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"Significance of Shear Wall in Multi-Storey G+10 Structure With seismic Analysis"

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ABSTRACT

Shear walls have been a crucial and significant structural component in multi-storied buildings for decades. Studying their role and impact on the structural response in such structures is highly interesting. During earthquakes, shear walls contribute to the building's stiffness and strength, but their importance is often overlooked during the design and construction phase. This study aims to demonstrate the effect of shear walls on the vulnerability of structures To test this hypothesis, a G+10 storey building was considered with two models: one without shear walls (bare frame) and another with shear walls, including openings. Various parameters, such as base shear, storey drift ratio, lateral displacement, bending moment, and shear force, were analyzed for both models. The modelling and analysis of these models were performed using the FEM-based software Staadpro 2008. The Equivalent Static method was employed for the analysis, which simplifies the determination of forces and displacements induced by lateral loads, like seismic forces The comparison of results between the two models sheds light on the significance of shear walls in enhancing the building's seismic performance. It is expected that the model with shear walls will exhibit improved behaviour compared to the bare frame model, owing to the additional stiffness and strength provided by the shear walls.

I. INTRODUCTION

In high-rise buildings, possessing adequate stiffness is of paramount importance to withstand the lateral loads imposed by wind or seismic events. To address this, Reinforced Concrete (RC) shear walls are commonly employed in structures located in seismic regions due to their exceptional attributes, including high strength, stiffness, and ductility. In RCC structures, a significant portion of the lateral load and shear force resulting from the load are borne by these shear walls Their considerable in-plane stiffness allows them to efficiently resist lateral loads and effectively control deflection. In certain high-rise buildings, the utilization of shear walls or their equivalents becomes indispensable for managing inter-storey deflections caused by lateral loads The proper design and incorporation of shear walls not only ensure safety but also offer robust protection against potential costly structural and non-structural damages during seismic events. By providing substantial stiffness and strength, shear walls effectively mitigate lateral deformations in the structure, thus minimizing damage to the building. Consequently, shear walls stand as vital structural components in multi-storey buildings located in earthquake-prone regions, owing to their substantial resistance to lateral seismic forces.The linear static analysis method is employed in this study, where the models are subjected to linear forces, indicating their elastic behaviour. By comparing the two models, various parameters are examined, including lateral displacement, storey drift, base shear, bending moment, and shear force of the structure. Through this comparative analysis, the research seeks to understand the influence of shear walls on the structural behaviour under lateral loads. The findings from this study can provide valuable insights into the significance of shear walls in improving the overall seismic performance of multi-storied buildings

METHODS OF SEISMIC ANALYSIS OF STRUCTURES

Various methods of differing complexity have been developed for the seismic analysis of structures. They can be classified as follows.
1. Linear and Nonlinear Static Analysis
2. Linear and Nonlinear Dynamic Analysis.

Methods of Static Analysis

The method of static analysis used here is Equivalent Static Method.

Equivalent Static Analysis

All design against earthquake effects must consider the dynamic nature of the load. However, for simple regular
structures, analysis by equivalent linear static methods is often sufficient. This is permitted in most codes of practice for regular, low- to medium-rise buildings and begins with an estimate of peak earthquake load calculated as a function of the parameters given in the code. Equivalent static analysis can therefore work well for low to medium-rise buildings without significant coupled lateral–torsional modes, in which only the first mode in each direction is of significance. Tall buildings (over, say, 75 m), where second and higher modes can be important, or buildings with torsional effects, are much less suitable for the method, andrequire more complex methods to be used in these circumstances.

Methods of Dynamic Analysis

The method s of dynamic analysis used here are Time History Method and Response Spectrum Method.

Time History Method

Time-history analysis is a step-by-step analysis of the dynamical response of a structure to a specified loading that may vary with time. The analysis may be linear or non linear. Time history analysis is used to determine the dynamic response of a structure to arbitrary loading.

Response Spectrum Method

The word spectrum in seismic engineering conveys the idea that the response of buildings having a broad range of periods is summarized in a single graph. For a given earthquake motion and a percentage of critical damping, a typical response spectrum gives a plot of earthquake-related responses such as acceleration, velocity, and deflection for a complete range, or spectrum, of building periods. Thus, a response spectrum may be visualized as a graphical representation of the dynamic response of a series of progressively longer cantilever pendulums with increasing natural periods subjected to a common lateral seismic motion of the base.

Design data:-

Type of Building - Residential
Live load - 3KN/m2
Earthquake load - IS :1893 (part 1) 1984
Storey height - 3m
Floors - G.F. + 10
Zone - IV
Concrete grade - M30
Steel reinforcement - Fe 415
Size of Column - 750x450mm
Size of Beams - 600x450mm

Modelling of Structure

i Description of building

The structure selected for this study is G+10 multi-storey building having a plan area of 20×12 m. The overall height of the building is 33 m and the building is assumed to be situated in Zone IV (gujrat). The foundation is assumed to be fixed and medium type of soil is considered for study. The analysis of the building was done using STAAD Pro and Indian Standard Code of Practice for Seismic Resistant Design of Buildings was used for design.

ii. Materials

In this study, high yield strength deformed bars are provided as per IS Code having yield strength 500N/mm2. Grade of concrete is M-30 with density 25 kN/m3 is adopted. The density of masonry infill used for main and partition wall is 20 kN/m3.

iii. Member dimensions

The size of beam and column provided are 600×450 mm and 750 x 450 mm respectively and both are modeled as frame element. The slab is provided horizontally over the floor area at each floor levels supported by beams having thickness 125 mm whereas, shear wall is provided vertically on the outer bay of the structure having thickness 200 mm. The infill walls are the partition wall that separates the different area of building. These walls are provided with brick masonry having thickness 230 mm for main wall or external walls and 115 mm walls for partition walls of building.

iv. Models prepared for study

In this study, total of 5 models are prepared with the help of STAAD.Pro v8i software for analysis of structure. It includes both model

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with shear wall and without shear wall with plan area 20×12 m and other properties and specifications of building have been stated above. These models are analyzed with seismic and wind loading in +X direction at zone IV.

Model without shear wall

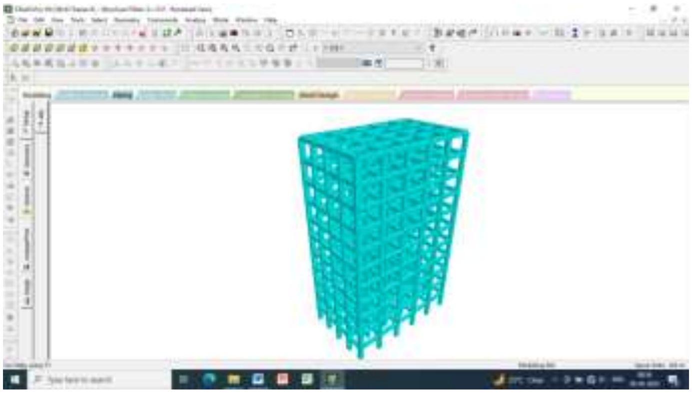

Fig 1 .without shear wall

Modelwith shear wall

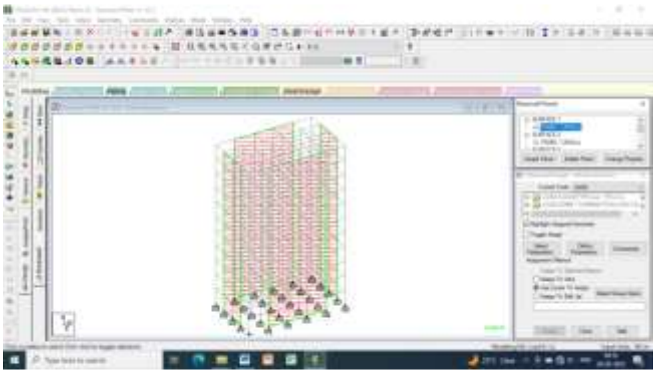

Fig 2.with shear wall

Loading in a structure:-

Live Load

Imposed load at all floor levels = 3.0 KN/m2, this live load is reduced by 50% for calculating the seismicweight of the structure as per provisions of IS 1893:2002.

Dead Load

The dead load and live load at different floor and roof levels will be considered for current analysis are-

Table 1: Dead load on structure

Weight of Slab	0.120 x 25	3.00 KN/m2
Weight of Floor Finish	0.040 x 24	0.96 KN/m2
Weight of Partition Wall	-	- 1.00 KN/ m2
Total Dead Load	**4.96 KN/ m2**	

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Seismic Loads

IS 1893-2002(part I) is used for seismic load calculations. The seismic loads were calculated using the formula as follows:

Design horizontal seismic coefficient:

Ah the design horizontal seismic coefficient is calculated using

$$A\,h = \frac{ZIS}{2RG}$$

Load combination

Table 2 load combination

Sl. No.	Load Combinations	Sl. No.	Load Combinations	Sl. No.	Load Combinations
1	SEISMIC X	7	1.2(DL+0.5LL-EQX)	13	1.5(DL-EQZ)
2	SEISMIC Z	8	1.2(DL+0.5LL+EQZ	14	0.9DL+1.5EQX
3	DEAD LOAD	9	1.2(DL+0.5LL-EQZ)	15	0.9DL-1.5EQX
4	LIVE LOAD	10	1.5(DL+EQX)	16	0.9DL+1.5EQZ
5	1.5(DL+LL)	11	1.5(DL-EQX)	17	0.9DL-1.5EQZ
6	1.2(DL+0.5LL+EQX)	12	1.5(DL+EQZ)		

Seismic zone factor

Table 3 seismic zone factor

Seismic Zone of India	Seismic coefficient of 1984	Seismic zone factor (z of 2002
V	0.08	0.36
IV	0.05	0.24
III	0.04	0.16
II	0.02	0.10

II. RESULT

Base shear

it can be seen that the maximum value of base shear increases by 146% in model withshear wall.

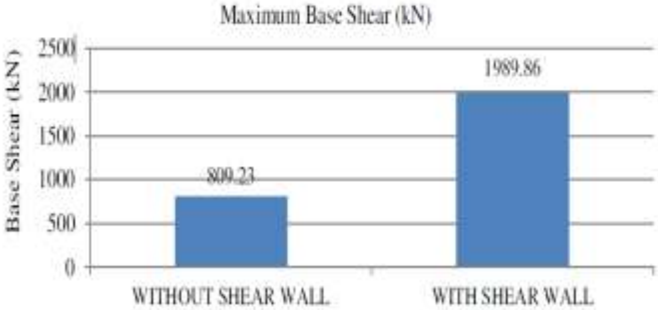

Fig 3 comparison of Maximum base shear

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Lateral displacement in x-direction

The maximum displacement in X-direction was noted in without shear wallmodel, the value of displacement decreases by 90.97% in shear wall model

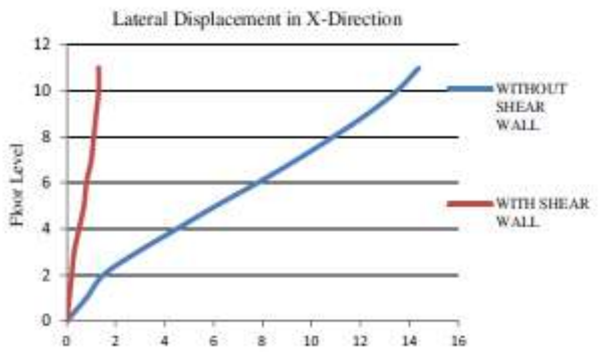

Fig 4 Comparison of lateral displacement in x-direction

Lateral displacement in y-direction

The maximum displacement in Y-direction was noted in without shear wallmodel, the value of displacement decreases by 85.35% in shear wall model.

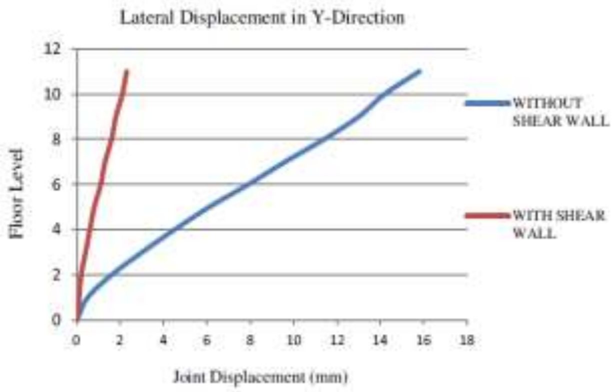

Fig 5 Comparison of lateral displacement in y-direction

Storey Drift in x-direction

It can be seen that reduction of storey drift in X-direction in model with shear wall when compared to the without shear wall model and it decreases by 90.20% in Y direction (by considering maximum values).

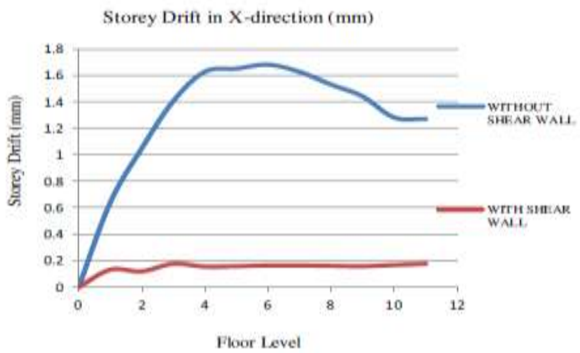

Fig 6 Comparison of storey drift in x-direction

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Maximum Bending Moment in Beam

It can be seen that the maximum value of bending moment increases by 71.58%in model with shear wall.

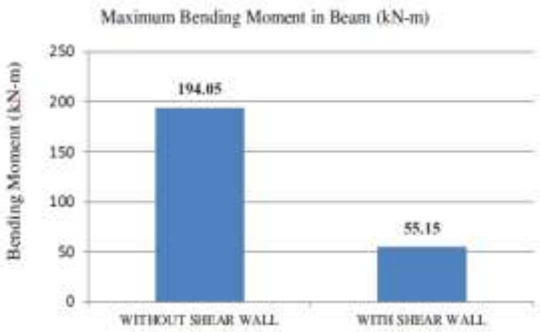

Fig 7 Comparison of maximum bending moment

Maximum Shear Force in Beam

It can be seen that the maximum value of shear force increases by 53.53% inmodel with shear wall.

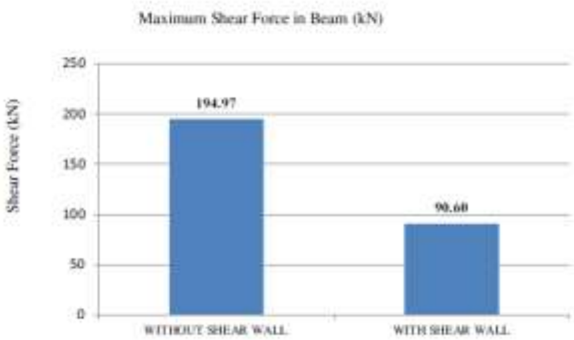

Fig 8 Comparison of maximum shear force

It is quite evident from the results shown above that without the use of shear wall it is nearly impossible to resist lateral loads applied on a structure.It is also very clear from the analysis that shear force gets cosiderably 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.From the above four cases discussed it is quite clear from the results that Case-III i.e Shear walls at corners show minimum displacement and moments hence from the above all cases this case can be considered most efficient and safe.Max shear force and Moments is also least for the Case-III.Hence Case-III i.e shear wall at corner is most suitable and safe among the various models studied and analysed.

Stresses in plates :-

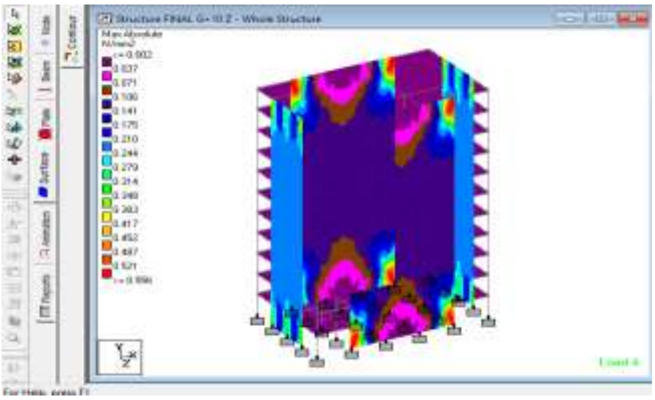

Fig 9 stresses in plates

III. CONCLUSIONS

- In multi-storey buildings, provision of shear walls is found to be effective in increasing the overall seismic response and characteristics of the structure.
- Shear walls are considered for analysis of RC frame in which equivalent static method can be effectively used.
- Shear wall ultimately increases the stiffness and strength of the structure and affect theseismic behavior of the structure.
- From the analytical result, it is observed that base shear increases in the model with shearwall when compared to the model without shear wall. This is due to increase in stiffness ofbuilding.
- The considerable reduction in lateral displacement is observed in the shear wall model when compared the model without shear wall. The reduction of displacement of storey is due to increase in stiffness of structure.
- For better seismic performance, a building should have proper lateral stiffness. Low lateral stiffness leads to large deformation and strain.
- Therefore, it is necessary to consider the shear walls in the seismic analysis of the structure
- which significantly increases the strength of overall frame and decreases the probability of collapse of the structure.

REFERENCES

[1]. ChittiproluRKumar R P 2014Significance of Shear Wall in High rise Irregular BuildingsInternational Journal of Applied Engineering Research vol. 4 issue spl-

[2]. Lakshmi K O Prof.RamanujanJSunil B, Kottallil L, PowethJEffect of shear wall location in buildings subjected to seismic loads, Journal of Engineering and Computer scienceVolume1 Issue.

[3]. OniPBVanakudre S B 2013Performance Based Evaluation of Shear Walled RCC Building by Pushover Analysis,International Journal of Modern Engineering Research Volume3Issue4pp-2522-2525.

[4]. Aainawala M SPajgade P S 2013Design of Multistoried R.C.C. Buildings with and without Shear Walls, International Journal of Engineering Sciences & Research Technology.

[5]. AnshumanSBhunia D Ramjiyani B 2011Solution of Shear Wall Location in Multi Store Building,International Journal of Civil and Structural Engineering Volume 2 No 2

[6]. Kasat S PatilSRautABhuskade S 2016Comparative Study of Multi Storey Building Under Action of Shear Wall Using Staad pro Software International Conference on Electrical, Electronics, and Optimization Techniques.