Seismic Analysis of High Rise Building with Rooftop Telecommunication Towers

GAURAV CHOUHAN*, SUMIT PAHWA, MURTAZA SAFDARI***, SUNINDA PARMAR*****

**M.Tech Scholar, Department of Civil Engineering, Alpine Institute of Technology, Ujjain*
***Associate Professor, Department of Civil Engineering, Alpine Institute of Technology, Ujjain*
****Assistant Professor, Department of Civil Engineering, Alpine Institute of Technology, Ujjain*

***Abstract**: For seismic loading in this research, response spectrum method is used to take part in the response of the earthquake effects. Some work had done previously but the work is still pending to improve the performance of the location of rooftop tower is yet to be implemented. The objective and the interest of this examination will study the activities of multistoried buildings having rooftop communication tower and the response of building under seismic loading. For the tower configurations, triangular plan is selected. G+10 buildings without tower and with tower is taken into account and G+6 buildings without tower and with tower along with analyzed in compliance of Indian Code of Practice for seismic resistant design of buildings by using I.S. 1893-2002. Parameters for both building with and without tower are computed and compared with each other.*

***Keywords*: Rooftop Telecommunication Tower, Axial Force, Storey Drift, Nodal displacement, Shear Force**

I.INTRODUCTION

One of the main problems in this era of construction world is the problem of vacant and stable land. This lack in urban areas has showed to the vertical construction magnification of low-rise, medium-rise, tall buildings and even sky-scraper (over 50 meters tall). These buildings generally used framed structures exposed to lateral loads along with vertical loads. These both factors may be inversely proportional to each other as the building which is planned to withstand perpendicular loads or resist the lateral loads. The loads mentioned here are lateral are the principal one as they are different against one another as the vertical loads are supposed to increase linearly with height; on the other hand crosswise loads are fairly changeable and rise quickly with elevation. When lateral loads of aunvarying wind or an seismic load arrives the overturning moment at bottom of the structure varies proportionally to square of the structure height. These lateral forces from the sideways have a tendency to influence the frame of the structure. The earthquake affected areas where the chances of earthquakes are comparatively higher the buildings collapsed which have not been designed in concern to these seismic loads.

II. OBJECTIVE

The aim of this study is as follows:

1. The objective of this thesis will study the activities of multistoried buildings having rooftop communication tower and the response of building under seismic loading

2. For seismic loading in this thesis response spectrum method is used to take part in the response of the earthquake effects.

3. Foe wind & earthquake forces we have to study the performance of self – supporting Telecommunication

4. According to IS-875 Part-III 1987we have to wind analysis of telecommunication tower for different wind zones

5. Parameters for both building with & without tower are computed & compared with each other.

III. METHODOLOGY & MODELLING APPROACH

Methodology: In this research we have to analysis by response spectrum method.

The descriptions of the structure and tower are listed in Table 1 and details of loading used in this work listed in Table 2.

Table 1: Details of building & triangular base rooftop tower

Building configuration	G + 6 & G + 10
Height of building	28.62m and 43.26 m
Dimensions of building	15 m x 9 m
Size of beam	400 mm x 300 mm
Size of column	450 mm x 450 mm
Concrete and Steel Grade	M25 & Fe 415 grade
Height of tower (square base)	15 m
Effective base width (square base)	3m wide
Panel height (square base)	1.5 m long
Horizontal and vertical steel members	ISA 110 x 110 x 8
Inclined members	ISA 90 x 90 x 12

Table 2: Details of loading

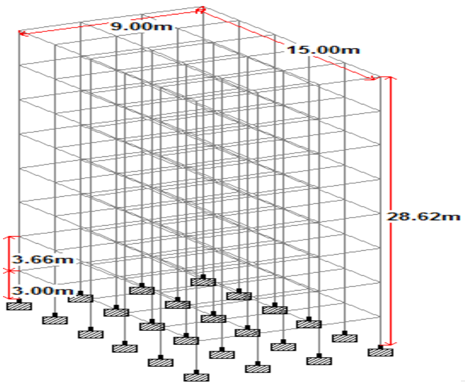
Earthquake parameters	Zone IV with RF 5 & 5% damping ratio
Period in X & Z direction	1.2978 & 1.0052 seconds
Dead load for floor and roof	12 KN/m^2 & 10 KN/m^2
Live load for floor and roof	4 KN/m^2 & 2 KN/m^2

Modeling Approach

Dynamic Method is used to analyze various models by using Staad pro software. Different models are prepared to analyze the G+6 and G+10 structures with and without telecommunication tower placing The performance and behavior of these ten models under various parametric studies are carried out for host structure along with tower and compared. The modeling approach includes types of cases considered for analysis of structure, the development, analysis of models and details of models. The structural analysis for Zone IV is carried out by response spectrum method.

Table 3: Details of various building models

Model 1	G + 6 storey building without tower
Model 2	G + 6 storey building with tower located on center of roof
Model 3	G + 6 storey building with tower at center of long side of building roof
Model 4	G + 6 storey building with tower at center of short side of building roof
Model 5	G + 6 storey building with tower located at corner of the roof
Model 6	G + 10 storey building without tower
Model 7	G + 10 storey building with tower located on center of roof
Model 8	G + 10 storey building with tower at center of long side of building roof
Model 9	G + 10 storey building with tower at center of short side of building roof
Model 10	G + 10 storey building with tower located at corner of the roof



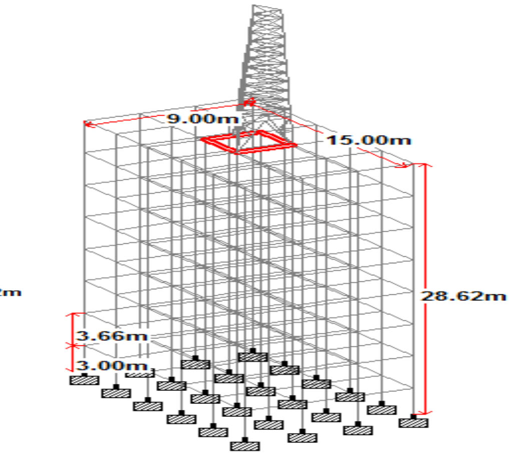
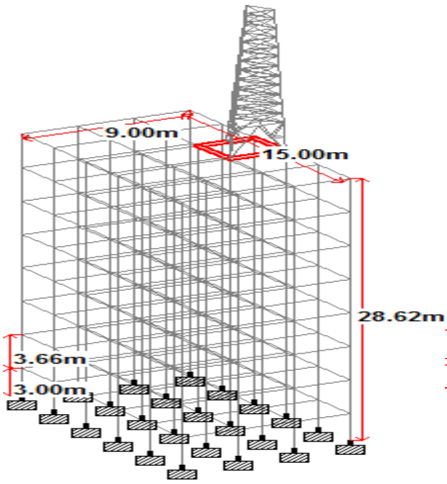


Figure: 1 3D Elevation Model-1Figure: 23D Elevation Model-2



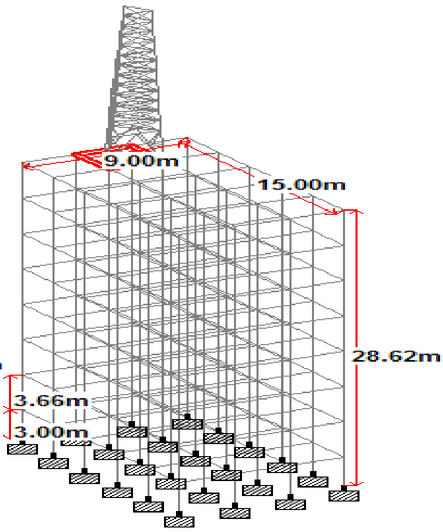
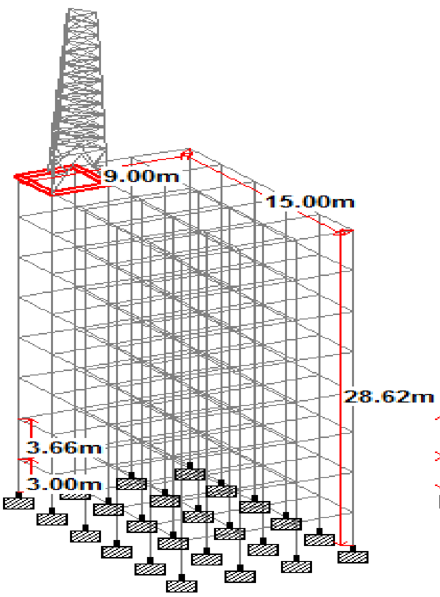


Figure: 3 3D Elevation Model-3Figure: 4 3D Elevation Model-4



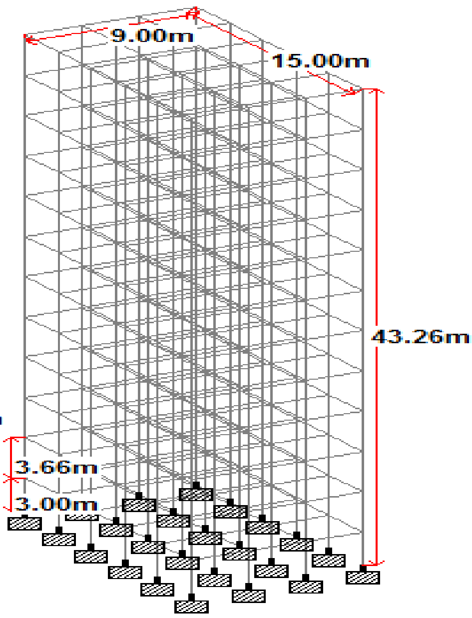


Figure: 5 3D Elevation Model-5 **Figure: 6 3D Elevation Model-6**

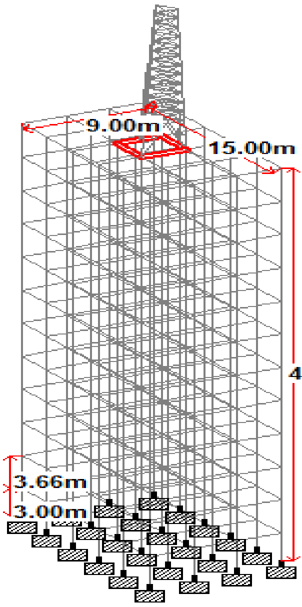


Figure: 7 3D Elevation Model-7

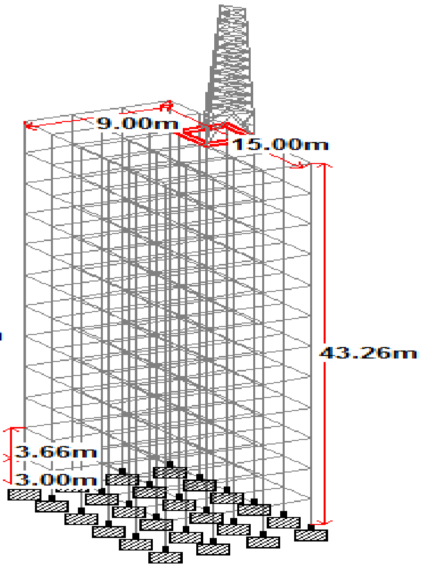


Figure: 8 3D Elevation Model-8

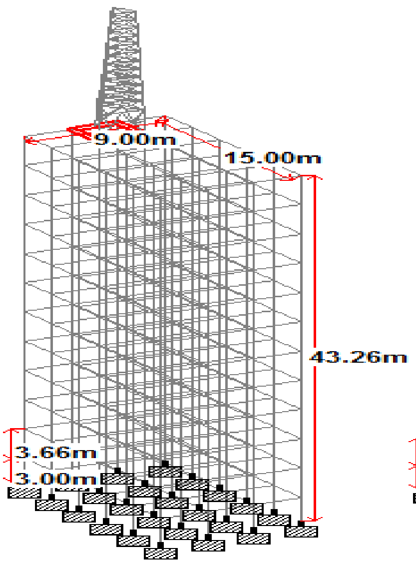


Figure: 9 3D Elevation Model-9

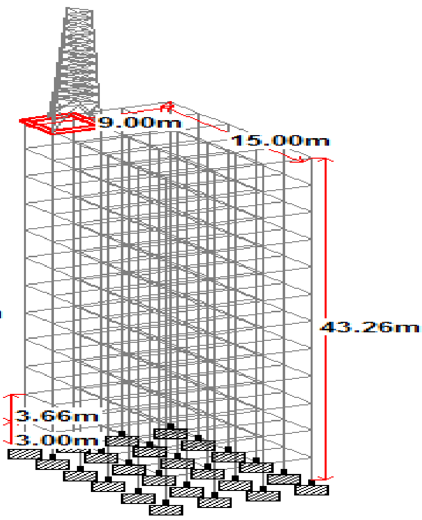


Figure: 10 3D Elevation Model-10

IV. RESULTS AND DISCUSSION

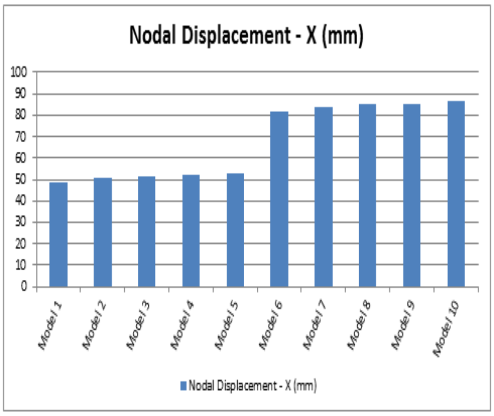
After analysis by staad pro the result parameters obtained is shown below table

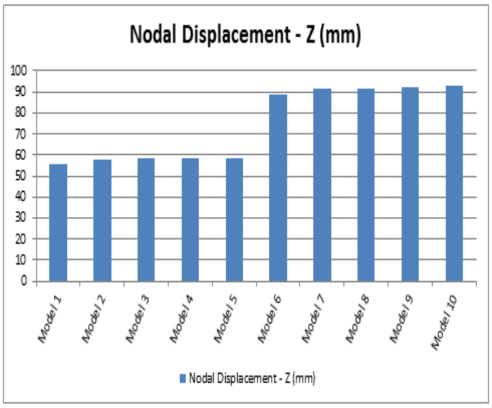
Table 4: Nodal displacement in Building (X and Z direction) for different Models

Different models		**For Buildings**	
		Nodal Displacement in different directions	
		X (mm)	**Z (mm)**
G+6	**Model 1**	48.541	55.522
	Model 2	50.890	57.965
	Model 3	51.379	58.287
	Model 4	51.895	58.341
	Model 5	52.653	58.804
G+10	**Model 6**	81.399	89.027
	Model 7	83.878	91.363
	Model 8	85.033	91.772

	Model 9	85.258	92.295
	Model 10	86.790	92.737

A shown in table the minimum value of nodal displacement in model 2 in X direction &Z directionin G+6 storey building and model 7 in G+10 storey building.



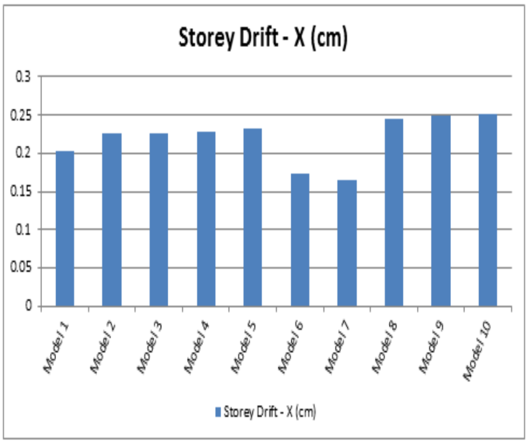


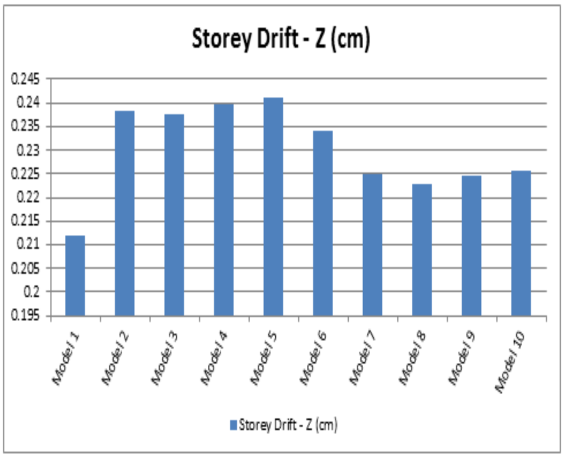
Graph 1: Nodal Displacement in Building(in X-direction)Graph 2: Nodal Displacement in Building (in Z-direction)

Table 5: Storey Drift in Building (X and Z direction) for different Models

Different models		**For Buildings**	
		Storey Drift	
		X (cm)	**Z (cm)**
G+6	**Model 1**	0.2031	0.2119
	Model 2	0.2261	0.2384
	Model 3	0.2268	0.2375
	Model 4	0.2286	0.2398
	Model 5	0.2316	0.2410
G+10	**Model 6**	0.1728	0.2340
	Model 7	0.1649	0.2250
	Model 8	0.2446	0.2227
	Model 9	0.2486	0.2245
	Model 10	0.2507	0.2258

A shown in table the minimum value of Storey Drift in model 2 in X direction & Z direction in G+6 storey building and model 7 in G+10 storey building.



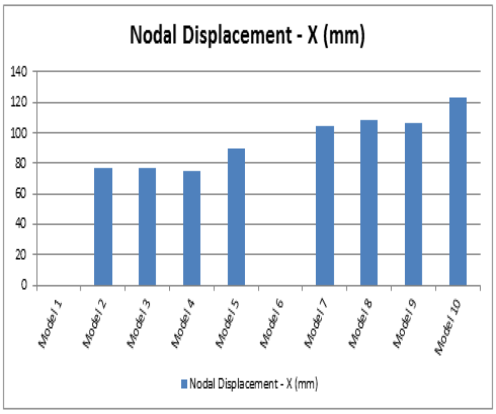


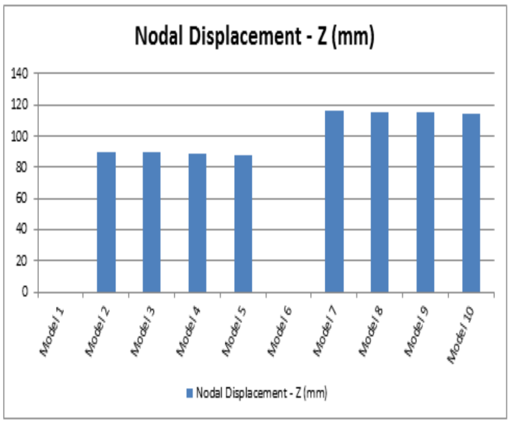
Graph 3:Storey Drift in Building(in X-direction) Graph 4: Storey Drift in Building (in Z-direction)

Table 6: Nodal displacement (X and Z direction) and Axial Forces (Compressive and Tensile) in Tower for different Models

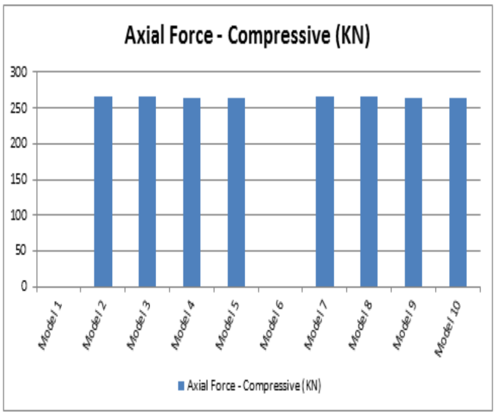
Different models		For Towers			
		Nodal Displacement		Axial Force	
		X (mm)	Z (mm)	Compressive (KN)	Tensile (KN)
G+6	Model 1	-	-	-	-
	Model 2	76.893	89.345	265.449	265.151
	Model 3	76.734	89.633	265.673	265.375
	Model 4	74.582	88.341	264.932	326.634
	Model 5	89.565	88.089	265.098	264.800
G+10	Model 6	-	-	-	-
	Model 7	104.893	116.345	265.461	225.661
	Model 8	108.842	115.687	265.679	225.627
	Model 9	106.857	115.600	264.943	224.679
	Model 10	123.619	114.089	265.104	224.866

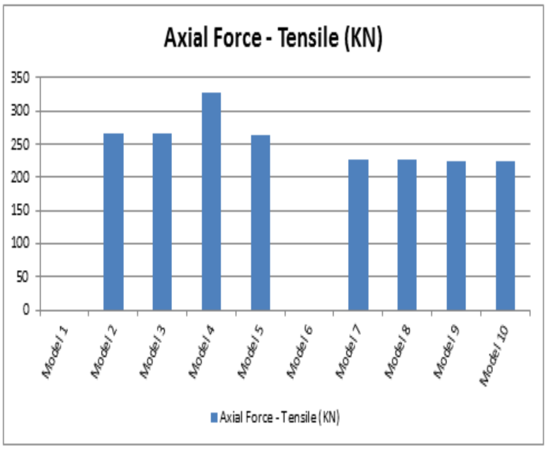
A shown in table the minimum value of nodal displacement & axial force in model 4 in X direction & Z direction in G+6 storey building and model 9 in G+10 storey building.





Graph 5: Nodal Displacement in TowerGraph 6: Nodal Displacement in Tower





Graph 7: Axial Forces in Tower(Compressive)Graph 8: Axial Forces in Tower(Tensile)

CONCLUSIONS

1. The minimum value of Nodal displacement for building model 2 and 7 for X and Z direction.

2. The minimum value of story drift for building model 3 and 8 among all tower placings.

3. Nodal displacement for tower shows the least values for model 4 and 9 for X direction, since the unit values are very less; model 4 and 9 again shows the least values for Z direction. Axial forces in compression obtained a least value for model 4 and 9 and the same model shows least values in tension.

4. Hence best suitable location of tower by considering different result parameters seems to be tower at center of short size of the building roof i.e. model 4 for G+6 storey building and model 9 for G+10 storey building.

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