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COMPARATIVE STUDY ON SEISMIC ANALYSIS BY CONSIDERING SHEAR WALL AND OPTIMIZATION TECHNIQUES FOR VARYING FLOOR LEVELS

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Abstract – In the seismic design of the buildings optimization of shear walls is very important because it acts as a major earthquake resisting member, these walls provide an efficient bracing system and offers great potential for lateral load resistance, at the same time reduces the weight of the structure. Seismic response of the building greatly depends upon the seismic response of these walls. Main focus of the present study is to achieve the optimization by providing and locating the shear walls appropriately in multistory framed structure .The effectiveness of shear walls and optimization has been studied with the help of six different models. The modal first, third and fifth are optimized structural models and the modal second, fourth and the sixth are shear wall structural models. An earthquake load is applied to buildings of 7,10 and 15 story located in the zone II .The parameters like lateral displacement, story drift and steel quantity are considered.

Key Words: Story displacement, story drift, steel quantity.

1. INTRODUCTION

The lateral load on the structure is the most important design criteria nowadays, the lateral load on different floor levels are also very important. wind load and earthquake loads also plays a significant role. From the study it is found that the impact of these load increases with the structural height. During wind load and ground excitation depending upon the magnitude of waves hitting the structure it might be in the form of surface waves or body waves. As the structure height increases the moment also increases in accordance with the heigh.t so it is very important to consider the wind effect on tall structures.

Some of the general practices made to resist lateral loads are shear wall, Moment resisting frames, tube structures, Bracings, Domed shaped buildings etc.

In case of wind as a factor the structure must have enough stiffness and strength which is good enough to resist

The displacement while avoiding possible damage for to the building. The structure should not be designed so that it should be in elastic limit during the action of lateral loads such as earthquake and wind load. The yielding of the structure should be allowed to reduce the strength for the economical design which indeed provides ductility which gives sufficient warning before the failure so that remedial measures can be taken for the people living inside.

1.1 STUDY OF THE EFFECT OF EARTHQUAKES ON THE HIGH RISE BUILDINGS

Structure has to sustain the dynamic action of the earthquake load and the wind load, but the design for the wind load is entirely different from the earthquake load. Wind load which will be acting as a pressure on the building, both in negative and positive direction. But earthquake loading will be mainly in horizontal but ground motion acceleration will be in all directions. while designing we assume ground motion excitation is only in the horizontal direction. This type of loading cause dynamic lateral as displacements. In case of wind load reversal might take place after long span of time which means the cyclic action may be rare.

1.2 BEARING OR SHEAR WALL

- Vertical plate-like RC walls called Shear Walls have very high stiffness and strength.
- These walls, generally start at foundation level and are continuous throughout the building height.
- Shear walls thickness can be as low as 150mm and may be as high as 400mm in high rise buildings.
- Shear walls are usually provided along both length and width of buildings.
- These walls, when provided properly, resist the major percentage of the seismic shear due to their enormous stiffness and transmit only a small part of the shear to the framing system.

1.3 STRUCTURAL OPTIMIZATION

Structural design plays a major role in both safety and economical aspects of the building. Resistance offered by the

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elements of the structure mainly depends upon the efficient structural design.

Following are the objectives of the present study of optimization of the structures

- Economy in construction
- Should satisfy both the stress and the displacement Criteria
- The optimization aim is minimizing the weight of the structure in high rise building.
- optimization using mathematical part of linear and nonlinear program.
- Reduction of the overall weight of the structure which will reduce the material requirement and thereby reducing the cost.
- Use of computer programming in optimization.

2. STRUCTURAL MODELING AND ANALYSIS

Modeling is carried in STAAD software. This software basically used for Structural and Earthquake design of structures. Drafting can be carried out for the Building systems. The visualization and 3D modeling can be carried out. In STAAD the architectural plan or Floor plan can be directly imported without taking much strain and their after modeling becomes comparatively easier. The Results obtained are almost near to the analytical values.

Table -1: DISCRIPTION OF THE STRUCTURE

Table1: Properties of Structure

Structure Type	Regular block modal
No of Story	G+7, G+10, G+15.
Structural Shape	Block Shape, block shape with shear wall, block shape with optimization Building
Total Building Height	24 m,33m,48m,
Area of the Structure	256m²

Table2: Material Description of Structure

Material Description	**Beam**	**Column**	**Slabs**	**Shear Wall**
Grade of Concrete	M25	M25	M25	M25
Grade of Steel	Fe-415			
Young's Modulus	2.5×10^6 N/mm²			
Density of Concrete	25 kN/m³			
Poisson's Ratio	0.2			

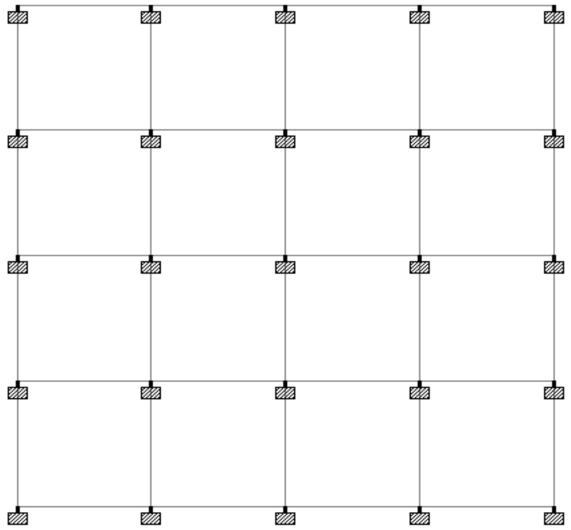


Fig. 1: Plan view of Model-1

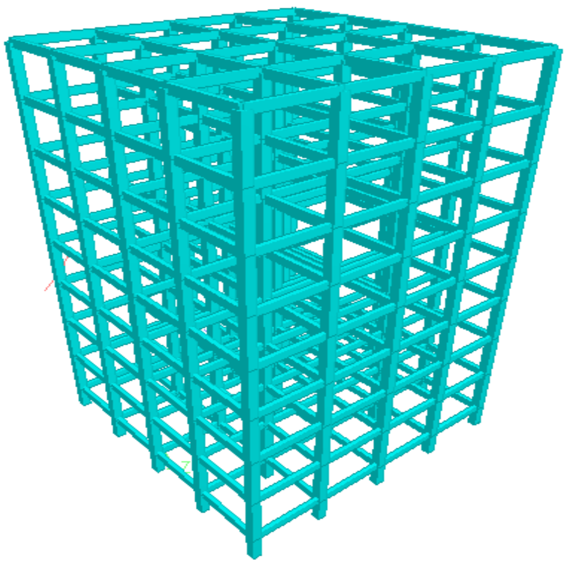


Fig.2: Three dimensional of Model-1

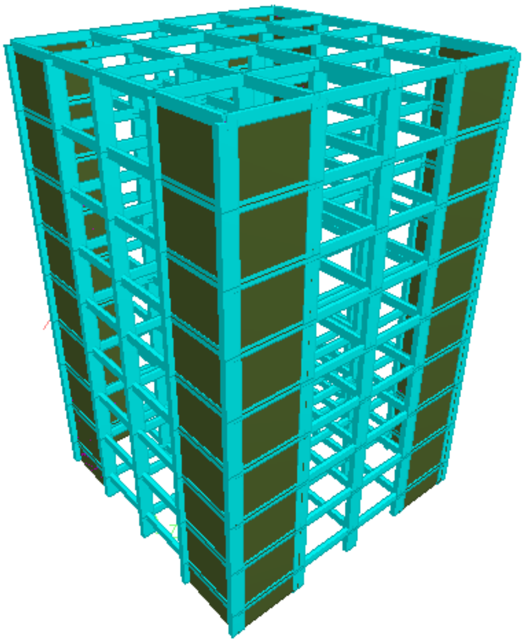


Fig 3: Three dimensional view of Model-02

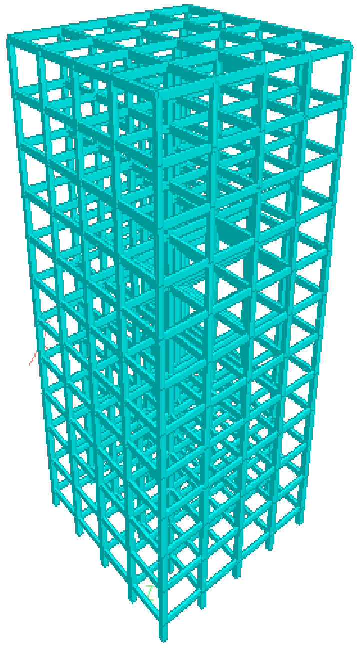


Fig 5: Three dimensional of Model-03

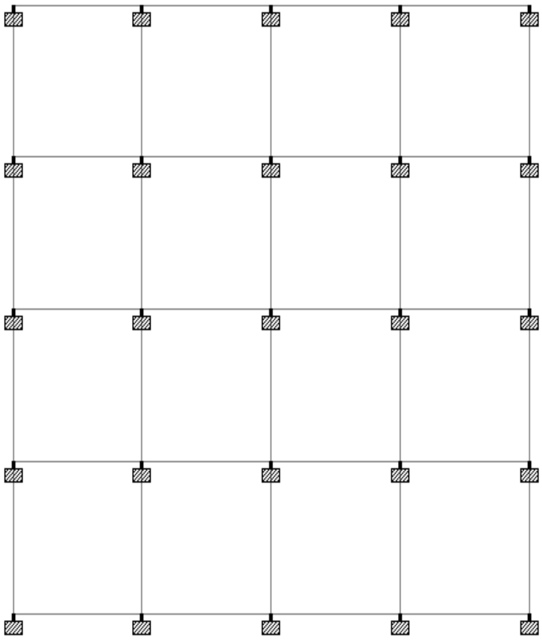


Fig 4: Plan view of Model-03

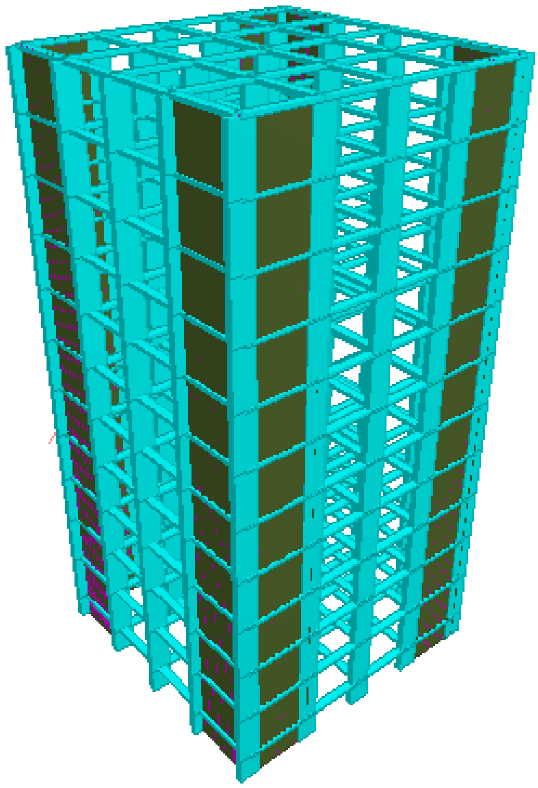
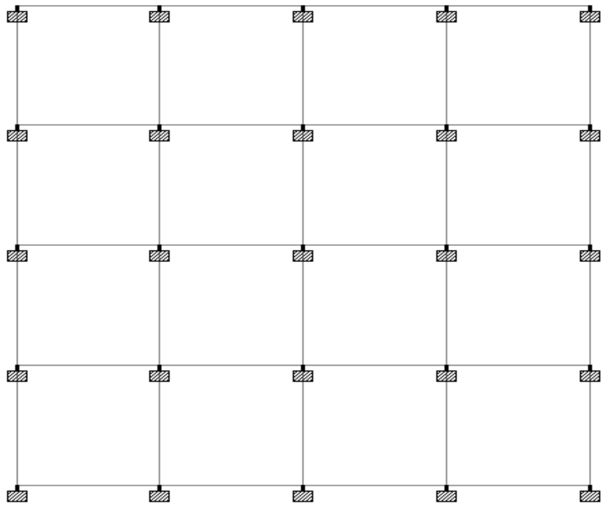
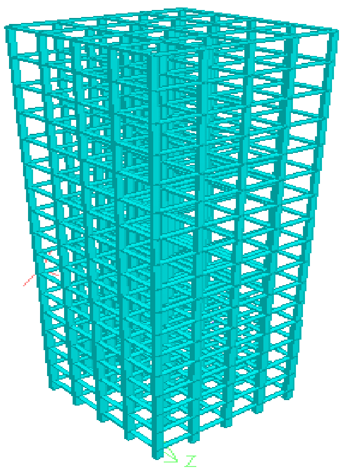


Fig 6: Three dimensional of Model-04





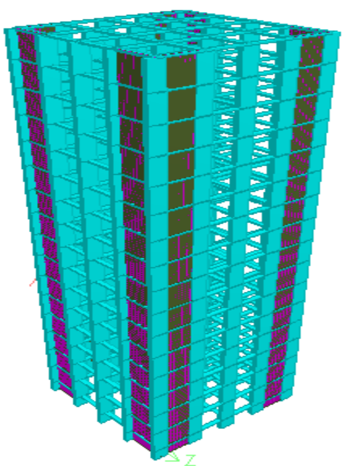


Fig9: Three dimensional of Model-06

Table 3: Detailing of Loads

Load Case Details	All Floor	On Roof
Live Load	3 kN/m^2	2 kN/m^2
Floor Finish	1.5 kN/m^2	1 kN/m^2
Wall load	11 kN/m^2	3 kN/m^2

Table 4: Seismic Coefficients

Seismic Coefficients	
Seismic Zone Factor	2
Per Code	0.1
Soil Type	II
Importance Factor	1
Response Reduction	5

4 RESULTS AND DISCUSSION

4.1 STOREY DISPLACEMENT

Story displacement is also known as lateral displacement each story displacement is related to base story. As the height of the story increases the displacement also increases displacement is directly proportional to the height of the structure.

4.2.1.1 Story displacement equivalent static analysis along x-direction (G+7)

Table 4.1: Story displacement x-Direction

Serial No	Storey No	Regular Building	
		With optimization (mm)	With shear wall (mm)
0	Base	10.001	1.597
1	Plinth	20.285	3.3333
2	3	34.769	5.489
3	6	48.6	7.934
4	9	60.995	10.555
5	12	72.008	13.16
6	15	79.85	15.9
7	18	83.89	18.604

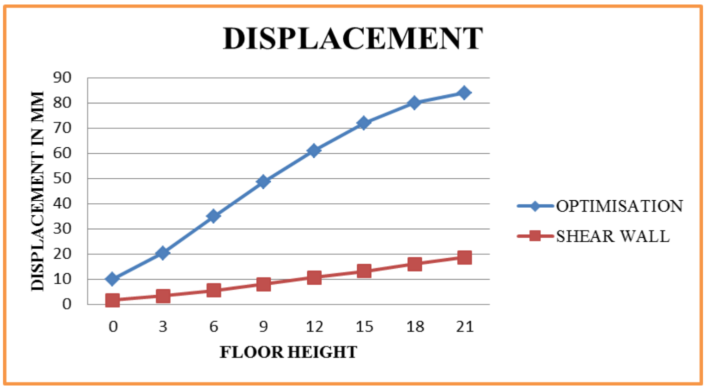


Fig 4.1: Story displacement equivalent static analysis along x-direction (G+7)

Story drift is the displacement of one level relative to the other level above or below.

4.2 Table 4.7: Story drift in X-Direction

Serial No	Storey No	Regular Building with optimization	Regular Building With shear wall
0	Base	0.45	0.44
1	Plinth	0.506	0.526
2	3	0.417	0.393
3	2	0.284	0.308
3	3	0.203	0.251
5	3	0.152	0.203
6	5	0.098	0.167
7	6	0.048	0.145

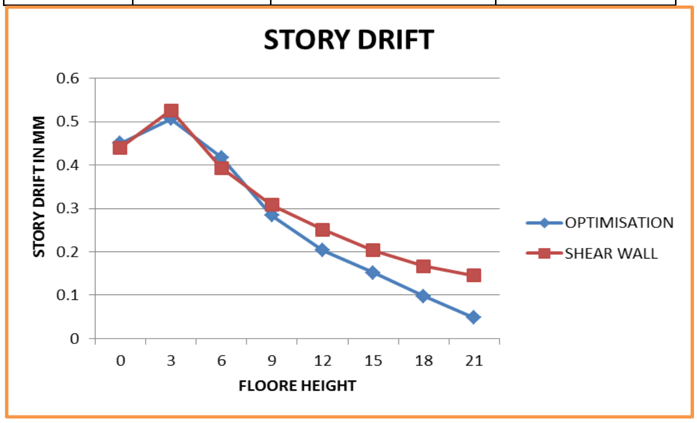
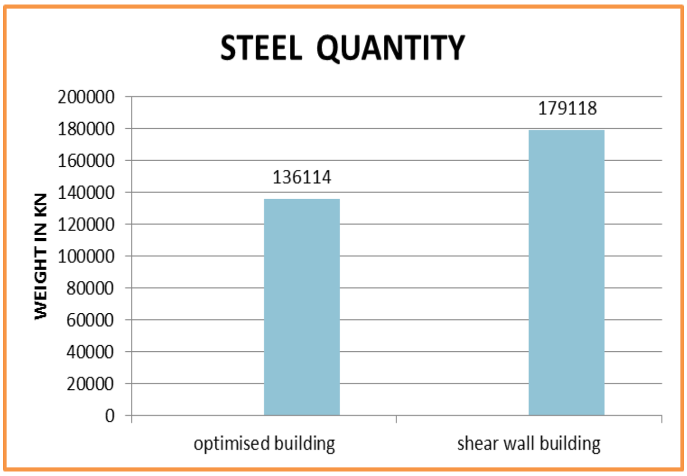


Fig 4.7: Story drift by ESA along x-direction

4.3 Steel quantity

Steel quantity slab conventional in a excluding its beams will be around 60 to 65 kg per m cubic. In beam it will be around 200 to 250 kg per cubic meter.

4.3.1 Steel quantity for optimized and shear wall building for (G+7)



5 Conclusions

In this study the analysis was carried out for 6 models of different heights that is 3 models with shear walls 1 and 3 models of optimized building. Comparative study is carried out for all regular and varying height structures, i.e., for G+7, G+10 ,G+15. The results obtained are as follows.

- Story displacement in X-direction optimization deflection is greater than Shear wall deflection of structure.
- Story displacement in Z- direction optimization deflection is lower than shear wall deflection of structure.
- Story drift in X -direction shear wall deflection is greater than optimization structures.
- Steel quantity is shear wall structure is greater than optimization structure

5.1 SCOPE OF FUTURE WORK

- Different terrain categories with different zones may be studied.
- Study by varying height of the structure can be carried out

- With varying plan irregularities, mass irregularities, torsional irregularities & vertical irregularity can be done.
- The research can be made on different wind speed

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