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An Analysis of Building with Different Height of Shear Wall at corners at Seismic Zone-III

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Abstract- Shear wall systems are one of the most commonly used lateral load resisting systems in high-rise buildings. Shear wall has very high in-plane stiffness and strength, which could be used to simultaneously resist large horizontal loads, and supports vertical or gravity loads. In multi-story buildings to resist lateral forces incorporation of shear walls has become inevitable. It is very necessary to determine the effective, efficient, and ideal location of the shear wall. This paper's study of G+5 storey building in zone-III is presented with some preliminary investigation which is analyzed by changing various heights of the shear wall at the corner position. This paper determines the node displacement, maximum shear force, maximum moment, and base shear with the help of STAAD-pro software. The building is modeled with a floor area of (28m*18m) with 7 bays along 28m span every 4m and 6 bays along the 18m span every 3m and each storey height is 3m.The analysis is carried out using STAAD-pro software. Analysis and comparative study have been done placing of the shear wall at different heights of building at the corner position.

Keywords- Seismic analysis, Shear Wall Analysis, STAAD.Pro, High Rise Building analysis.

I. INTRODUCTION

Shear walls are vertical elements of the structure i.e. the horizontal force resisting system [2]. Shear walls are a type of structural system that provides lateral resistance to the building. Shear walls are designed to resist in-plane lateral forces, typically wind and seismic loads. Reinforced shear wall has high in-plane stiffness.

Positioning of the shear wall has shear wall resists loads parallel to the plane of the wall. Shear walls are typically light-framed or braced wooden walls with shear panels, reinforced concrete walls, reinforced masonry walls, or steel plates. Shear walls generally start at the foundation level and are continuous throughout the building height. In absence of shear wall axial load and bending moments are maximum on column [6].

The construction of shear walls in building damages due to the effect of lateral forces due to earthquakes and high wind can be minimized [8].

The thickness of the reinforced concrete wall can be as low as 150mm or as high as 400mm in high-rise buildings. Shear walls are usually provided along both the length and width of buildings. All of the load combinations are in the STAAD Pro software. Loads like dead load, live load, earthquake load, and another load. The load combination is 1.5 (dead load + earthquake load) is to be more critical. [11].

In residential building construction, shear walls are straight external walls that typically form a box that provides all of the lateral support for the building. When shear walls are designed and constructed properly and they will have the strength and stiffness to resists the horizontal forces [9].

In building construction, a rigid vertical diaphragm is capable to transfer lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Examples are the reinforced concrete wall or vertical truss. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of

structure and occupants create powerful twisting (torsion) forces. A structure with a shear wall offersa significant reduction in lateral sways [10]. A study has been carried out to determine the strength of the Reinforced shear wall of a multi-story building by changing the shear wall location and replacing the shear wall with an intermediate beam.

Parameters like maximum shear force, maximum bending moment, node displacement, and base shear are observed and compared. The different types of models are as follows.

- Type 1 Building without shear wall
- Type 2 Building with the shear wall up to 12 m height
- Type 3 Building with the shear wall up to 15 m height
- Type 4 Building with the shear wall up to 18 m height

II. OBJECTIVE

- To analyze and compare the buildings with shear walls at various heights at the corner and without shear walls with the help of STAAD pro software.
- To calculate maximum node displacement values in x-direction and z-direction and Y-direction and compare all types of buildings.
- To calculate maximum bending moment in columns in y-direction and z-direction in different directions in all types of buildings.
- To calculate the maximum shear force in columns in y-direction and z-direction in a different direction in all types of buildings.
- To calculate maximum bending moment in beams of all types of buildings.
- To calculate the maximum shear force in beams of all types of buildings.
- To calculate base shear in x-direction and z-direction in all types of buildings.

III. METHODOLOGY

There are many ways to test the performance of various arrangements described above. The STAAD.PRO software simulates various loading conditions and shows results about how the structure will perform in actual scenarios. The software offers various types of analysis techniques such as p-delta analysis, static analysis, geometric non-linear analysis, buckling analysis, dynamic analysis, Time history analysis, etc. In our paper study of the multi-storeyed frame under seismic loads has been investigated for various heights of shear walls at the corner. An analysis of multi-storeyed frames of G+5 stories has been carried out.

The building was assumed to be located in seismic zone III. The shear walls were provided at different heights of the building at the corner. The analysis of the building has been carried out by static method approach using STAAD Pro V8i SELECT series 6.

A G+5 multi-storey frame with three different heights of shear walls at a corner situated in seismic zone III has been taken for the study. The size of the building in the plan is 28m x18m. Height of each storey= 3m, Size of column= 300mm x 300mm, Size of beam= 230mm x 230mm, Shear wall thickness= 200mm, Slab thickness= 150mm, Concrete mix used= M30, Grade of steel= Fe415. Dead loads and Live loads have been taken as per IS 875 (Part 1) 1987 and IS 875 (Part 2) (1987), respectively Seismic load calculation has been done based on the IS 1893 (part 1)2002.

The load combinations considered in the analysis are 1.5(DL+LL), 1.5(DL+EQ), 1.2(DL+LL+EQ), and 0.9DL+1.5EQ, etc. Shows various features which are given as input to the software to simulate the loading conditions. After successfully performing the analysis the results are compared Results and Discussion section.

IV. MODEL DETAILS

Table 1 . Details of model.

Properties	Details
Type of building	Residential
Stories	G+5
Storey height	3m
Beam dimension	0.23m x0.23m
Column dimension	0.3mx0.3m
Shear wall thickness	200mm
Depth of slab	150mm
Grade of concrete	M_{30}
Grade of steel	Fe_{415}
Support condition	Fixed
Earthquake Zone	III
Live load	3 KN/m^2
Floor finish	1 KN/m^2

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Calculation of dead load- Self weight of slab	0.15x25=3.75KN/m^2
Zone factor	0.16
Response reduction factor	5.0
Importance factor	1.0
Soil type	medium soil
Rock and soil site factor	2
Damping ratio	5%
Period in Z-direction	0.50sec

Different type of model made

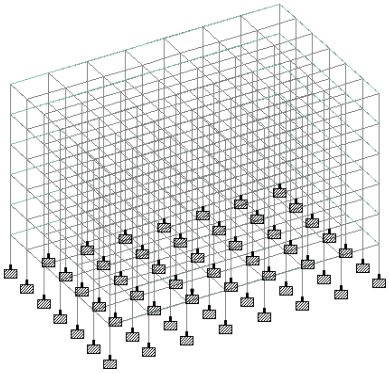

Fig 1. A Building without shear wall.

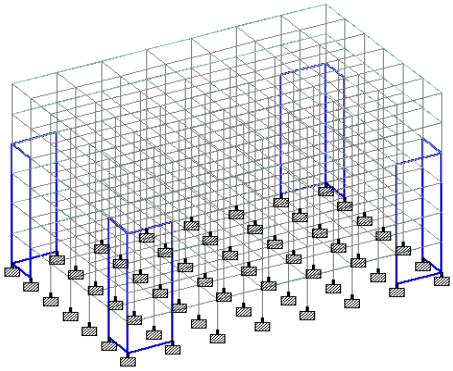

Fig 2. A building with shear wall up to 12 m height

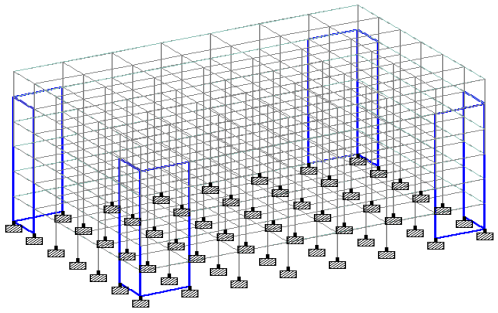

Fig 3. A Building with shear wall up to 15 m height

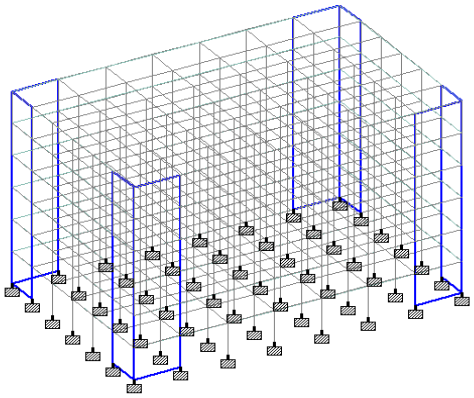

Fig 4. A Building with shear wall up to 18 m height.

V. RESULTS & DISCUSSION

In this paper, an attempt has been made to test & find the best heights to provide shear walls in multi-storey buildings. In total, 4 different configurations were made and results were analyzed.

When considering maximums hear force and maximum bending moment Type 4configured showed the least values of maximum shear force and bending moment in beams and columns.

Table 2. Value of maximum nodal displacement of X-direction, Y- direction and Z- direction.

Type	Node displacement in X-direction in mm
Type 1	28.764
Type 2	20.527
Type 3	18.690
Type 4	18.269
Type	Node displacement in Y-direction in mm
Type 1	42.763
Type 2	12.061
Type 3	7.192
Type 4	7.029
Type	Node displacement in Z-direction in mm
Type 1	90.939
Type 2	42.769
Type 3	38.002
Type 4	38.707

Table 3. Value of base shear for all types of structure in X-direction and Z-direction.

Type	Base shear in X-direction in kn
Type 1	319.02
Type 2	670.90
Type 3	825.68
Type 4	812.98
Type	Base shear in Z-direction in kn
Type 1	1098.55
Type 1	1161.88
Type 2	1177.72
Type 3	1193.55

Table 4. Value of bending moment in column in Y-direction and Z-direction in KN-m.

Type	Bending moment in column in Y-direction in knm
Type 1	136.240
Type 2	50.237
Type 3	29.045
Type 4	27.568
Type	Bending moment in column in Z-direction in knm
Type 1	59.772
Type 2	65.310
Type 3	37.727
Type 4	29.869

Table 5. Value of Shear force in column in Y-direction and Z-direction.

Type	Shear force in column in Y-direction in kn
Type 1	92.164
Type 2	34.858
Type 3	21.306
Type 4	20.339
Type	Shear force in column in Z-direction in kn
Type 1	36.686
Type 2	37.391
Type 3	24.166
Type 4	17.623

Table 6. Value of maximum Bending moment in beam.

Type	Bending moment in beam in knm
Type 1	111.336
Type 2	34.433
Type 3	26.461
Type 4	11.710

Table 7. Value of maximum Shear force in beam.

Type	Shear force in beam in kn
Type 1	76.414
Type 2	24.669
Type 3	21.306
Type 4	9.055

VI. CONCLUSION

In this paper, the main aim was to an analysis of shear wall at various heights of a building at the corner position. The parameters Maximum node displacement, Base shear, Maximum bending moment, Maximum shear force in columns and beams at different direction has been considered. The node displacement is reduced in building with an increase of height of the shear wall in a different direction. The maximum node displacement is building without the shear wall.

A building with a shear wall has more earthquake resistance compared to a building without a shear wall. Base shear is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of the structure. The value of base shear is increase with the increase of the height of the shear wall. The maximum base shear is found out type 4 (shear wall up to 18 m) structure.The value of bending moment and shear force is decreased with the increase of the heights of the shear wall. The minimum value of bending moment and shear force is observed is type 4 (shear wall up to 18 m height) structure.

REFERENCES

[1] Anil Baral, Dr. SK. Yajdani (2015) "Seismic Analysis of RC framed building for Different position of Shear wall" International Journal of Innovative Research in Science Engineering and Technology ISSN (Print): 2347-6710 | ISSN (Online): 2319-8753 Vol. 4

International Journal of Science, Engineering and Technology

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[2] Ashok Thakur, Arvindersingh (2014) "Comparative analysis of a multistoreied residential building with and without shear wall using STAAD Pro." International journal of recent research Aspects (ISSN: 2349-7688 vol.1, pp. 54-57) .

[3] Bureau of Indian Standards: IS-1893, part 1 (2002), "Criteria for Earthquake Resistant Design of Structures: part1 General provisions and Buildings" New Delhi India.

[4] Bureau of Indian Standards: IS-875, part 1 (1987), Dead load on buildings and Structures, New Delhi India.

[5] Bureau of Indian Standards: IS-875, part 2 (1987), live loads on buildings and Structures, New Delhi India.

[6] Himalee Rahangdale, S.R.Satone (2013) "Design and Analysis of Multistore building with Effect of shear wall" International Journal of Engineering Research and Application ISSN: 2248-9622 Vol.-3 pp. 223-232

[7] IS 456: 2000 "Plain and Reinforced Concrete-Code of Practice" Fourth revision, Bureau of Indian Standards, New Delhi India?

[8] P.Kalpana, R.D.Prasad, B.Krandhikumar (2016) "Analysis of building with and without Shear wall at Various Heights and Variation of Zone III and Zone V" International Journal of Engineering Research and Application. ISSN: 2248-9622Vol. 6 pp. 05-11

[9] Priyanka Kosare, Deepti Hazari (2019) "Study of Behaviour of Multi-storey Building with Shear walls" International Research journal of Engineering and Technology. e-ISSN: 2395-0056, p-ISSN: 2395-0072 Volume: 06 Issue; 07

[10] Ravi Shankar Mishra, V.Kushwaha, S. Kumar (2015) "A Comparative study of Different Configuration of shear wall location in soft storey Building subjected to Seismic load" International Research Journal of Engineering and Technology e-ISSN: 2395-0056, p- 2395-0072 Volume: 02

[11] V.abhinav, M. Vasudeva naidu, Dr.S.sreenathareddy, Prof. S.Madan mohan (2016) "Seismic Analysis of multi storeyRC Building with Shear wall using STAAD Pro" International Journal of Innovative technology and Research. 3776-3779 Volume No.4