Design and Analysis of Telecommunication Tower

Madhusudhan C[1], Rakshitha A Y[2], Shubha Shree B M[3], Soumya N K[4]

Abstract –Over the past 30 years, the growing demand for wireless and broadcast communication has spurred a dramatic increase in communication tower construction and maintenance. Failure of such structures is a major concern. In this paper a comparative analysis is being carried out for different heights of towers using different bracing patterns for Wind zones I to VI and Earthquake zones II to V of India. Gust factor method is used for wind load analysis; modal analysis and response spectrum analysis are used for earthquake loading. The results of displacement at the top of the towers and stresses in the bottom leg of the towers are compared.

Keywords: bracing, gust factor method, spectrum analysis, wind load analysis, wireless communication.

I. INTRODUCTION

Telecommunication tower is generally developed by a civil engineering, electronics engineering, structural engineering and Electrical engineering. Structural engineers, civil and co engineers are responsible for the design of structure and placing of that racking and bays for the equipment to be installed in as well as for the plant to be placed on. From the past 30 years, the demand of growing wireless communication and broad communication in unpredictably increase in telecommunication tower construction and maintenance. in different countries of the world the 4-legged self-supporting towers are used for the communication purposes. There is unpredictable increase in the communication industries from the last few years. Due to this increase in the installation tower is increase in the coverage area and network consistency. In wireless communication tower plays a vital role in these generation hence failure of such structure in a disaster is a major concern. Therefore, ultimately importance should be given to avoid in failure of towers from all possible extreme conditions. In all case studies the researchers only considered the effect of wind load only on the 4-legged self-supporting towers.

II. SYSTEM MODEL

The communication tower was we analysed in Staad.Pro v8i software. The models are created by coordinate data for the points and the element connectivity table and suitable sections are assigned.

The boundary conditions were estimate by fixing 4 lower most nodes. The loads are calculated above the applied level for the appropriate nodes, deformation of structure under applied load, stress @ different level.

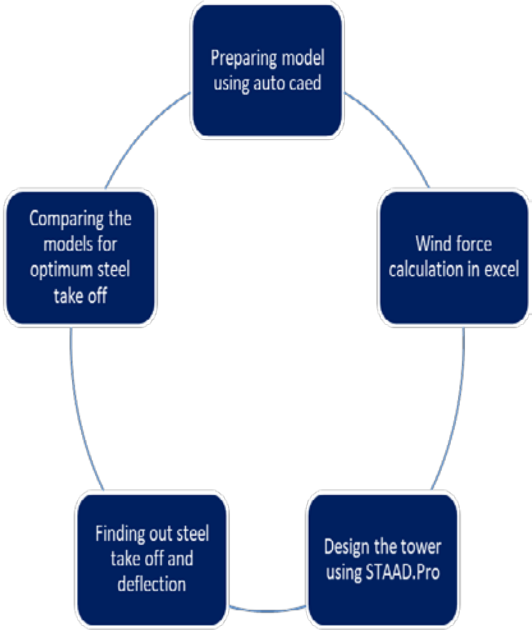
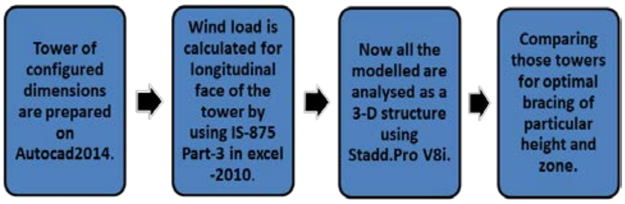


Fig. 2.1 System Model Of Project.

III. PROPOSED METHODOLOGY

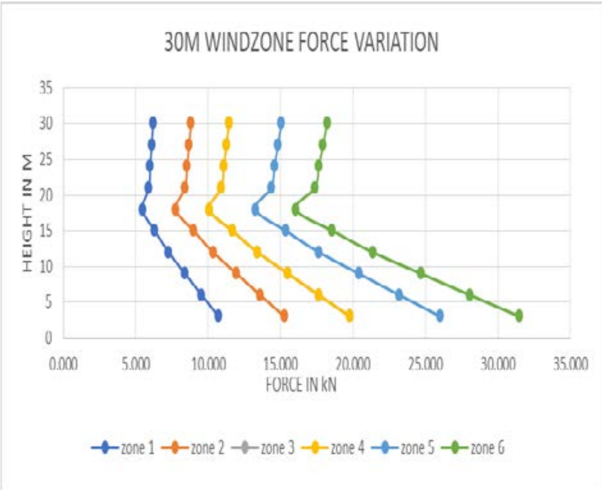
With different heights 30m, 40m and 50m of K W X bracing are consider the analysis of telecommunication tower the wind force is considered as the primary force. By using gust factor method, the wind effect on the structure is studied and by carrying out stability of the communication tower.



IV. SIMULATION/EXPERIMENTAL RESULTS

Heights 30m, 40m and 50m of K W X bracing are consider the analysis of telecommunication tower the wind force is considered as the primary force. By using gust factor method, the wind effect on the structure is studied and by carrying out stability of the communication tower.

$\boldsymbol{F = cf * A * pd * table\ no - 26}(\varnothing)$.



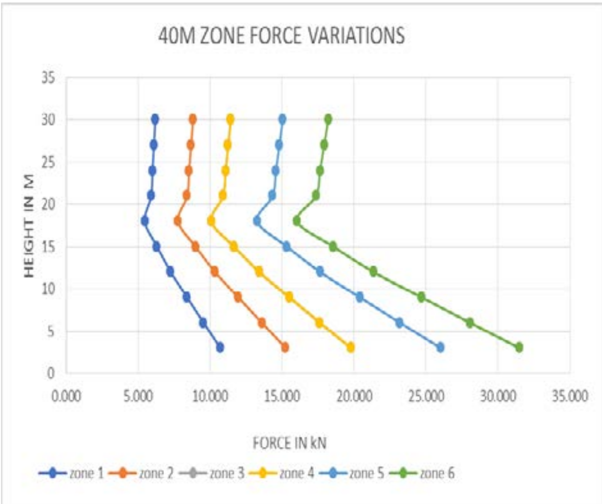


Table 1: Details Of Tower

Height of tower	30m	40m	50m
Height of slant portion	18m	28m	35m
Height of straight portion at top of tower	12m	12m	15m
Base width	7m	8m	9m
Top width	1m	1m	2m

Displacement variation in mm

Tower height	Wind zone	K bracing	W bracing	X bracing
30		7.899	8.122	8.217
40	Zone 1	26.459	24.854	24.583
50		64.173	64.28	55.648
30		10.946	0.945	10.739
40	Zone 2	30.691	29.2821	32.075
50		86.239	89.787	77.722
30		13.934	13.931	13.669
40	Zone 3	37.52	37.999	42.806
50		114.493	114.293	98.287
30		15.9	16.865	20.282
40	Zone 4	43.67	45.075	52.135
50		137.817	130.414	112.875
30		20.99	20.981	21.282
40	Zone 5	56.009	56.221	56.934
50		162.323	172.162	158.988
30		26.774	29.765	32.252
40	Zone 6	67.065	68.248	64.06
50		175.647	188.599	174.557

Stress variation in N/mm^2

Tower height	Wind zone	K bracing	W bracing	X bracing
30		7.899	8.122	8.217
40	Zone 1	26.459	24.854	24.583
50		64.173	64.28	55.648
30		10.946	0.945	10.739
40	Zone 2	30.691	29.2821	32.075
50		86.239	89.787	77.722
30		13.934	13.931	13.669
40	Zone 3	37.52	37.999	42.806

50		114.493	114.293	98.287
30		15.9	16.865	20.282
40	Zone 4	43.67	45.075	52.135
50		137.817	130.414	112.875
30		20.99	20.981	21.282
40	Zone 5	56.009	56.221	56.934
50		162.323	172.162	158.988
30		26.774	29.765	32.252
40	Zone 6	67.065	68.248	64.06
50		175.647	188.599	174.557

Steel take-off of different tower in tonnes

Tower height	Wind zone	K bracing	W bracing	X bracing
30		5.541	6.224	8.699
40	Zone 1	10.987	11.652	13.852
50		12.905	14.587	15.784
30		5.687	6.508	8.84
40	Zone 2	11.258	14.521	16.547
50		14.997	18.287	18.498
30		7.089	9.608	11.408
40	Zone 3	12.589	15.698	17.475
50		16.576	18.676	19.676
30		7.402	9.827	10.807
40	Zone 4	13.695	16.547	18.365
50		16.576	19.575	20.125
30		8.694	9.663	10.476
40	Zone 5	14.587	17.254	18.999
50		17.381	19.692	19.755
30		9.872	11.233	12.155
40	Zone 6	15.236	17.999	19.222
50		17.381	19.799	19.983

V. CONCLUSION

- Displacement increases with the increase in speed of the wind. Results displayed that the increase in the displacement from wind zone I to wind zone VI is maximum for W-Bracing and it is minimum for K-Bracing.

- For all wind zones tower height between 30m to 40m with different bracing patterns does not show much difference in displacement.

- For wind zone I to IV, tower height between 40m to 50m having K-Bracing or W-Bracing gives maximum value of displacement and X-Bracing gives minimum value of displacement.

- For wind zone V and VI tower height between 40m to 50m having W-Bracing gives maximum value of displacement and X-Bracing gives minimum value of displacement.

- Stress increases with the increase in speed of the wind. Results show that the increase in stress in the bottom leg members of the tower from wind zone I to wind zone VI is maximum for K Bracing and it is minimum for X-Bracing.

- Stress increases with the increase in the height of the Tower. Results show that the increase in stress is maximum for K-Bracing and it is minimum for X-Bracing.

- There is a steep increase in the displacement in Earthquake Zone V for all considered type of bracing pattern. Results show that the increase in the displacement from earthquake zone II to VI is Maximum for W-Bracing and it is Minimum for K-Bracing.

- For all earthquake zones stress at the bottom leg members of the tower is maximum for X Bracing and it is minimum for W-Bracing.

- The change in weight when height increases from 30m to 40m is about 41.07% and from 40m to 50m is 26.02%. Weight is maximum for X-bracing and minimum for K-bracing for the same tower height.

- There is a gradual decrease in the natural frequency of the structure as the height of tower increases. This is due to the influence of mass as the height increases the mass starts to play predominate role than stiffness there by reducing the natural frequency of the structure. The comparison shows that the frequency of the tower with X- bracing have the least natural frequency since its stiffness is higher as the weight of the structure is more and as compared to others.

VI. FUTURE SCOPES

Generally, failure of telecommunication towers is due to high intensity winds. By using these kinds of bracing like K, W and X different type of telecommunication towers are designed. With different heights 30m, 40m and 50m. For the analysis of telecommunication tower the wind force is considered as the primary force. by using gust factor method, the wind effect on the structure is studied and by carrying out stability of the communication tower.

REFERENCES

[1]. Rajasekharan, J. & Vijaya, S. (2014): "Analysis of Telecommunication Tower Subjected to Seismic & Wind loading". International Journal of Advancement in Engineering Technology, Management and applied science.

[2]. Jesumi, A. & Rajendran, M. G. (2013): "Optimal Bracing System for Steel Towers". International Journal of Engineering Research and Applications.

[3]. Bhatt, R., Pandey, A. D. & Prakash, V. (2013): "Influence of modelling in the response of steel lattice mobile tower under wind loading". International Journal of Scientific Engineering and Technology.

[4]. Amiri, G. & Boostan, A. (2002): "Dynamic Response of Antenna-Supporting Structures". 4th Structural Specialty Conference of the Canadian Society for Civil Engineering. P.1-9.

[5]. Siddesha, H. (2010): "Wind Analysis of Microwave Antenna Towers". International Journal of Applied Engineering Research.