International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 03 | March - 2022 ISSN: 2582-3930

ANALYSIS OF A MULTI-STOREYED RESIDENTIAL BUILDING WITH SHEAR WALL AT CORNER

Abhishek Mishra[*1], Jitendra Kumar[*2], Kumar Vanshaj[*3]

[*1]Assistant Professor, CED, Institute of Engineering Technology Lucknow, India
[*2]M.Tech research scholar, CED, Institute of Engineering Technology Lucknow, India
[*3]Assistant Professor, CED, Institute Of Engineering Technology Lucknow, India

Abstract - Shear wall systems are one of the most commonly used lateral load resisting system in high rise residential buildings. They resist in-plane loads that are applied along its height, Shear wall has very high in plane stiffness and strength which could be used to simultaneously resist large horizontal loads and support vertical or gravity loads making them quite advantageous in many structural engineering applications. It was observed that Multi-storeyed R.C.C. Buildings with shear wall is economical as compared to without shear wall. The Articles deals with comparative study of G+15 Storey building in Zone IV is presented with some preliminary investigation which is analysed shear wall at corner to determine parameter like axial load and moments. This analysis is done by using Software package STADD-pro. The buildings are modelled with floor area of 256 sqm (16m x16m) with 4 bays along 16 m span each 4 m. and 4 bays along the 16 m span each 4 m. The design is carried out using STAAD.PRO software. The main aim of the present work is therefore to make a comparative study of structural system and orientation with the shear wall at corner. There are lots of literatures available on design and analysis of the shear wall system. However, the decision about the location of shear wall in multi-storey building is not much discussed in any literatures. A study on a residential building with shear wall at corner was analysed.

***Keywords*:** Shear wall, Lateral forces, Staad Pro, Multi-storeyed.

1. INTRODUCTION

Shear walls are a type of structural system that provides lateral resistance to the building or structure. Shear walls are vertical elements of the structure i.e. the horizontal force resisting system. Shear walls are constructed to counteract the effect of lateral loads acting on the structure. Analysis of shear wall may appear as an important design element because high rise structures are continuously becoming taller and slender. Earthquake has always been a threat to human civilization from the day of its existence, devastating human lives, property and man-made structures. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. To perform accurate analysis a structural engineer must determine some information such as structural loads, geometry of the structure, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. A study has been carried out to determine the strength of RC shear wall. This information is then compared with the criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behaviour. The aim of design is the achievement of an acceptable probability that structures that are being designed will perform satisfactorily during their design life. With an appropriate degree of safety, they should be able to sustain all the loads and deformations of normal construction and use and have enough durability and adequate resistance to the effect of seismic loads and wind loads. Account should be taken of accepted theories, experiments and experience and the need to design for durability. If these walls are installed systematically, then an improvement in stability will be achieved in them.

2. LITERATURE REVIEW

Himalee Rahangdale and S.R. satone (2013) Design and Analysis of Multi-storeyed Building with Effect of Shear Wall", International Journal of Innovative Research in Science, Engineering and Technology. Vol. 6, Issue 3 May 2013.Here in this paper the Study of G+5 Storey building in Zone IV is presented with some preliminary investigation which is analysed by changing various position of shear wall with different shapes for determine parameter like axial load and moments. Different location of shear wall effect on axial load on the column. In absence of shear wall axial load and moments are maximum on column.

Ashok Thakur and Arvinder Singh *Comparative* Analysis of a Multi-storeyed Residential Building with and Without Shear Wall using STADD Pro. International Journal of Innovative Research in Science, Engineering and Technology. Vol. 1, Issue 3 June 2014. Here in this paper the analysis is done by using Software package STADD-pro. The buildings are modelled with floor area of 216 sq. (18m x12m) with 6 bays along 18 m span each 3 m. and 4 bays along the 12 m span each 3 m. The design is carried out using STAAD.PRO software. The main aim of the present work is therefore to make a comparative study of structural system and orientation with the shear walls and without shear wall. There are lots of literatures available on design and analysis of the shear wall system. However, the decision about the location of shear wall in multi-storey building is not much discussed in any literatures. A study on a residential building with shear wall and without shear wall was studied to understand the effect of lateral loads.

M. S. Aainawala and Dr. P. S. Pajgade **(2014)** "Design of Multi-storeyed R.C.C. Buildings with and without Shear Walls", International Journal of Innovative Research in Science, Engineering and Technology. Vol. 6, Issue 3 July 2014. Here in this paper Shear walls have very high in-plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. An earthquake load is applied to a building for G+12, G+25, G+38 located in zone II, zone III, zone IV and zone V for different cases of shear wall position. Lateral displacement and story drift are calculated in all the cases. It was observed that Multi-storeyed R.C.C. Buildings with shear wall is economical as compared to without shear wall.

P. P. Chandurkar and Dr. P. S. Pajgade "Seismic Analysis of RCC Building with and Without Shear Wall", International Journal of Innovative Research in Science, Engineering and Technology. Vol. 3, Issue 3 May 2013.Here in this paper main focus is to determine the solution for shear wall location in multi-storey building. Effectiveness of shear wall has been studied with the help of four different models. Model one is bare frame structural system and other three models are dual type structural system. An earthquake load is applied to a building of ten stories located in zone II, zone III, zone IV and zone V. Parameters like Lateral displacement, story drift and total cost required for ground floor are calculated in both the cases replacing column with shear wall.

3. OBJECTIVES OF THE PROJECT

This research is based on the shear wall at corner in G+15 Storey building. The following objectives are taken for these project are as follows:-

1. To Study about shear wall behaviour with variation in different parameters such as.
- Story displacement
- Base shear
- Story drift.
2. To Modelled a G+15 storey multi-storey Building by software approach.
3. To investigate the seismic response of G+15 RC framed structure for shear wall at corner in seismic zone IV.
4. To find the optimum structure & thickness of shear wall structure in G+15Storey model.

4. METHODOLOGY

The principle objective of this paper is to analyse and design a multi-storeyed building [G +15] using STAAD Pro. The design involves load calculations manually and analysing the whole structure by STAAD Pro. Staad Pro features a user friendly interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. Complicated and tall structures need very time taking and tier some 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 1893-2016 (part 1).

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

Calculation of Primary Loads Common for All the Frame Models

IS 875 (PART-1) is referred for the values of unit weight of the structural materials for calculation of dead load and IS 875 (PART-2) is referred for the value of floor live load and roof live load

Dead Load of the Beam and Column - This can be provided by applying load factor -1

- Dead Load of the Slab = (unit weight of reinforced concrete X thickness of the slab) o = 25X 0.150 = 3 .75KN/m2
- Dead Load of the wall = (unit weight of the brick masonry X thickness X wall height)
- Dead Load of wall = 20X 0.26 X (3-0.4) = 13.52 KN/m
- Live Load = 3 KN/m2
- Roof Live Load = .75 KN/m2
- Floor Load = 25×.15×1 = 3.75KN/m2
- Load Combinations –Apply automatic load combination as per IS 1893-2016 (part 1).

DESIGN DATA

Type of Building	Residential
Live load	3KN/m2
Earthquake load	IS 1893-2016 (part 1)
Storey height	3m
Floors	G.F. + 15
Zone	IV
Steel reinforcement	Fe 415
Size of Column	600x600mm
Size of Beams	500x500mm

Table: 1

DETAILS OF MODELS

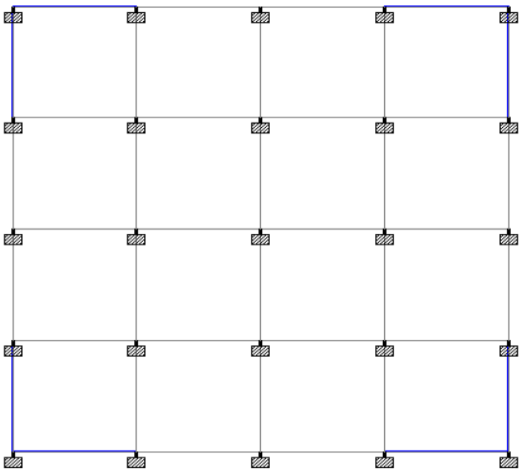


Fig 1: Shear Wall at Corner (Top View)

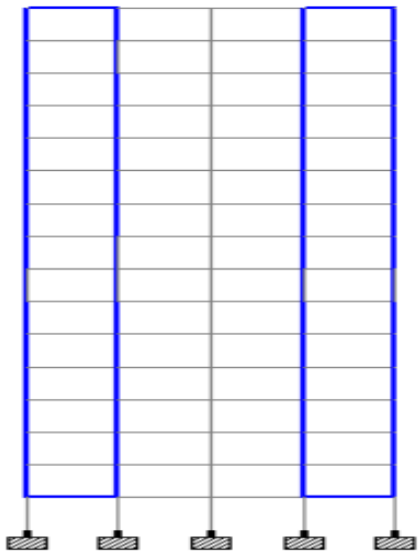


Fig 2: Shear Wall at Corner (Side View)

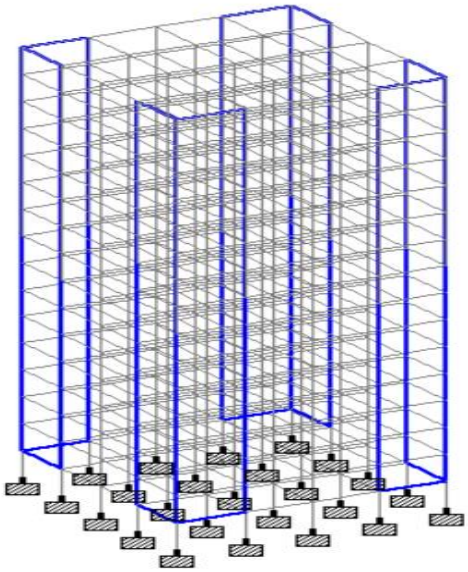


Fig 3: Shear Wall at Corner (Isometric View)

5. DISCUSSION AND RESULTS

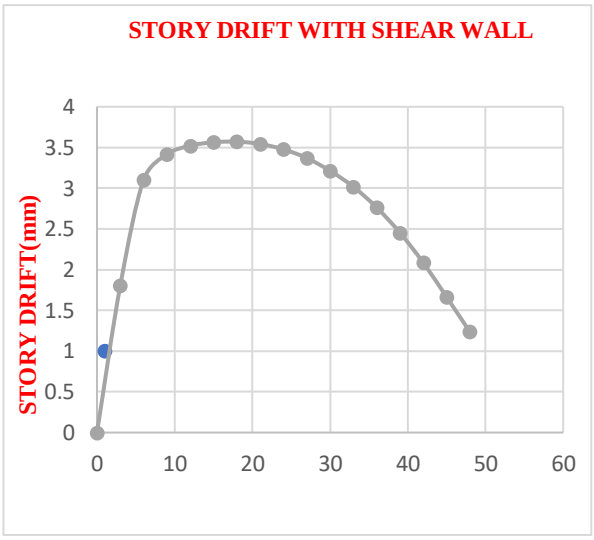
The graph shows the value of storey drift for structures in which shear wall is provided. From the graph it is observed that the value of storey drift is shear wall at corners. Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure. If shear wall is not provided in the

structure the value of base shear is minimum. From the graph it is clear that value of base shear increases with the provision of shear wall it means shear walls provide more safety to resist lateral loads.

STORY DRIFT WITH SHEAR WALL

Floor No.	BUILDING HEIGHT(m)	STORY DRIFT WITH SHEARWALL(mm)
G	0	0.00
1	3	1.81
2	6	3.10
3	9	3.42
4	12	3.52
5	15	3.57
6	18	3.57
7	21	3.54
8	24	3.48
9	27	3.37
10	30	3.21
11	33	3.02
12	36	2.76
13	39	2.45
14	42	2.09
15	45	1.66
16	48	1.24

Table: 2

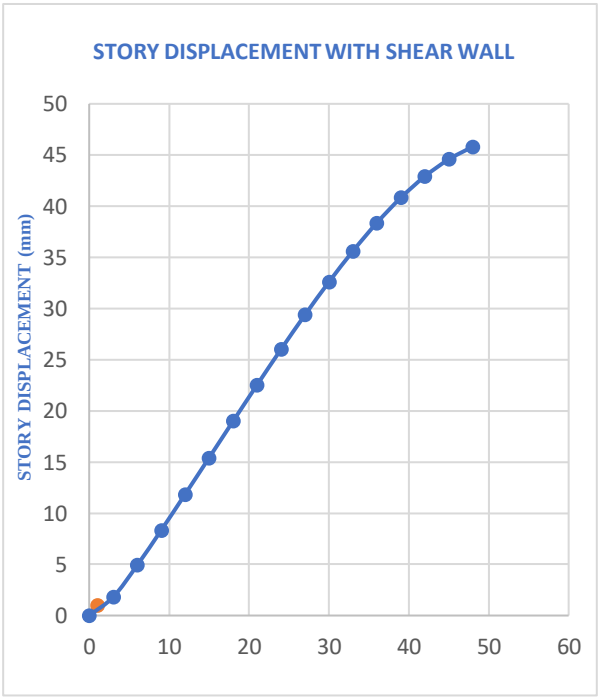


Graph 1: story drift with shear wall

STORY DISPLACEMENT WITH SHEAR WALL

Floor No.	BUILDING HEIGHT(m)	STORY DISPLACEMENT WITH SHEARWALL(mm)
G	0	0.00
1	3	1.81
2	6	4.91
3	9	8.32
4	12	11.85
5	15	15.41
6	18	18.98
7	21	22.53
8	24	26.00
9	27	29.38
10	30	32.59
11	33	35.61
12	36	38.37
13	39	40.82
14	42	42.91
15	45	44.57
16	48	45.81

Table: 3

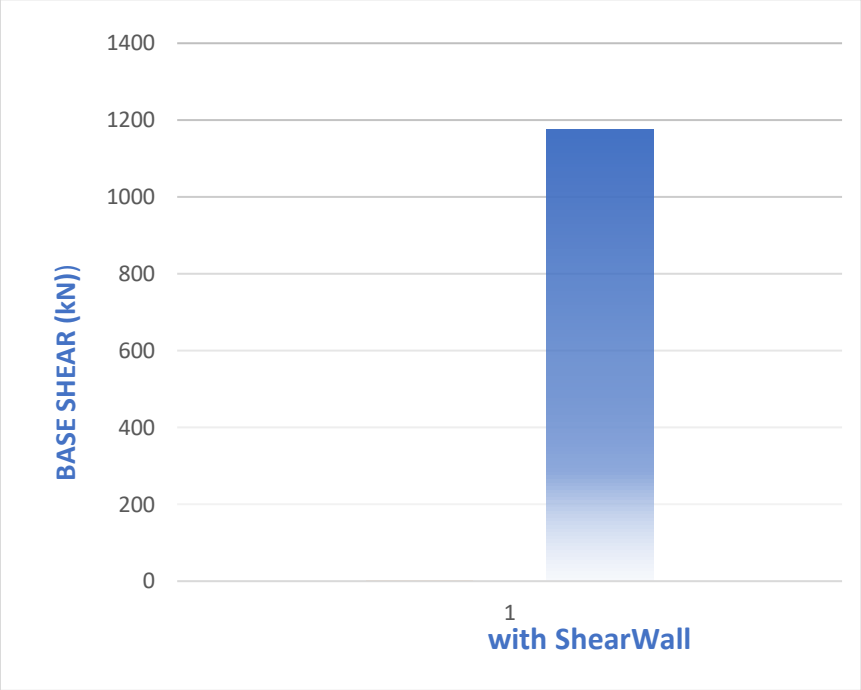


Graph 2: Story Displacement with Shear Wall

BASE SHEAR WITH SHEAR WALL

BASE SHEAR WITH SHEARWALL (kN)
1175.27

Table: 4



Graph 3: Base Shear with Shear Wall

6. CONCLUSION

It is quite evident from the results shown above that with the use of shear wall. It is also very clear from the analysis that shear force gets considerably reduced by the use of shear wall. Not only shear force on the members but Max Moment and Displacements also gets reduced. The members near to the shear walls show very little or negligible displacement or moments and structure as a whole becomes more stable and safe against the lateral forces though the self-weight of the structure increases.

The conclusive outcomes drawn from the study are enlisted below:

- The study is conducted for both the directions viz. lateral and longitudinal direction
- The dual structural configurations should be necessary to overcome the lateral effects in the form of displacements to any tall structures.
- Strength criteria of the soil also play an important role in structural stability. Soil type should also be checked as per Indian Standardization IS 1893-2016 (part 1).
- Earthquake analysis should be checked in particular zones or cities to analyse the data in different manner.
- Checking of the analysis of different parameters and its validation as per Indian Standards is necessary along within the limits.
- Results have been obtained using STAAD Pro. Version 2004

REFERENCES

1. Earthquake Resistant Design of Structures by Pankaj Agarwal.
2. "Effect of change in shear wall location on storey drift of multi-storey residential building subjected to lateral load", Ashish S. Agrawal and S. D. Charkha, International journal of Engineering Research and Applications, Volume 2, Issue 3,may-june 2012, pp.1786-1793.
3. V.Abhinav, Seismic Analysis of Multi Story RC Building with Shear Wall Using STAAD.pro .international journal of innovative technology and research volume no.4, issue no.5, august – September 2016, 3776 – 3779
4. Ashishs.agrawal, s.d.charkha, "effect of change in shear wall location on storey drift of multi-storey building subjected to lateral loads,) international Journal of Engineering Research and Applications (IJERA) ,Vol. 2, Issue 3, May-Jun 2012.
5. Madhurivassavai, V. Bhargavi, E.V. Raghava Rao, 'Analysis and Design of Multi-storeyed Building With G+8 Floors by Using Staad.pro', International Journal of Advanced Technology and Innovative Research', Vol. 08, Issue 02, ISSN 2348-2370, February – 2016.
6. R. Sanjaynath, Mr. K. Prabin Kumar, 'Analysis and Design of (G+20) Multi – Storey Residential Building Using Staad.pro' Saveetha University, Chennai. Volume 119 ISSN: 1314-3395, 17 November 2018. [7] T. Dinesh Kumar, 'Design And Analysis of High-Rise Building Using Staad.pro' SSRG International Journal of Civil Engineering. Volume 6 Issue 6 – June 2019
7. Khaja Begum, 'Analysis and design of a multi storied building with shear wall by using Staad.pro' International Journal of Engineering Sciences & Management, January – March 2018.
8. Misam Abidi, mangulkar madhuri. N., 'Review on shear wall for soft storey High-Rise building', International Journal of Advanced of Engineering and Advanced Technology, Volume: 01, Issue: 06, August 2012.
9. Himalee Rahangdale , S.R.Satone, Design And Analysis Of Multi-storeyed Building With Effect Of Shear Wall, International Journal of Engineering Research and Applications (IJERA), Vol. 3, Issue 3, May-Jun 2011
10. IS: 875 (Part 1) – 1987(second revision) Indian Standard Code of practice for Design loads (other than earthquake) Part-1 dead loads.
11. IS: 875 (Part 2) - 1987(Second Revision) Indian Standard Code of practice for design loads (other than earthquake) Part-2 imposed loads.
12. IS 1893 (Part 1) : 2016(Fifth Revision) Indian standard Criteria for earthquake resistant Design of structures