7th National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(1st and 2nd March 2019)
International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

Study of Telecommunication tower in Telecommunication and Broadcasting Sector

Yash More[1], Yogesh Naik[2], Chirag Nagarkar[3], Jitendra Palkar[4]
Department of Civil Engineering, Viva Institute of Technology, Mumbai University, INDIA

Abstract- *With the rapid development of the communication sector in the country, telecommunication towers play a vital role in telecommunication & broadcasting sectors. There are many structural forms available for towers among those guyed mast &self-supporting are important ones and are generally used for many years. So the main aim of our study is comparative analysis of these two towers. The comparative study will be based on several parameters such as loading conditions (wind load, live load, dead load etc.) analysis of structural & foundation design and cost estimation. In first stage both towers having same dimensions and height are designed on Staad Pro v8i software and respectively same loads are applied on both the towers. Also wind load calculations are done. Loading conditions are applied on both structures and the results are obtained. In second stage these results are validated by manual calculations. Also the economical aspect is designed as well, taking the cost of the production, foundations work and the erection of structures into considerations. Finally the model representing both this towers will be prepared.*

Keywords—Communication Sector, Telecommunication Towers, Broadcasting Sectors.

I. INTRODUCTION

1.1 Background

A guyed mast tower is a tower structure which consists of a free-standing basement, in most cases of concrete or lattice steel with a guyed mast on the top. The anchor basements of the guyed mast can be on the top of the tower or on the ground. Guyed masts are structures broadly used in the field of telecommunication; their stability is based on pretensioning the cables. Prestressing of the cables is imposed during construction of the mast and it should be rectified periodically. The initial guy tension may vary from 8% to 15% of the breaking strength of the guy, and is usually recommended to be 10%. Over the years, the collapse of several guyed masts has been attributed to galloping. This phenomenon occurs under certain wind conditions when the guys (which support the shaft laterally) experience large amplitude oscillations. At the time of high winds in each hurricane season, the guys suffer variations of their tension that are not always rectified and which provoke a change in the structural behavior of the mast.

The guyed masts are used for meteorological measurements, power transmission or wireless communication in the telecommunications industry. Modern tall guyed masts constructed of high-strength and lightweight elements tend to be more flexible and lightly damped than those in the past. Therefore, the sensitivity of such guyed mast to dynamic excitation by wind attains considerable importance.

Guyed masts exhibit a high nonlinear behavior due to cable presence and the change of stiffness under wind and prestressing loads. The natural frequencies of the mast depend among other factors on the magnitude of the guy's tension at the time of vibration. The cable element has therefore received a lot of attention in the literature and numerous models have been suggested.

1.2 Objectives

1. To make it cheaper than building a completely free-standing tower, this can withstand the same force.

2. To allow for very easy upgrading of existing structures.

3. To design raised structure which typically supports antennae and one or more sets of transmitter/receivers or GPS receivers.

ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

II. LITERATURE REVIEW

Use of cellular phone or mobile phone (MP) has increased exponentially as it became a part of everyday life. With increase in cell phone communication, the number of cell towers getting installed is also increasing every day. We studied different projects of different people over the world dealing with the same cause. In this section we mention the references of paper from which we designed using suitable method and approach towards this project.

2.1 Review

1. Assist. Prof. R. TugrulErdem, Ph.D. Celal Bayar University, turkey;

The nonlinear analysis of a guyed steel lattice mast 80m in height is performed using the SAP 2000 program. Load conditions are taken from IS 498. The altitude of structure is 1500m and snow region IV is adopted. The relationship between ice thickness and wind speed was determined.

It was determined that the lattice mast safely stands at lower speed as the ice thickness value increases.

2. A. Ismail;

This study provides dynamic field measurements of 138m guyed towers located at Qussia city, Upper Egypt. Measurements of ambient tower vibrations are used to determine the dominant natural frequencies of tower. The measurements were made using 'LMS SCADAS' system.

The updated finite element model leads to evaluate the exact ultimate behavior of seismic resistance. The corrosion of tower's steel element has a significant effort on tower's seismic resistance.

3. Marcel Isardro R. De oliveia;

The alternative structural analysis modeling strategy based on less conservative model combining 3D beam finite elements in main structures in bracing system and eliminating use of dummy bars. The comparison is focused on structural response in terms of displacement, bending moment stresses, natural frequencies and buckling loads. Further comparisons of the two above mentioned methods and another design alternative only using 3D beam finite elements on three existing guyed steel telecommunication towers are described. The comparison is focused on the tower structural response in terms of displacement, bending moments, stresses, and natural frequencies and buckling loads.

It is determined that the stress values based on the three investigated methodologies were significantly modified. The displacement values are not changed and adoption of third mixed design strategy in which the bracing system are modeled by truss element.

4. S. Kogul, A.M.L.N. Gunathikala;

Behavior of existing guyed mast tower (which were not initially designed considering earthquake loading) are selected and analyzed under existing seismic loading using ANSI/TIA-222-G tower design code and results, observations and conclusions based on this analysis are presented.

Structural actions (member forces, support reactions, deflections etc.) developed in all selected guy towers under most probable type of seismic loads relevant to Sri Lanka are very low compared with same under design wind loads when seismic analysis is done. It will survive under minor to moderate earthquake.

7th National Conference on
"Role of Engineers in Nation Building" organized by VIVA Institute of Technology, Mumbai
(1st and 2nd March 2019)
International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

III. CALCULATION

Table no: 4.1.1.1
Antenna Specifications

Sr. No.	Description	Nos.	Length	Width	Thickness	wt.	Total wt
			mm	mm	mm	kg	kg
1	GSM 1	3	2500	250	150	25	75
2	GSM 2	6	1500	170	150	20	120
3	M/W circular	4	600	diameter		30	120

Total equipment load = 315 kg — Consider g=10m/s^2(approx.)
3.15 kN — then 1 kg=10 N

No. of node = 12 nos
Load on each node= 0.2625 kN

Live load = 100 kg
1 kN

Wind load

	service wind		Operational wind	
Basic wind speed = Vb =	39	m/s	26.00	m/s
K1 = Risk factor =	0.92			
K2=	1.1			
K3 =	1			
Design wind speed = Vz				
Vz= Vb x k1 x K2 x K3 =	39.468	m/s	26.312	m/s
pz = 0.6 Vz^2 =	934.6338	N/m^2	415.3928	N/m^2
	0.935	kN/m^2	0.415	kN/m^2

Wind force F = force coefficient x wind pressure x area of structure
F = Cf x pz x A

Sr. No.	Description	Nos.	Length (h)	Width (b)	Thk (a)	h/b	a/b	Cf
			Mm	mm	mm			
1	GSM 1	3	2500	250	150	10	0.6	1.8
2	GSM 2	6	1500	170	150	8.8	0.9	1.7
3	M/W circular	4	600	diameter				1.2

International Journal of Engineering Research & Science (IJOER)
ISBN: [978-93-5321-411-1] ISSN: [2395-6992] [Vol-5, Issue-3, March- 2019]

Sr. No.	Description	Length (h)	Width (b)	Cf	Area	Force	Force	
		mm	Mm		m^2	kN	kN	
1	GSM 1	2500	250	1.8	0.625	1.051	0.467	0.233658
2	GSM 2	1500	170	1.7	0.255	0.405	0.180	
3	M/W circular	600	diameter	1.2	0.283	0.317	0.141	

Table no: 4.1.4.1 CF Value

ϕ	Cf
0.2	2.7
0.25	2.5
0.3	2.3

4.1.4 Calculation of wind load on tower:

Solidity ratio = ϕ = (net area of bay /Total area of bay)

Total area of bay	=	2.322576	Sqm
Net area of ther bay	=	0.56	Sqm
Solidity ratio = ϕ	=	0.24	
Cf of angle section	=	3.05	
Cf of pipe section	=	2	
D*Vd	=	3.508705	m^2/s

Table no: 4.1.4.2 CF Value

ϕ	Cf
0.2	2.1
0.25	2
0.3	1.9

		Service		Operational	
UDL on Angle section	=	0.143	kN/m	0.063	kN/m
UDL on Pipe section	=	0.166	kN/m	0.074	kN/m

IV. RESULT

A guyed mast and self-supporting telecommunication tower of 30m height is analyzed and designed:

The configuration of tower is as follows;

Height of tower = 30m

Base width = 1.524m

Top width = 1.524m

Type of tower: - Three legged lattice tower for guyed mast and four legged lattice tower for self-supporting tower

No. of members = 243 for guyed mast and 232 for self-supporting tower

The total wind load acting on structure is on

Angle section = 0.143 KN/m

Pipe section = 0.166 KN/m

V. CONCLUSION

In the present era, technology is growing at a rapid phase which requires adequate communication means like mobile phones, internet, radio communication systems including radio stations, communication towers. If we could optimize the design of towers and use less resource, it will save a lot of money and resources. In olden day's angle sections are used in making of truss in towers, currently tabular sections are preferred as they are more economical.

The wind load acting on the telecommunication towers will be comparatively less in magnitude as it is open structure with more openings, but failure of the towers is mainly due to high intensity winds and earthquakes. So high factor of safety should be given to wind loads and seismic loads.

REFERENCES

[1] British Standards Institution, Lattice towers and masts Part 4: Code of practice for loading of guyed mast, BS 8100-4:1995. London, UK; 1995.

[2] Canadian Standards Association, Antennas, towers, and antenna supporting structures, CSA S37-01. Rexdale, Canada; 2001.

[3] Telecommunications Industry Association, "Structural standards for Steel Antenna Towers and Antenna Supporting Structures", TIA/EIA-222-G. EUA; 2005.

[4] Kahla N. B., Dynamics of a single guy cable. Computers and Structures, Vol. 54, No. 6, 1995, pp. 1197-1211.

[5] Mifitano G., Computer - Aided Free Vibration Analysis of Guyed Towers. Department of Civil and Geological Engineering, University of Manitoba, 2000.

[6] Madugula M. K. S. Dynamic Response of Lattice Tower and Guyed Mast. Virginia, USA; 2002.

[7] Di Pilato M., Martelli F., Martinelli L. Corotational cable elements to model suspended cables under wind loading. 5th European & African Conference on Wind Engineering, Florence, Italy: 2009.

[8] Ghugal Y, Salunkhe M. Analysis and Design of Three and Four Legged 400KV Steel Transmission Line Towers: Comparative Study. International Journal of Earth Sciences and Engineering. 2011 October; 4(6), 691-694.

[9] Lakshmi V, Raja Gopala Rao A. Effect of Medium Wind Intensity On 21M 132kV Transmission Tower. 2012 August; 2(4), 820-824.

[10] Selvaraj M, Kulkarni S M, Ramesh Babu R. Behavioral Analysis of built up transmission line tower From FRP pultruded sections. International Journal of Emerging Technology and Advanced Engineering. 2012 September; 2(9), 39-47