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Analysis of G+4 Multistoried Building for Various Locations of Shear Wall Considering the Effect of Torsion Using Response Spectrum Method

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ABSTRACT

This paper deals with the analysis of an irregular multi-storied building .The analysis is dynamic with the use of Response Spectrum Method. Shear Walls in general can be defined as the arrangement provided to resist the lateral forces such as due to wind and earthquake. It's generally noticed that the effectiveness of the Shear wall changes with the change in its location. Hence this research paper focuses on the effectiveness of shear wall considering various locations of the plan of building. The building plan considered is irregular in shape resembling the letter "L". The building considered in the analysis is a G+4 structure.8 Models representing different location of shear wall have been considered in the analysis. The analysis has been purely done through software approach using the software STAAD Pro for analysis. The analysis has been done taking torsion into consideration and analyzed as per IS code. The parameters considered for comparison are peak storey shear considering peak storey shear, peak storey shear considering torsion, drift and average displacement.

Keywords: *STAAD Pro, Response Spectrum Method, Torsion, Peak Storey Shear, Average Displacement, Drift, Dynamic Analysis*

I. INTRODUCTION

Study of generation, propagation and further recording of elastic waves in the earth and also about the study of sources producing them is termed Seismology. In this analysis we have considered only seismic forces as lateral force and not wind load as based on the assumption that at any instant of loading; only one of the two forces will be in effect. So we have considered severe of the two.

The structure considered in the analysis has been analysed in Zone III. The general aim of seismic zoning has been delineating the regions of similar probable intensity of ground motion in a country, so that suitable measures can be provided which will help in resisting adequately effects due to earthquake in constructed facilities, as a step to disaster mitigation.

In general, structural design of buildings due to effects due to earthquakes aims at safety of structure during the time of major earthquakes. Loading due to earthquakes requires a brief knowledge and understanding of the behaviour of structure under large inelastic, cyclic deformations.

Earthquake forces are caused due the distortions induced by the motions of the ground on which the structure rests. The magnitude and distribution of the forces and the displacements resulting from the ground motion are influenced by the properties of multi-storey structure and its foundation, as well as the character of ground motion.

As displacement occurs on the ground on which the structure is resting, the base of the structure resting on the ground moves in the direction of ground motion. But the portion of the building above the base part resists this movement since the inertia of the building mass resists the motion causing the building to distort.

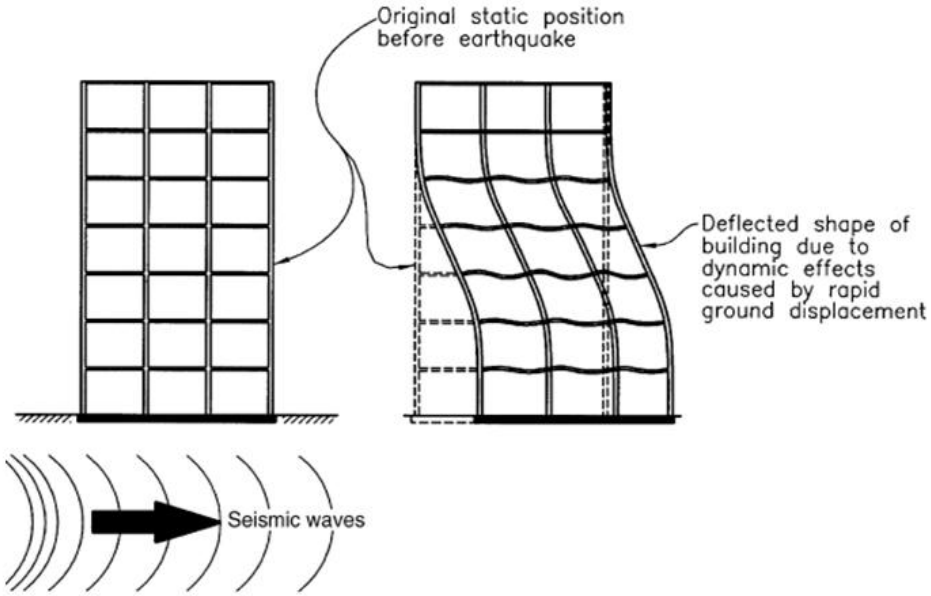


Fig 1- Behaviour of Structure during Earthquakes

In general the force due to earthquake subjected by the structure is

$$V_B = \alpha_h W$$

Where

α_h= design horizontal seismic coefficient of a structure

W= Seismic Weight of a building

V_B = Design seismic base shear force

The design horizontal seismic coefficient can be computed as

$$\alpha_h = \left(\frac{Z}{2}\right)\left(\frac{I}{R}\right)\left(\frac{S_a}{g}\right)$$

Where

Z= Zone Factor

I=Importance Factor

R=Response Reduction Factor

S_a/g= average response acceleration coefficient

II. PROBLEM FORMULATION

Grade of Concrete: M-20

Grade of Steel : Fe-415

Height of Building: 18 m for 5 storied building

Thickness of Shear Wall: 150 mm

Method used for analysis: Response Spectrum Method

Dead Load considered: 4.25 KN/m^3

Live Load considered: 4 KN/m^3

Dimensions of beam: 450mm X 600mm

Dimensions of Column: 380mm X 530mm

Zone Factor Z considered: 0.16 for Zone III

Response Reduction Factor R considered: 3 for Ordinary Moment Resisting Frame

Importance Factor I considered: 1

Soil Type considered: Medium Soil

Response Acceleration Coefficient S_a/g: 2.5

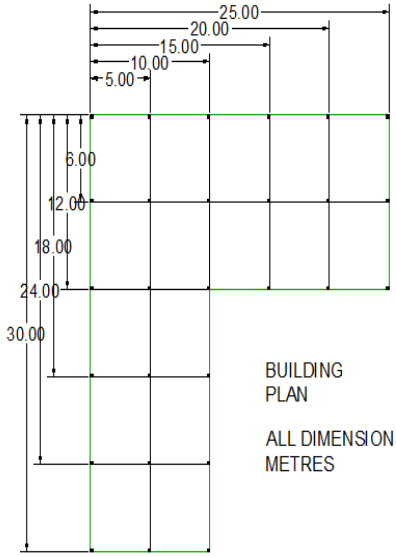
Floor to Floor Height: 3.6m

Damping considered: 5%

Maximum Dimension along X direction: 25 m

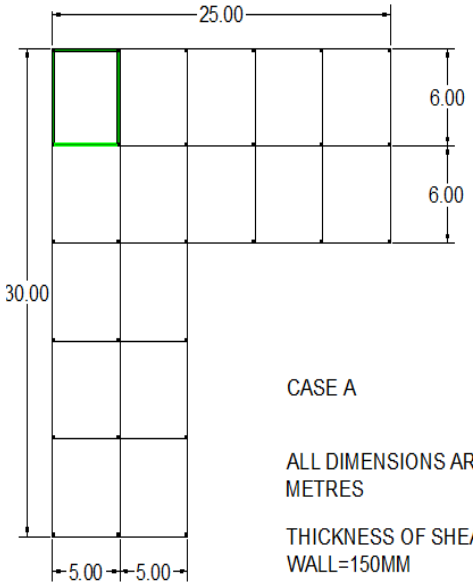
Maximum Dimension along Z direction: 30 m

Software used: STAAD Pro



BUILDING PLAN

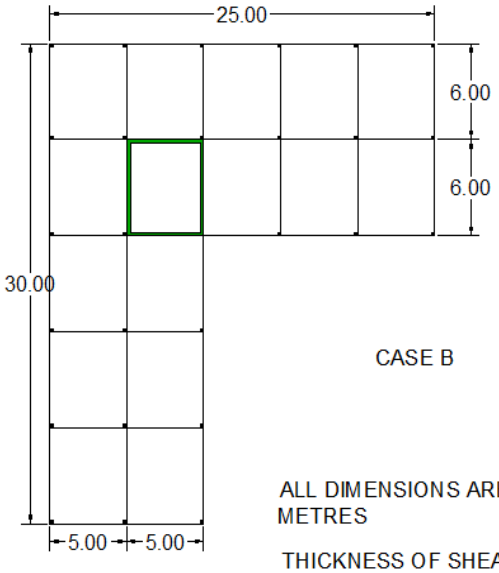
ALL DIMENSIONS ARE IN METRES



CASE A

ALL DIMENSIONS ARE IN METRES

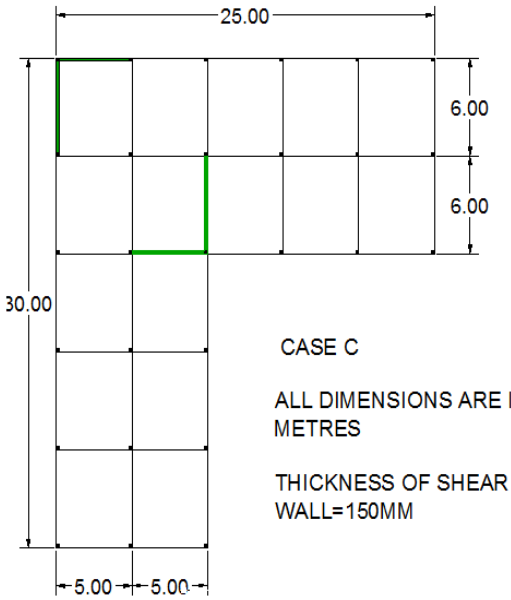
THICKNESS OF SHEAR WALL=150MM



CASE B

ALL DIMENSIONS ARE IN METRES

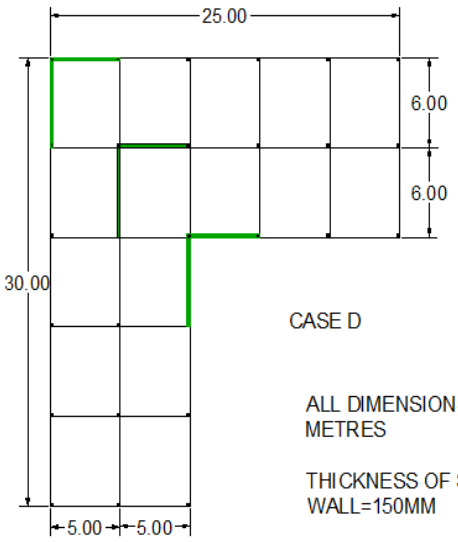
THICKNESS OF SHEAR WALL=150MM



CASE C

ALL DIMENSIONS ARE IN METRES

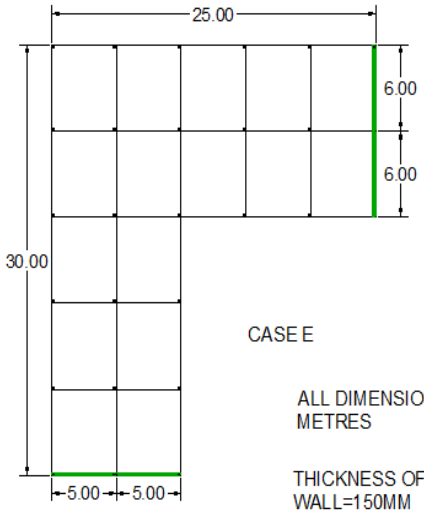
THICKNESS OF SHEAR WALL=150MM



CASE D

ALL DIMENSIONS ARE IN METRES

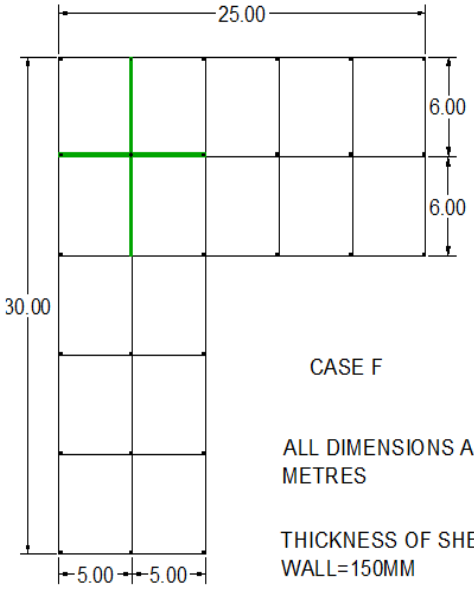
THICKNESS OF SHEAR WALL=150MM



CASE E

ALL DIMENSIONS ARE IN METRES

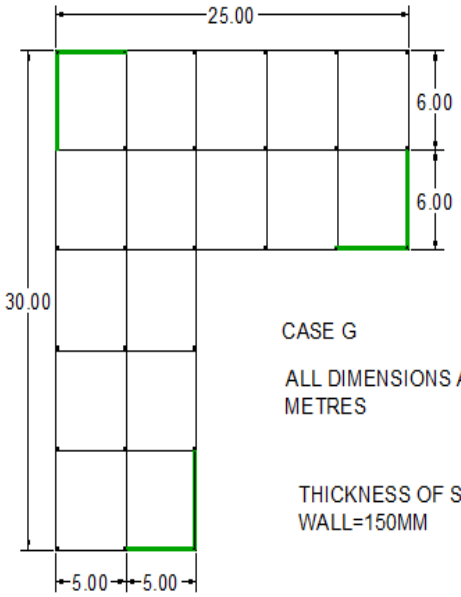
THICKNESS OF SHEAR WALL=150MM



CASE F

ALL DIMENSIONS ARE IN METRES

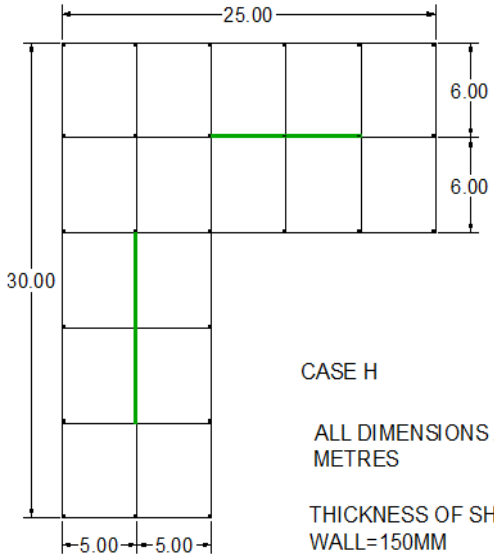
THICKNESS OF SHEAR WALL=150MM



CASE G

ALL DIMENSIONS ARE IN METRES

THICKNESS OF SHEAR WALL=150MM



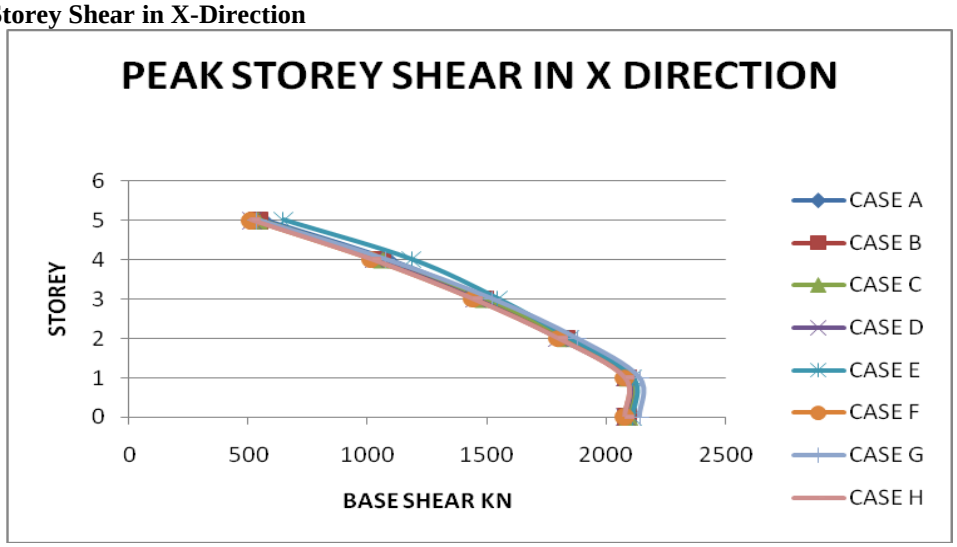
CASE H

ALL DIMENSIONS ARE IN METRES

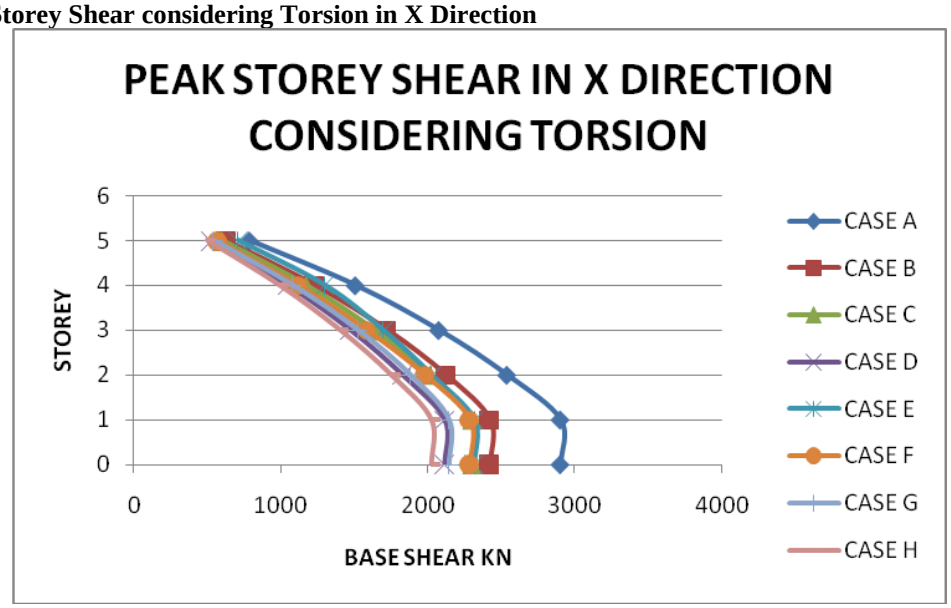
THICKNESS OF SHEAR WALL=150MM

III. RESULTS

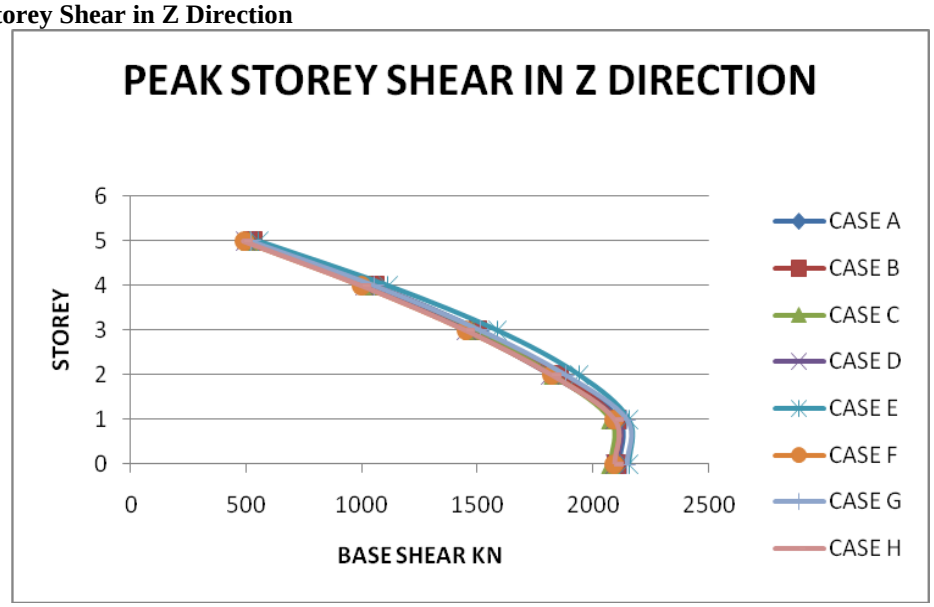
3.1 Peak Storey Shear in X-Direction



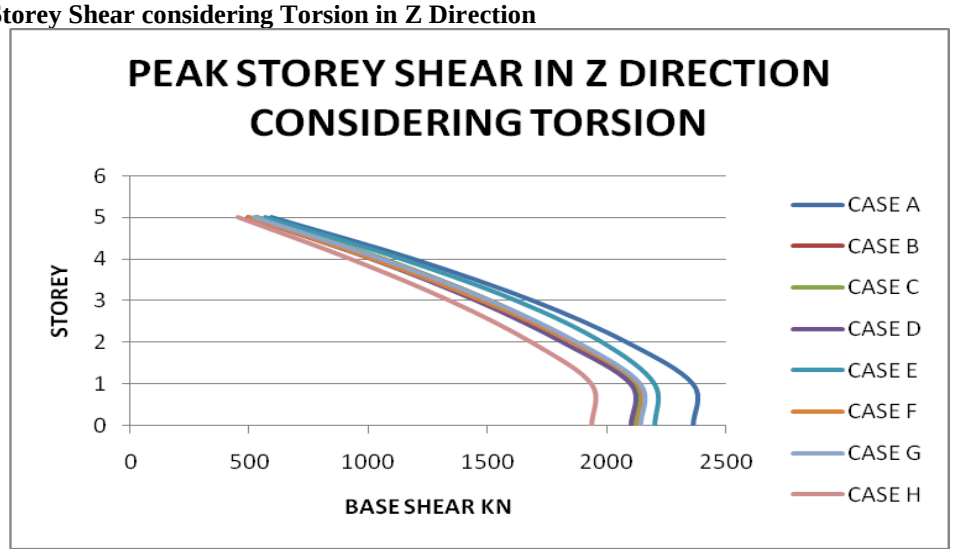
3.2 Peak Storey Shear considering Torsion in X Direction



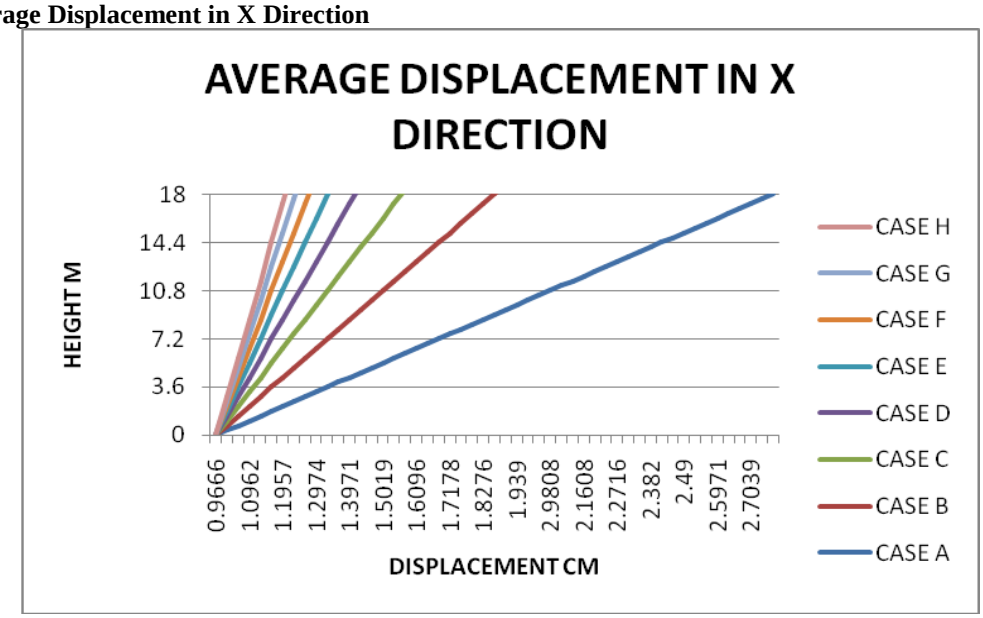
3.3 Peak Storey Shear in Z Direction



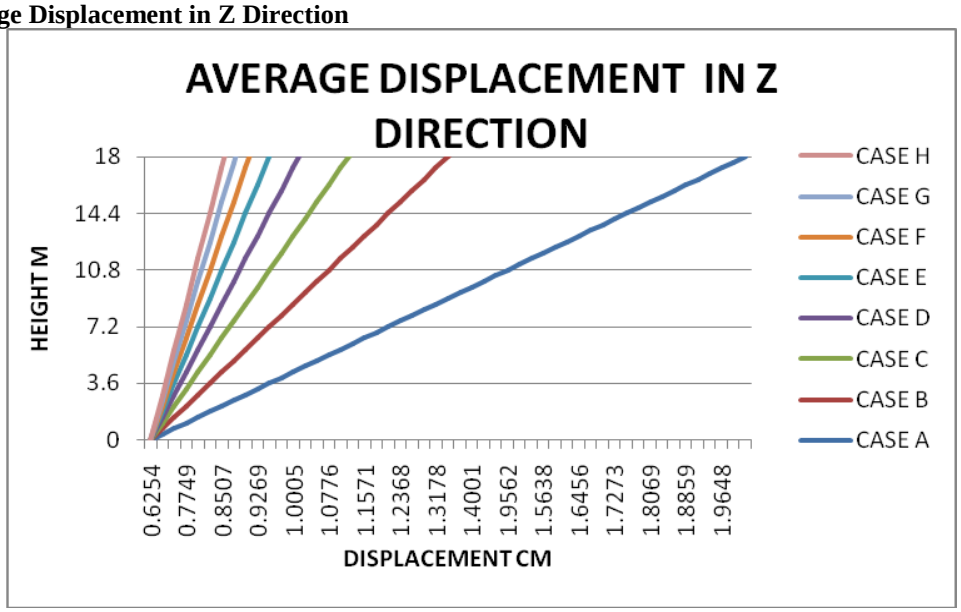
3.4 Peak Storey Shear considering Torsion in Z Direction



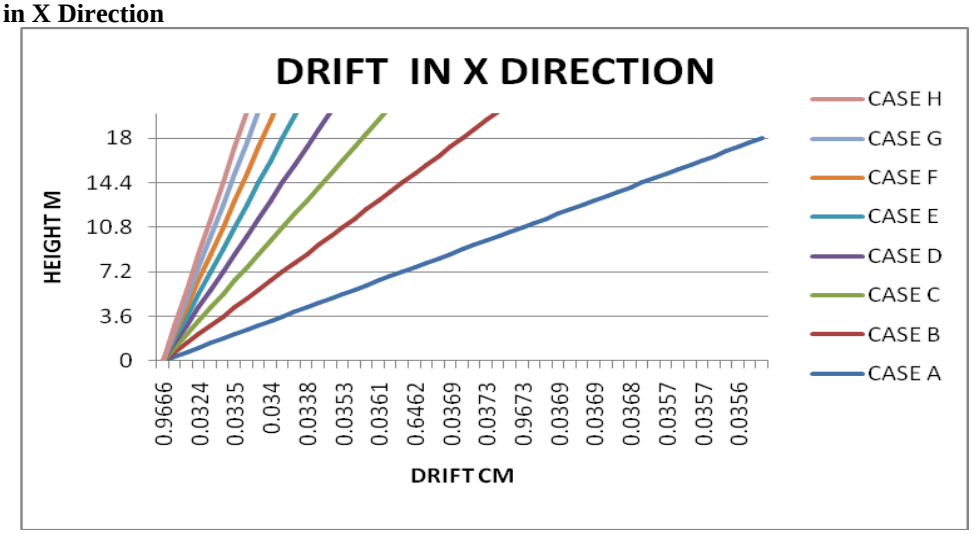
3.5 Average Displacement in X Direction



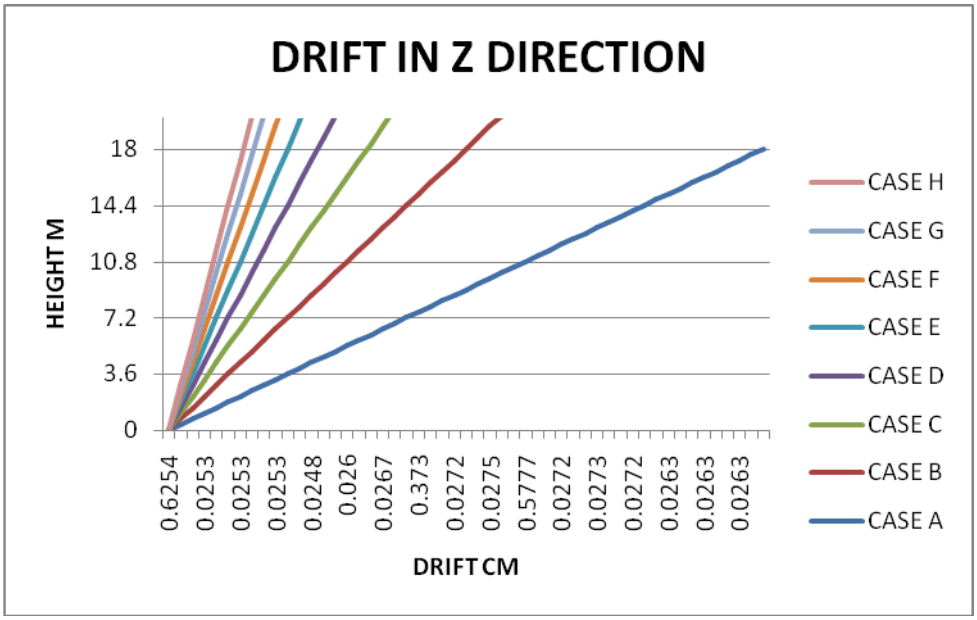
3.6 Average Displacement in Z Direction



3.7 Drift in X Direction



3.8 Drift in Z Direction



IV. CONCLUSION

4.1. Its concluded that considering the case of Peak Storey Shear and peak storey shear considering torsion along both the horizontal directions, Case H gives the best results.
4.2. Its seen that considering the parameter of Average Displacement along both the horizontal directions , Case G gives the best results.
4.3. Its seen that considering the parameter of Drift along both the directions, Case G gives the best results.
4.4 Hence the best combination of all is CASE H.

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