Ahmed Raza Khan, 2021, 9:3
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

Structural analysis of RCC building with shear wall design with load combinations using STAAD-Pro

M.Tech. Research Scholar Ahmed Raza Khan, Prof. Anuj Verma
Dept. of Computer Science
Rajshree Institute of Management and Technology
Bareilly, India

Abstract- Shear walls are structural walls designed to resist lateral stresses produced in the wall plane by wind, earthquakes, and flexural components in buildings. The wind behaviour of buildings with corded walls is examined and compared in this article using the STAA D pro and three types of load conditions, namely dead load, live load, and wind load. The purpose of this paper was to look at and analyse several research initiatives aimed at improving lateral load and shear wall behaviour. Given that shear walls can withstand large sections of the lower portion of the structure and the framework can withstand lateral loads in the higher parts of the structure, buildings that are similar in nature built in India. In India, base levels are used for car parks and garages, and officers, and top floors are used for residential use.

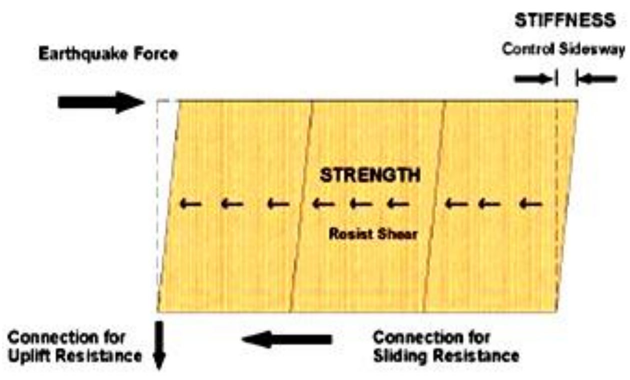
Keywords – Shear wall, STAAD PRO, Wind behavior, Multistory building.

I. INTRODUCTION

Today's structural engineering research is mostly focused on earthquakes and wind. The bulk of buildings nowadays have asymmetrical settings to satisfy architectural requirements or for other reasons. The irregularity may be horizontal or vertical, and the structure's bulk, stiffness, and strength are distributed unevenly across the building's height. For the static structure, the wind flow only interacts with the structure's external shape. The deflections under the wind load are minimal when the structure is very stiff. As a result, the structure is deemed static.

For dynamic structures, there is additional interaction with the structure's motion. Natural wind, gusts, and other aerodynamic forces constantly impact high buildings. The shear wall is mainly opposed by two types of forces: shear strengths and rising forces. Shear walls should be laterally strong to resist the earthquake's horizontal energy while preventing excessive sideways movement from the roof or floor above. There are many types of shear walls. They include connected wall shear, core type wall shear, wall support column shear, structural wall with frame, rigid frame wall shear, and so on. Wind load is the result of wind pressures acting on the construction surfaces during a wind event. Because pressure or load increases with the square of wind velocity, this wind pressure is mainly determined by the wind speed (i.e., doubling of wind speed results in a four-fold increase in wind load or pressure).

A hurricane may produce both long and short wind loads, causing long-term wind damage to buildings (gusts). While wind pressure is treated as "static" or continuous stresses for design purposes, the real loads fluctuate greatly depending on the wind and wind direction. We looked at buildings G+12, G+20 and G+26 exposed to wind loads and had different shear wall layouts in our study. The wall-frame structure was analysed to find the maximum lateral deformation and maximum shear forces.



II.STAAD-PRO

This programme is a structural analysis and computer design tool developed by Research Engineers International in Yorba Linda, California. Bentley Systems bought Research Engineers International at the end of 2005. It's the world's design and structural analysis software. The analysis is done numerically using the STAND.PRO programme, which is a finite-element package that enables the solution of linear and nonlinear PDEs, as well as the elasticity modulus of the beam material.

STAAD-Pro is a comprehensive finite element analytics and design solution that includes a cutting-edge user interface, viewing tools, and international design codes. It can analyse any structure that has been exposed to static loading, dynamic response, soil-structure interactions, wind, earthquake, and movement loads. STAAD-Pro V8i is the premier FEM analysis tool for all types of projects, including skyscrapers, slums, plants, bridges, stadiums, and marine structures.

Advanced Analysis and Design. With advanced analytical features such as linear, static, response spectrum, temporal, cable, and pushover and nonlinear analyses, STAAD-Pro V8i provides your engineering team with a scalable solution to meet the requirements of your project. STAAD-Pro V8i reduces the amount of time it takes to properly load a structure by automating stressors like as wind, earthquakes, snow, and cars.

III. WIND ANALYSIS

The main wind rate(Vb) for all locations is IS 875 and is tailored to reach the design wind speed for a chosen structure at any elevation (Vz).

"$V_z = V_b k_1\ k_2\ k_3$"

Where, Vz = design wind velocities in m/s at any level, Vb = basic m/s wind velocity, k1 = risk factor, k2 = ground roughness and height factor and k3

India's fundamental wind speed map applies to the various areas of the nation chosen by the code, as applicable in 10 m above average level. At whatever height above the mean level of the ground the design wind pressure is achievedvia the following connection between wind pressure and wind speed.

$$P_z = 0.6\ V_z$$

Where Pz represents the wind pressure in N/m 2 at height z, and Vz represents the design wind speed in m/s at height z.

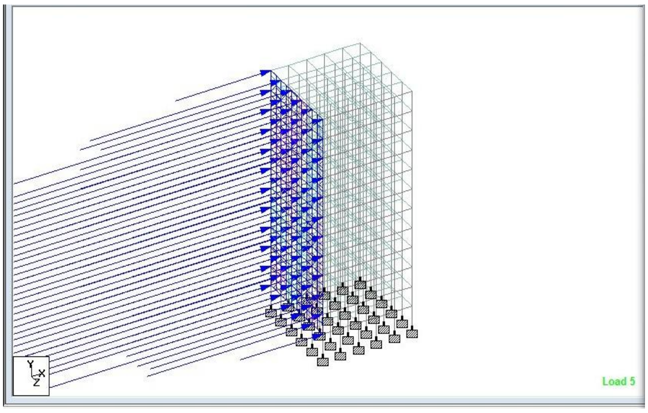
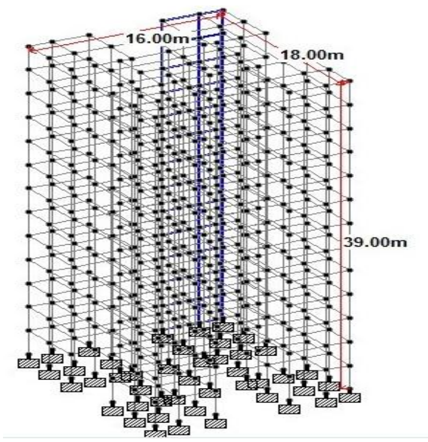


Figure 2: Applying Wind Load on Building Structure

As an input into STAAD-Pro software, these values are provided for drawing, analysis, and design reasons.

Supports- The structure's base supports are fixed. Figure illustrates the G+12, G+20 and G+26 construction structure with dimensions.



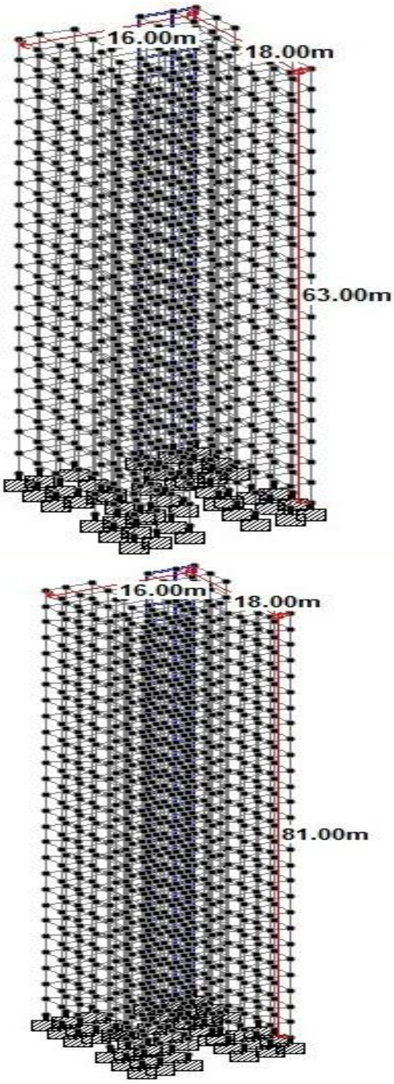


Figure 3 G+12, G+20 and G+26 Building structure with dimensions

Loading- Partially optimised loading by hand and remaining load generator tests were carried out using STAAD-Pro. The loading instances were treated as:-

Load case 1: Dead load
Load case 2: Live load
Load case 3: Wind load

Self-weight- STAAD-Pro with self-weight control in the load case column is able to determine the self-weight of the building.

Dead Load from Slab- STAAD-Pro can create dead loads from a slab by specifying the ground thickness and loads per sqm per level. In the calculations, the weight of the beam, the weight of the column, the weight of the RCC slab, the weight of the terracing, the weight of the external walls, the weight of the internal walls, and the weight of the parapet above the roof were all considered completed.

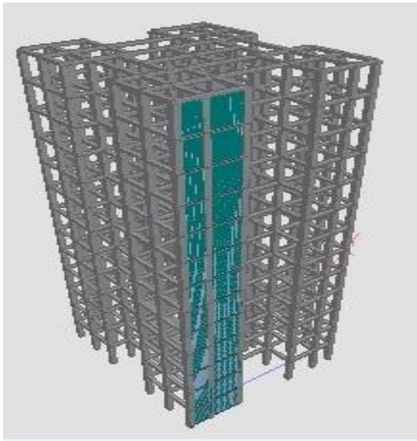


Figure 4 G+12 building shear wall structure.

IV.METHODOLOGY

In this research a structure of the G+12, G+20 and G+26 was designed and all loads like dead load, live load, wind load according to IS standard and seismic loads according to IS Standard were studied.
Table 2.1 shows the structural information derived from the reference is seen in the following.

Table 1: The structure details take from reference

Young's modulus of M20 concrete, E	2.8×10^7 KN/m^2
Grade of concrete	M20
Grade of Steel	Fe415
Density of Reinforced Concrete	25KN/m^3
Modulus of elasticity of brick Masonry	2100×10^3 KN/m^3
Density of brick masonry	20 KN/m^3
No of storey	G+12, G+20 & G+26
Beam Size	0.3m x 0.3 m (G+12) 0.35m x 0.35m(G+20) 0.4m x 0.4m (G+26)
Column size	0.45 m x 0.45m(G+12) 0.5m x 0.5m (G+20) 0.6m x 0.6m (G+26)
Shear wall thickness	0.2 m
Height of all storey	39m (G+12) 63m (G+20) 81m (G+26)
Height of each floor	0.3 m
Type of Soil	Medium
Type of structure	Special Moment Resisting Frame

V.RESULTS AND DISCUSSION

a set of instructions The results of using STAAD-Pro to analyze the construction of all frames, including the different positions of shear walls, are listed below. Factors to consider include interstory drift, base shear, and lateral displacement.

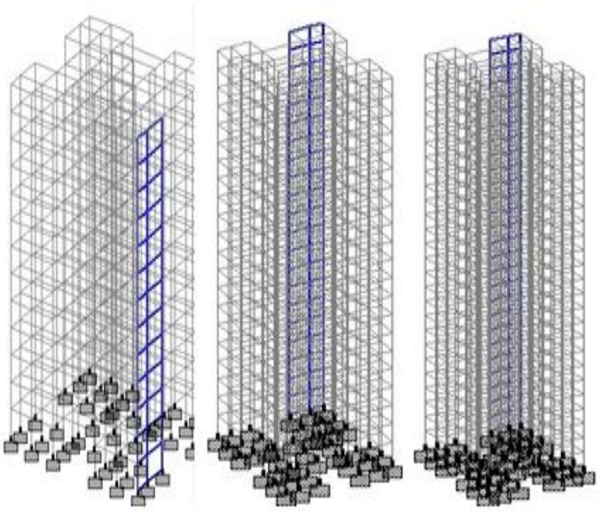


Figure 5:G+12, G+20 and G+26 Building Shear wall structure

The image above has shown that the Shear walls of the multi-floor building at each node.

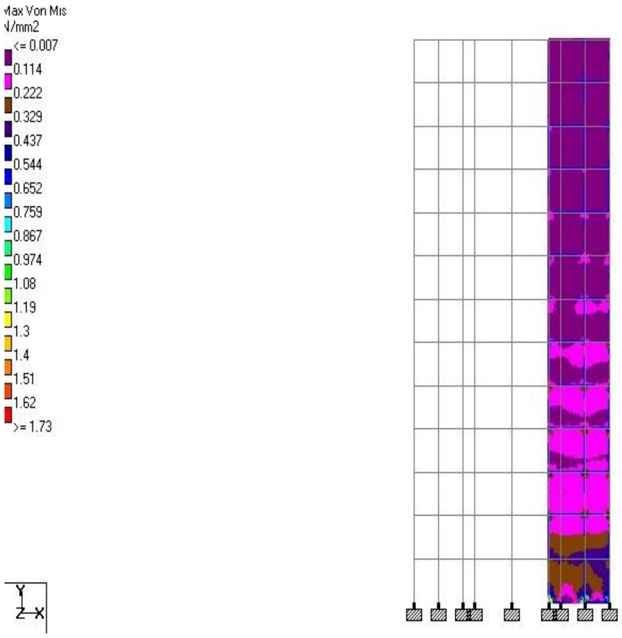


Figure 6 Stress generated in Shear wall in G+12Building Structure

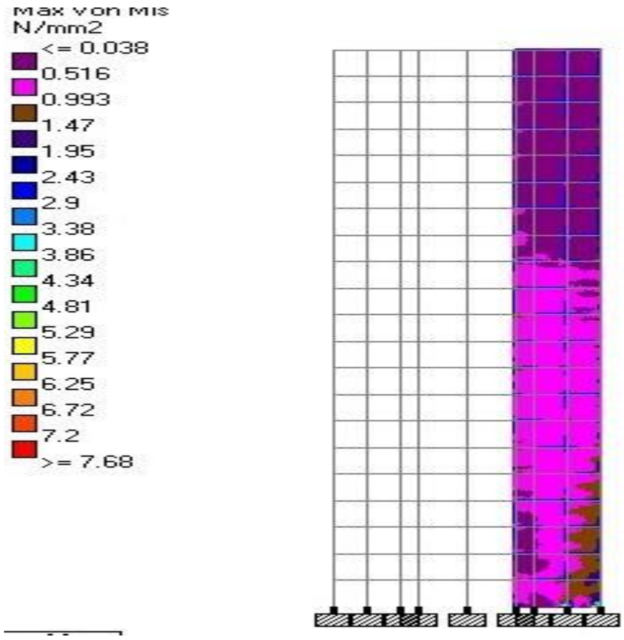


Figure 7 Stress generated in Shear wall in G+20Building Structure

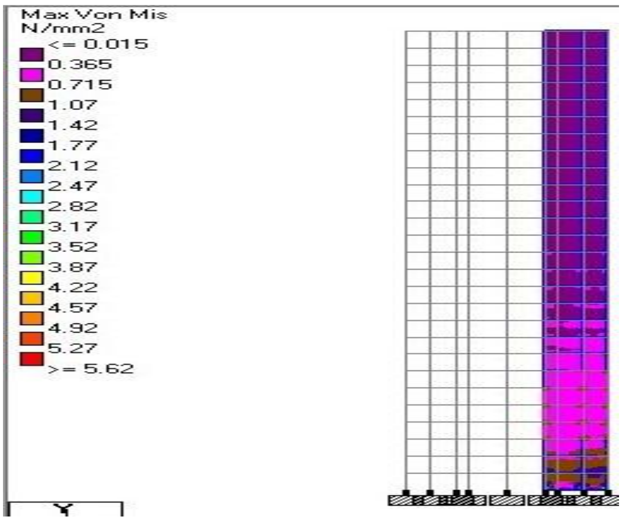
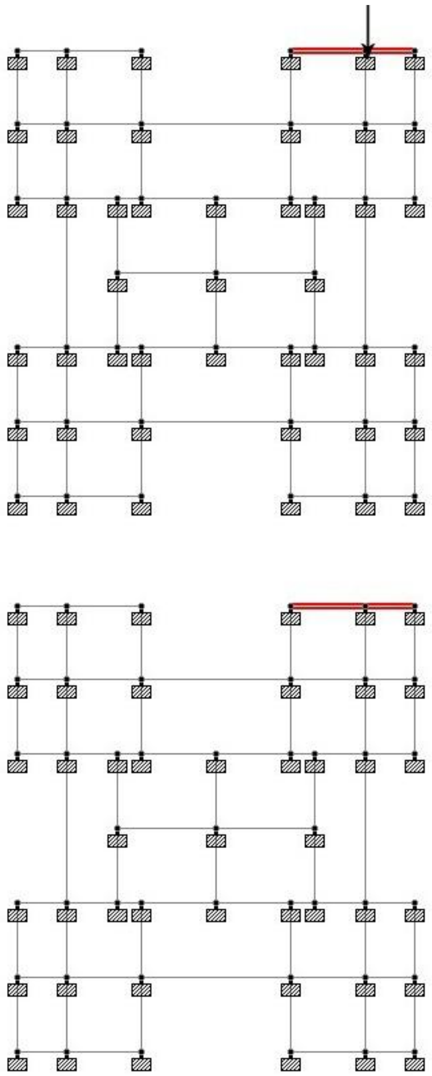


Figure 8 Stress generated in Shear wall in G+26 Building Structure

The figures above 6, 7 & 8 show that the maximum from a lack of stress produced in shear walls at various load conditions.

1. SLocations of shear wall

The figure illustrates STAAD-Pro building structure for shear walls G+12, G+20 and G+26.



(a) Shear wall location 1
(b)Shear wall location 2

Figure 9 Shear wall locations in building structure

All frame models with various shear wall locations have been analyses using the STAAD-Pro programme and results are shown below.

Table 2 Maximum and Minimum Von Miss Stress in shear wall at location due Load case 1

Load Case	Building Structure	Maximum Stress at shear wall location (N/mm^2)	Minimum Stress at shear wall location (N/mm^2)
LC 1(Dead load)	G+12	2.59	0.145
LC 1(Dead load)	G+20	2.72	0.177
LC 1(Dead load)	G+26	2.77	0.179

Table 3 Maximum and Minimum Von Miss Stress in shear wall at location due Load case 2

Load Case	Building Structure	Maximum Stress at shear wall location (N/mm^2)	Minimum Stress at shear wall location (N/mm^2)
LC 2 (Live Load)	G+12	5.63	0.092
LC 2 (Live Load)	G+20	7.68	0.516
LC 2 (Live Load)	G+26	9.08	0.611

Table 4 Maximum and Minimum Von Miss Stress in shear wall at location due Load case 3

Load Case	Building Structure	Maximum Stress at shear wall location (N/mm^2)	Minimum Stress at shear wall location (N/mm^2)
LC 3 (Wind Load)	G+12	1.73	0.165
LC 3 (Wind Load)	G+20	3.73	0.247
LC 3 (Wind Load)	G+26	5.62	0.365

Figure 10 indicates, as a result of the various load circumstances in various locations of the shear wall, the stress generation and distribution of the shear wall. The highest stress produced in shear walls at various heights or colour regions is shown in figure 10 above.

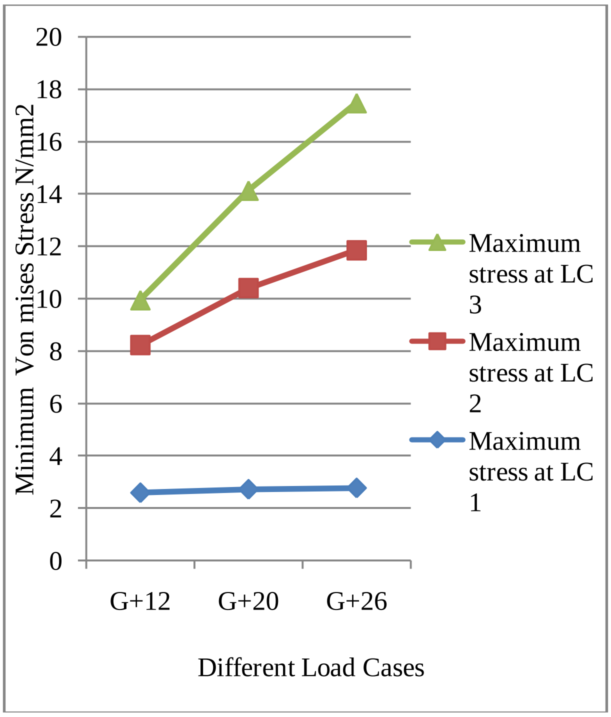


Figure10 Maximum Von-Misses Stress generated in multistory building structure (G+12, G+20 & G+26)

Shear wall in different locations

The red and blue colours indicate that the shear wall at position 1 & 2 is under maximum stress. At location 1 in case 1 the tension reduces as the building height increase, and at location 2 is the same place 1 but the stress in position 2 is more than location 1 as shown in figure 9. The findings stay the same, too. Therefore the position 1 is more efficient on the shear wall. We mentioned or concluded in above and after the study that the 1st shear wall is better, since the stress distribution and deflection in walls in this wall are lower than in position 2.

Table 5 Displacements Comparison on Wall loads

Frames	Max nodal displacement at top node
G+12	7.10 mm
G+20	29.85 mm
G+26	59.65 mm

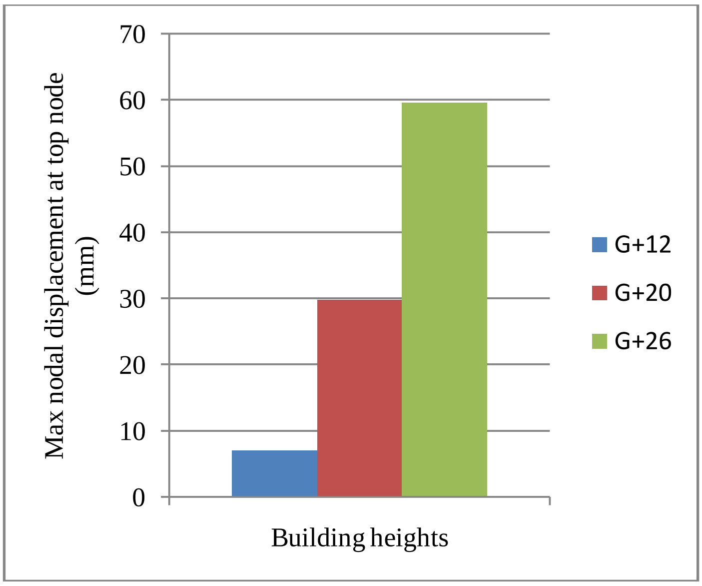


Figure 11 Displacements Comparison on Wall loads

VI.CONCLUSION

- In this project it is concluded that the G+12 structure shear wall is generated less value of von-misses stress.
- Also it is concluded that in the G+20 structure shear wall is generated less value of von-misses stress on structure at location 2 as compare to location 1.
- From finally at above results or conclusion is that the location 1 is more efficient and in future we adopt the location of shear wall (location 1).
- Across multistory structure with shear wall it is determined, as per study, that both the displacement and their stress are relatively less than R.C.C. without Shear Wall construction, even at a different level. So now we may adopt it in an optimum position with the shear wall.
- Building with shear wall, compared to construction without shear wall, is completed at cheaper cost.
- STAAD-Pro becomes more and more critical in the analysis of engineering & scientific problems.

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