EARTHQUAKE BEHAVIOR OF BUILDING USING STAAD PRO

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Abstract - *Shear wall system is one of the most commonly used to resist lateral forces like seismic load, wind loads etc. Shear walls have very high strength and stiffness which provides stability to structure. The scope of the nowadays work is to study earthquake (seismic) responses of different storey buildings with and without shear wall, considering different seismic zones. An earthquake load will be applied to a building for G+15, G+25, G+45 located in zone III and different cases of shear wall position. An analysis will be performed using STAAD Pro software. Various parameters such as lateral displacement and story drift will be studied.*

***Key Words*: Analysis and Design, Seismic Behaviour, Shear wall system, Displacement, Storey Drift, STAAD Pro**

1.INTRODUCTION

The race towards new heights and architecture has been challenges. When the building increases in height, the stiffness of the structure becomes more important. Reinforced Concrete Buildings are adequate for resisting both the vertical and horizontal load. High-rise have continued to upward higher and higher facing strange loading effects and very high loading values due to dominating lateral loads.

In buildings built in region likely to experienced earthquake of high intensity or high winds then more suitably advisable shear wall structure. The design of these walls for seismic forces requires special consideration as they should be safe under repeated loads. The design of building adopted in the Indian Code IS 1893(Part 1) :2002 "Criteria for Earthquake Resistant Design of Structure" to ensure that structure possess at least a minimum strength to withstands minor earthquake occurring frequently; resist moderate earthquakes without significant structural damages though some non-structural damages may occur; and aims that structure withstand major earthquake without collapse.

For gain more plane stiffness, reduces lateral displacements and dissipate energy during strong motions the most sufficient systems are shear wall and bracing system use. Damages due to earthquake can be prevented by adding such structural elements like shear wall and bracing systems. The design criteria for high-rise buildings are strength, serviceability, stability and human comfort. Thus, the effects of lateral loads like wind loads, earthquake forces are attaining increasing importance and almost every designer is faced with the problem of providing adequate strength and stability against lateral loads.

1.1 Objective

- The main objective is to check and design seismic response of building using STAAD Pro.
- To design building using STAAD Pro.
- To analyse lateral displacement, storey drift, time history analysis and cost of the building for different cases of shear wall in different zones.

2. BUILDING MODELING

These buildings were designed in conformity to the Indian Code of Practice for Earthquake load (Seismic) Resistant Design of Buildings. The buildings were assumed to be fixed at the base. The buildings were modeled using software STAAD Pro. Models were studied in 3rd zones comparing lateral displacement and storey drift for all structural models under consideration.

Table -1: Building Dimensions

SR NO.	PARTICULAR	DIMENSION
1	Length of building	45.20(M)
2	Width of building	14.56(M)
3	Height of building (G+15)	45(M)
4	Height of building (G+25)	75(M)
5	Height of building (G+45)	135(M)
6	Typical story height	3(M)
7	Live load on floor	2 KN/M^2
8	Floor finishing	$4.6KN/M^2$
11	Grade of concrete	M25
13	Thickness of slab	0.15(M)
14	Zone 3	Z.F.= 0.16

Model 1– Framed structure.

Model 2– The building with shear wall Lift area

Model 3– The building with shear walls on corners.

Model 4– The building with shear walls at Insides.

2.1 Building Plans

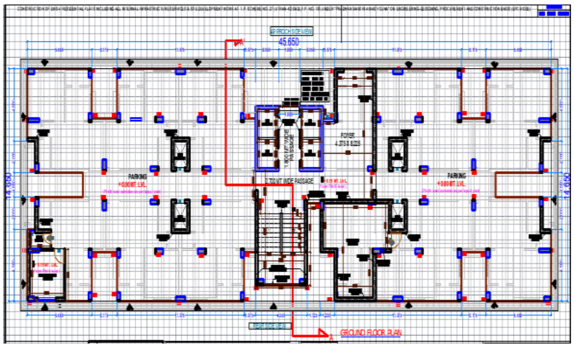

Fig -1: AutoCAD Plan

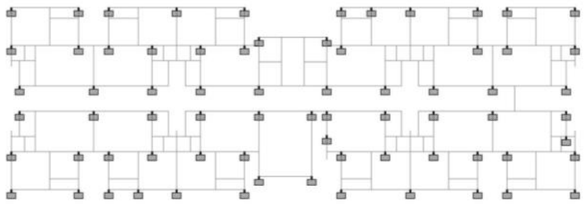

Fig -2: Model-1

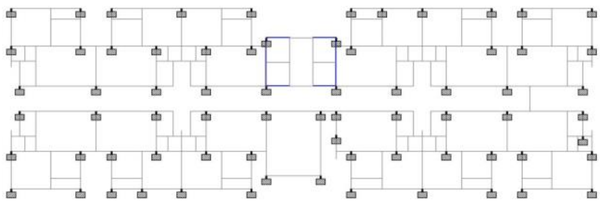

Fig 3: Model-2

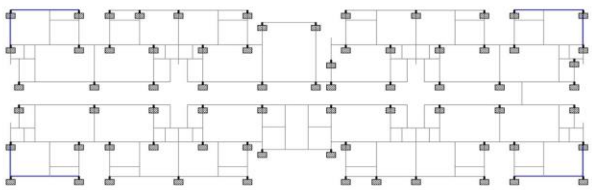

Fig -4: Model-3

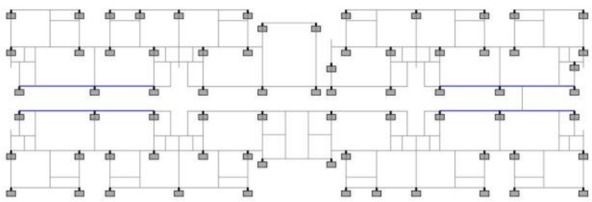

Fig -5: Model-4

2.2 3-D Models of Buildings

G+15 Buildings

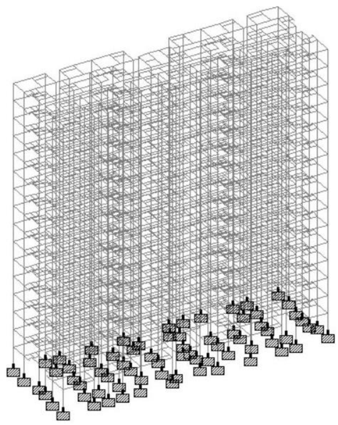

Fig -6 Model-1

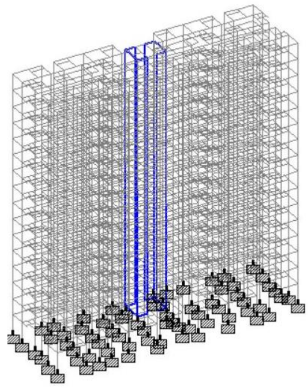

Fig -7 Model-2

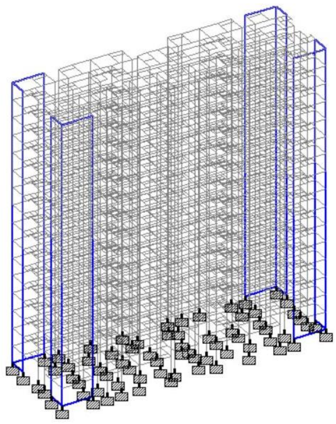

Fig -8 Model-3

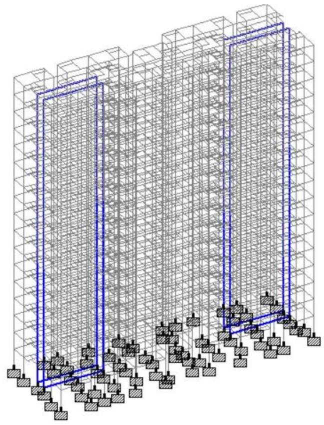

Fig -9 Model-4

G+25 Buildings

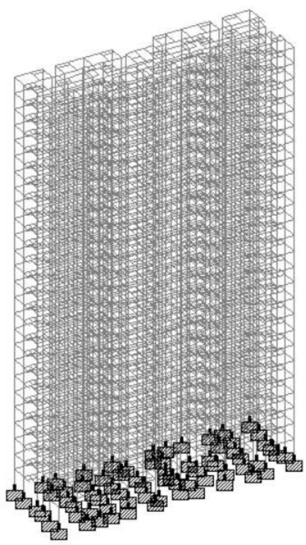

Fig -10 Model-1

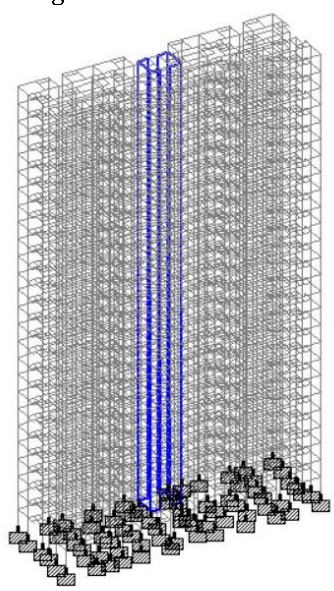

Fig -11 Model-2

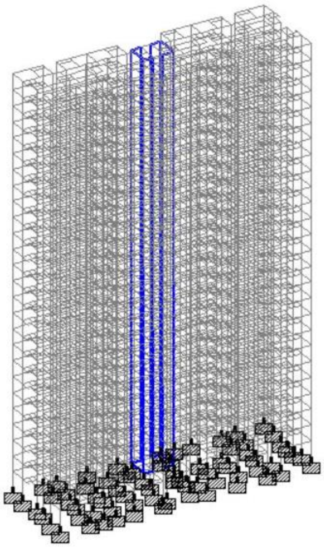

Fig -12 Model-3

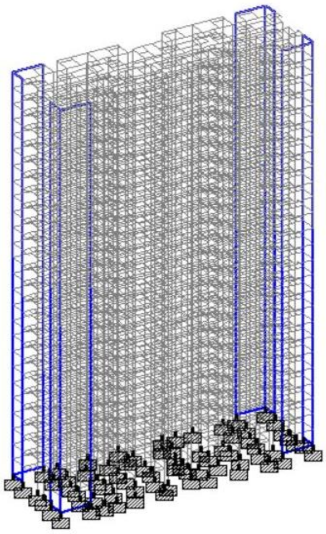

Fig -13 Model-4

G+45 Buildings

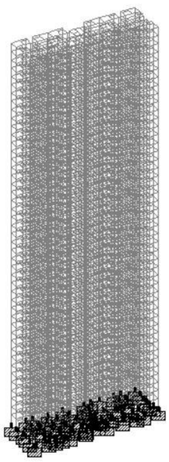

Fig -14 Model-1

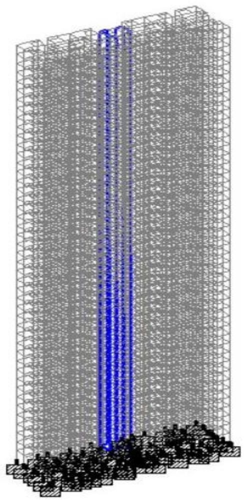

Fig -15 Model-2

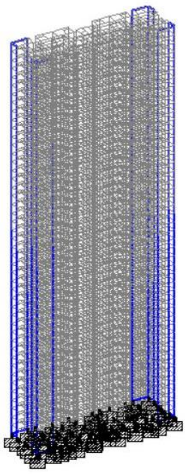

Fig -16 Model-3

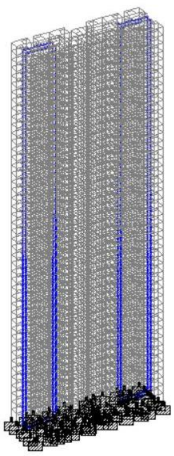

Fig -17 Model-4

3. METHODOLOGY

It demands to select the exact process to analyse a certain structural frame considering its corresponding characteristics related to seismic as earthquake analysis was very difficult portion in the field in structural engineering.

1. Static Analysis
2. Dynamic analysis

    i. Response Spectrum Method
    ii. Time History Method
    iii. Pushover Analysis

1. Static Analysis:

    It is known as equivalent static force method. In this method, the base shear is calculated from the weight of building. Earthquake forces are calculated in normalized way in this method. Live loads and dead loads are considered according to the norms and distributed along in each storey.

2. Dynamic Analysis:

    It shall be performed to access the design seismic force, and its spreading in various levels or stories along the height of the building, and in the various lateral load resisting element.

- Regular Buildings:

All framed buildings height greater than 40m in height in zones IV and V and greater than 90m in height in zone II and III.

- Irregular Building:

All framed buildings higher than 12m in zones IV and V, and greater than 40m in height in zones II and III.

i. Response Spectrum method:

The response of buildings having a vast range of periods is summarized in a single graph by this method. This method shall be performed using the design spectrum specified in code or by a site-specific design spectrum for a structure prepared at a project site. The values of impairing for building may be taken as 3 and 5 percent of the critical or demanding, for the purposes of changing of steel and reinforce concrete buildings, respectively

ii. Time History Analysis:

The usage of this method shall be on an appropriate ground motion and shall be performed using accepted principles of dynamics. In this method, the time histories of the structural response to a given input are obtained ad a result.

4. RESULTS

4.1 Lateral Displacement

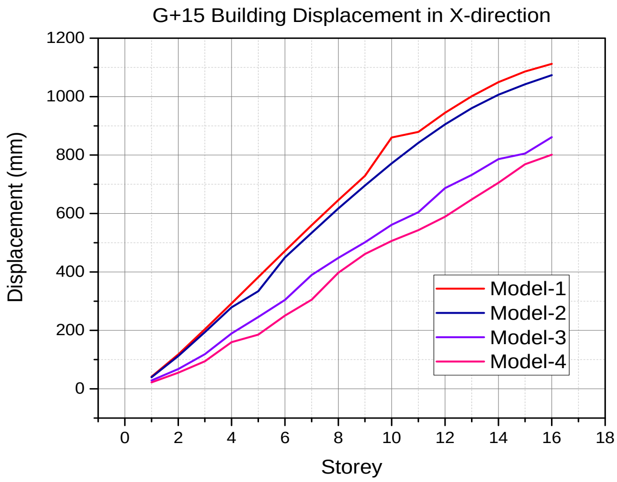

Chart-1: G+15 Building Displacement in X-Direction

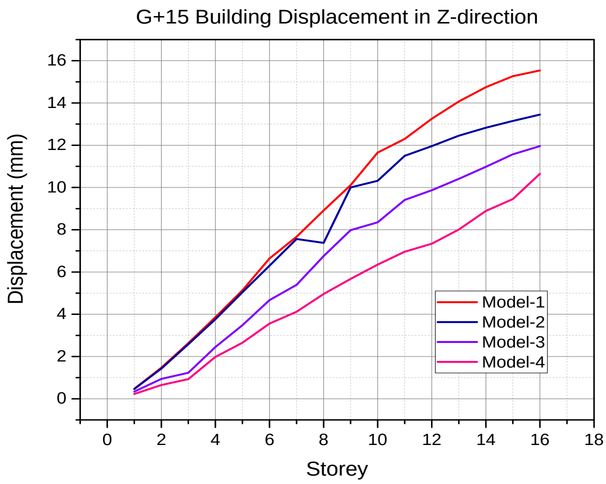

Chart-2: G+15 Building Displacement in Z-Direction

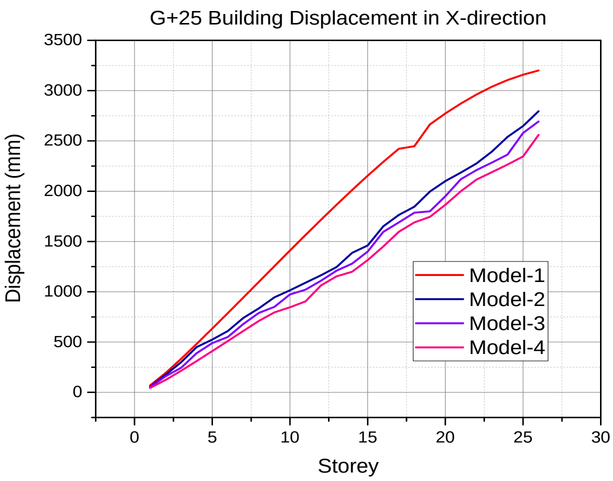

Chart-3: G+25 Building Displacement in X-Direction

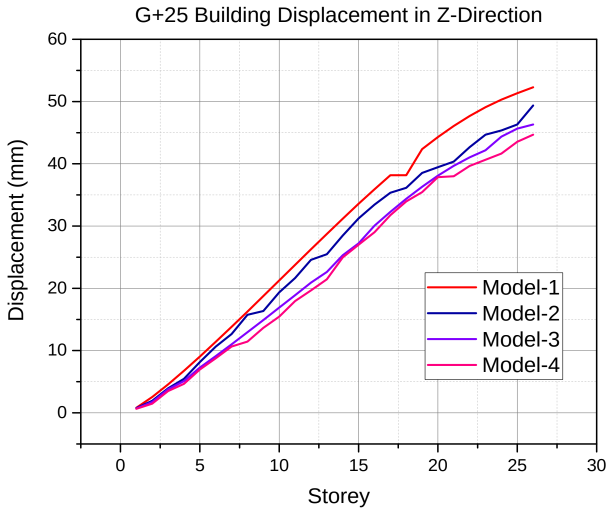

Chart-4: G+25 Building Displacement in Z-Direction

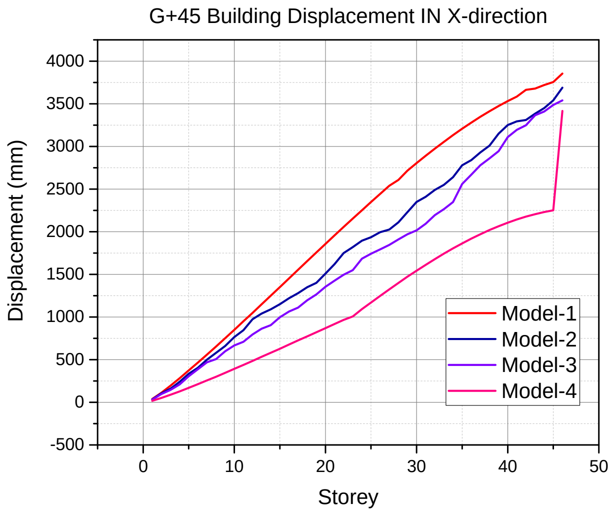

Chart-5: G+45 Building Displacement in X-Direction

Chart-6: G+45 Building Displacement in Z-Direction

4.2 Storey Drift

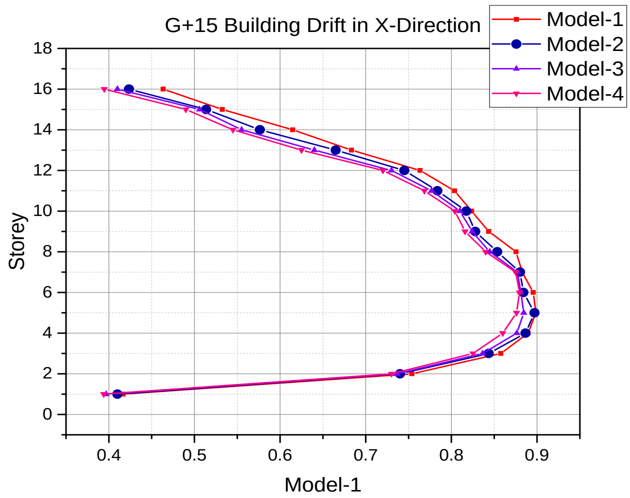

Chart-7: G+15 Building Drift in X-Direction

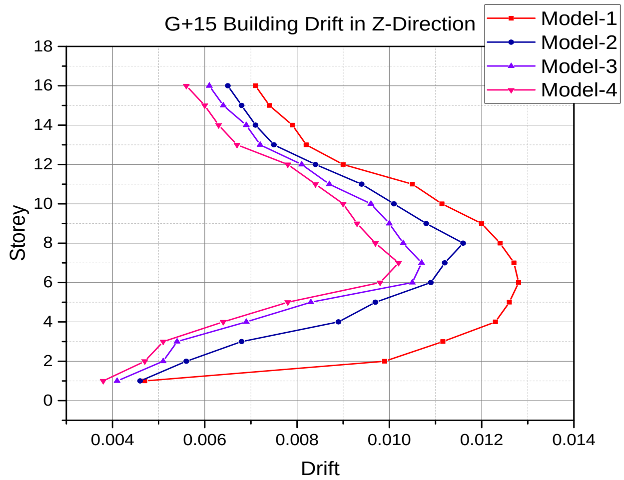

Chart-8: G+15 Building Drift in Z-Direction

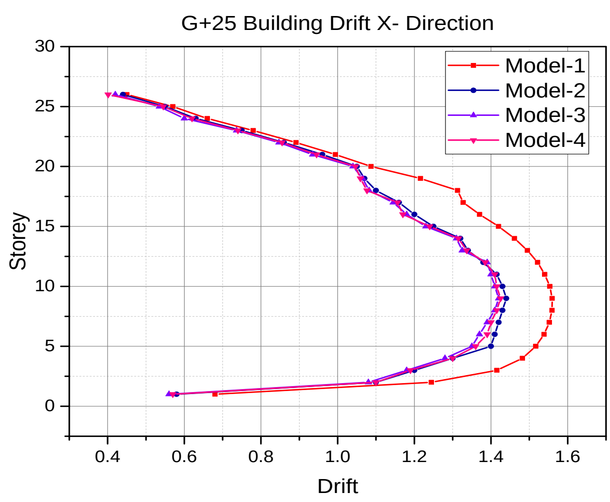

Chart-9: G+25 Building Drift in X-Direction

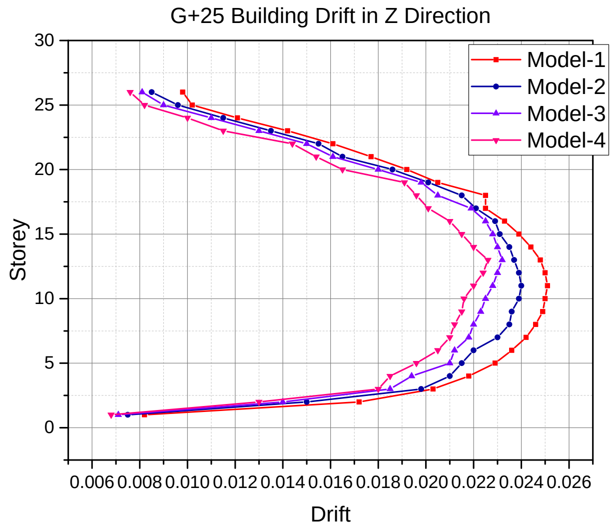

Chart-10: G+25 Building Drift in Z-Direction

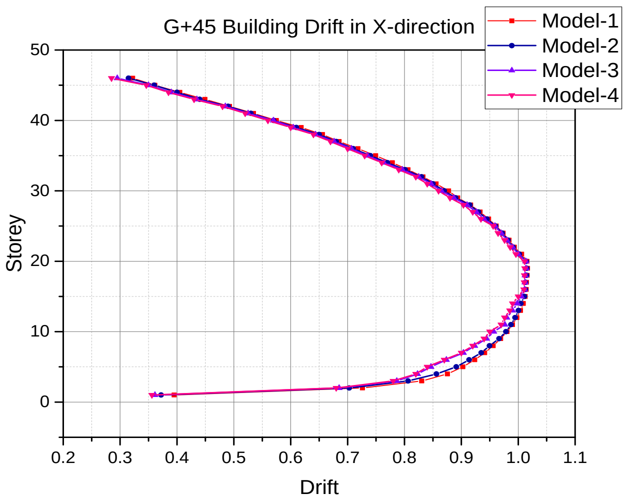

Chart-11: G+45 Building Drift in X-Direction

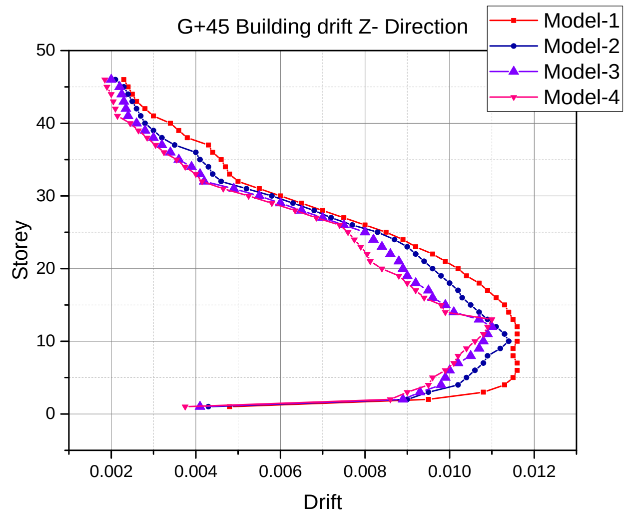

Chart-12: G+45 Building Drift in Z-Direction

5. CONCLUSION

G+15, G+25, G+45 Buildings without shear wall and with different positions of shear wall analyzed is STAAD Pro. From above results for Displacement:

- G+15:

In X Direction: Model 4 is 28% less compared to Model-1, Model 3 is 22 % less compare to Model-1, Model-2 is 4 % less compared to Model-1.

In Z Direction: Model 4 is 30 % less compare to Model-1, Model 3 is 20% less compare to Model-1, Model 2 is 13 % less compare to Model-1.

- G+25:

In X Direction: Model 4 is 20% less compared to Model-1, Model 3 is 15 % less compare to Model-1, Model-2 is 12 % less compared to Model-1.

In Z Direction: Model 4 is 14 % less compare to Model-1, Model 3 is 11% less compare to Model-1, Model 2 is 5 % less compare to Model-1.

- G+45:

In X Direction: Model 4 is 12% less compared to Model-1, Model 3 is 9 % less compare to Model-1, Model-2 is 4 % less compared to Model-1.

In Z Direction: Model 4 is 8 % less compare to Model-1, Model 3 is 7% less compare to Model-1, Model 2 is 4 % less compare to Model-1.

From above results from storey drift:

High rise structures are subjected to excessive deflection. Deflection obtained by STAAD pro is checked by IS Code limitation for serviceability

6. REFERENCES:

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