 3m Floors |
| Ground Floor Height | - | 3m |
| Basement Height | - | 3.5m |
| Zone | - | IV |
| Concrete grade | - | M30 |
| Steel reinforcement | - | Fe 415 |
| Size of Column | - | 300 *300mm |
| Size of Beams | - | 400 *300mm |

The model for different cases considered is shown below:

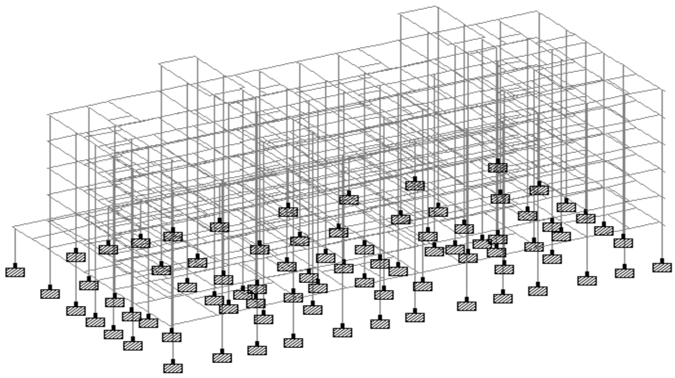

Figure 2. R.C.C. building Model without shear walls

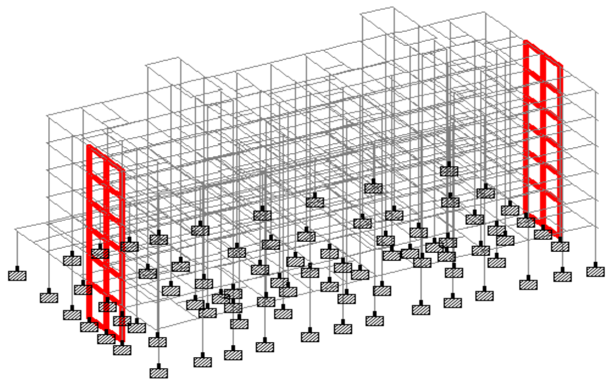

Figure 3. R.C.C. building Model with Shear walls on sides

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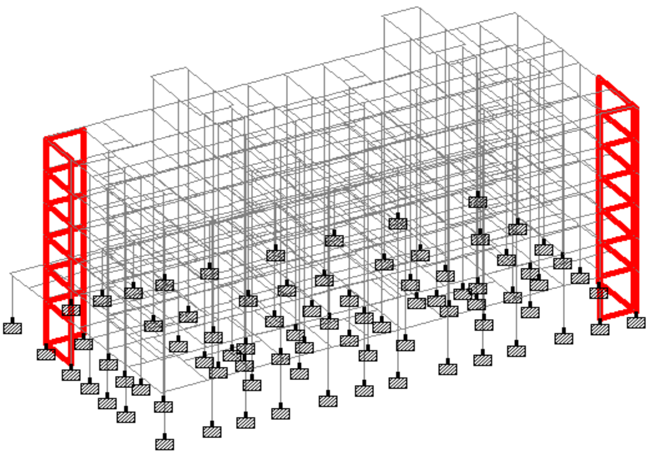

Figure 4. R.C.C. building Model with shear walls at corners

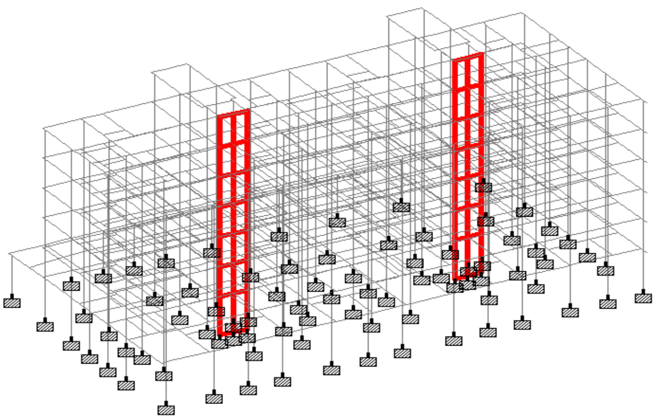

Figure 5. R.C.C. building Model with Shear walls at centre

## III. RESULT AND DISCUSSION

Four different models have been analysed for different locations of the shear wall and then results are compared as:

I. Building without shear wall
II. Building with shear wall at sides
III. Building with shear wall at corners
IV. Building with shear wall at center

Comparison has been made from the results obtained by STAAD.Pro and the suitable model is selected.

Table 1-5 gives results of maximum shear forces (kN), maximum moment (kN-m) and maximum local Displacement (mm) of various members for the selected model amongst four cases. The members are selected from top and bottom storey and from each corner of structures for all the four cases. The members selected are both horizontal and the vertical i.e. the results compared below are for both the beams and the columns of different stories.

Table 1: Maximum shear force in beams (kN)

| MEMBER NO. | CASE I | CASE II | CASE III | CASE IV |
|---|---|---|---|---|
| 2628 | 60.587 | 51.954 | 46.667 | 44.839 |
| 2122 | 76.793 | 59.080 | 50.576 | 50.873 |
| 1616 | 88.309 | 59.196 | 51.031 | 54.091 |
| 1110 | 97.066 | 58.665 | 51.926 | 56.747 |
| 604 | 100.394 | 57.852 | 52.530 | 59.413 |
| 87 | 85.752 | 52.823 | 52.823 | 63.225 |

Table 2: Maximum shear force in columns (kN)

| MEMBER NO. | CASE I | CASE II | CASE III | CASE IV |
|---|---|---|---|---|
| 2650 | 1.008 | 0.322 | 5.725 | 12.764 |
| 2144 | 19.832 | 16.122 | 1.900 | 8.782 |
| 1638 | 35.692 | 30.548 | 4.024 | 4.359 |
| 1132 | 48.079 | 42.082 | 11.255 | 1.281 |
| 626 | 77.467 | 70.766 | 19.647 | 3.229 |
| 109 | 37.851 | 33.265 | 14.291 | 4.454 |

Table 3: Maximum moments in beams (kN-m)

| MEMBER NO. | CASE I | CASE II | CASE III | CASE IV |
|---|---|---|---|---|
| 2628 | 56.259 | 42.265 | 37.903 | 33.761 |
| 2122 | 76.325 | 54.662 | 37.021 | 42.692 |
| 1616 | 93.071 | 54.410 | 38.552 | 47.536 |
| 1110 | 105.532 | 52.670 | 40.322 | 51.411 |
| 604 | 108.406 | 48.948 | 40.968 | 51.830 |
| 87 | 85.381 | 35.414 | 37.474 | 49.971 |

Table 4: Maximum moments in columns (kN-m)

| MEMBER NO. | CASE I | CASE II | CASE III | CASE IV |
|---|---|---|---|---|
| 2650 | 36.196 | 33.283 | 26.986 | 25.454 |
| 2144 | 61.909 | 56.861 | 32.615 | 30.978 |
| 1638 | 82.020 | 74.716 | 40.474 | 32.406 |
| 1132 | 96.151 | 87.074 | 49.620 | 35.049 |
| 626 | 142.579 | 131.032 | 58.607 | 37.113 |
| 109 | 113.439 | 108.414 | 52.932 | 29.142 |

Table 5: Deflection in beams (mm)

| MEMBER NO. | CASE I | CASE II | CASE III | CASE IV |
|---|---|---|---|---|
| 2628 | 41.316 | 36.976 | 29.653 | 9.229 |
| 2122 | 37.939 | 33.962 | 25.039 | 8.216 |
| 1616 | 32.759 | 29.432 | 20.158 | 6.995 |
| 1110 | 25.724 | 23.276 | 14.743 | 5.420 |
| 604 | 17.083 | 15.670 | 9.191 | 3.586 |
| 87 | 7.678 | 7.206 | 4.058 | 1.685 |

## IV. CONCLUSION

In the present study position of shear walls is analysed by varying their positions. As per the results depicted from the present study, it can be seen clearly that it is hard to resist lateral loads applied on the structure without shear walls. Based on the present study, following conclusions can be made:

- The members near the shear walls show little or negligible displacement or moments and structure as whole becomes a lot of stable and safe against lateral forces.
- Shear wall at center is most suitable and safe from among the models analyzed, minimum displacement and moments are noticed for this case.
- From all the load combination, the load combination of 1.5DL+1.5EQX is found to be critical combination for all the models.
- The least max displacement for columns from all the cases is for the Case-IV which is 9.2mm for the top level and that for bottom story is 1.6mm.
- The shear force is maximum at the ground level for structure without shear walls as compared to others.

Hence, it can be said that building with the shear wall at center is more efficient than all other types of shear walls considered in the present study.

## V. REFERENCE

[1] Ali, S. E and Aquil, M. M. U, "Study of strength of RC shear wall at different location on multi-storied residential building", Journal of engineering and research and applications ISSN: 2248-9622, volume 4, Issue 9, September 2014.

[2] Bhunia, D; Ramjiyani, B. and Anshuman; "Solution of shear wall in multi storey building", International journal of civil and structural engineering, Volume 2, no. 2, 2011.

[3] El-Betar, S.A.; "Seismic performance of existing R.C. framed buildings", HBRC journal 2015.

[4] IS: 875 (PART I)- 1987: Indian Standard Code of Practice for Design Loads Part I Dead Loads.

[5] IS: 875 (Part 2) – 1987 Indian Standard Code of Practice for Design Loads Part II Imposed Loads.

[6] IS: 1893 (Part I) – 2002 Indian Standard Criteria for Earthquake Resistant Design of Structures.

[7] Korkmaz, K. A.; Sari, A. and Carhoglu, A. I.; "Seismic risk assessment of storage tanks in Turkish industrial facilities", Journal of Loss Prevention in the Process Industries Volume 24, Issue 4, July 2011.

[8] Kaya, E. S.; Katayama, T. and Yamao, T.; "Seismic Response Analyses of the folded cantilever shear structure: Analytical and Experimental studies", Procedia Engineering Volume 14, 2011.

[9] Ormeno, M.; Larkin, T. and Chouw, N.; "Evaluation of seismic ground motion scaling procedures for linear time-history analysis of liquid storage tanks", Engineering Structures, Volume 102, November 2015.

[10] Ruiz, R. O.; Garcia, D. L. and Taflanidis, A. A.; "An efficient computational procedure for the dynamic analysis of liquid storage tanks", Engineering Structures Volume 85, February 2015.

[11] Setia, S. and Sharma, V.; "Seismic response of RCC building with soft storey", International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 (2012).

[12] Wong, K. K. F.; "Seismic Applications of nonlinear response spectra based on the theory of modal analysis", Procedia Engineering, Volume 14, 2011.

[13] Zhai, C. H.; Zheng, Z.; Li, S. and Xie, L. L.; "Seismic analysis of a RCC building under main shock-aftershock seismic sequences", Soil Dynamics and Earthquake Engineering, Volume 74, July 2015.