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Wind Analysis of Tubular Telecommunication Tower with Bracing Systems

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***Abstract**: - This research paper consists of effects of wind force on tubular tower Structure with different bracing system. The Indian standard code of practice IS- 875:1987(Part III), IS-800-2007 guidelines and methodology are used to analyze the tower structure. Etab2015 structural analysis software is used to analyze the tower under the effect of wind forces in zone III. wind analysis done by Response Spectrum Analysis. The behaviour of tower was examined and compared on the basis of displacement and base shear.*

Introduction

The telecommunication industry plays a great role in human societies and thus much more attention is now being paid to telecommunication towers Fig.1 than it was in the past. The Indian telecom service business is the fastest growing one in the world, with over seven million mobile subscribers being added every month. This expanding base possesses challenges to mobile operators in terms of augmenting and upgrading infrastructure to maintain to quality of services. During the natural disasters such as the earthquakes telecommunication towers have the crucial task of instant transmission of information from the affected areas to the rescue centres. The general availability of a wide range of square, rectangular, and round structural tubing increased. The use of tubular joints greatly improved the aesthetic qualities of the truss, and the higher load carrying capacity of the structural capacity of the structural tube members provided a wide range of applications for a triangular cross section truss. Tubular sections are used for truss members, the range of different standard shapes and sizes produced is much less than wide flange shapes and availability of some standard shapes is still limited. Due to these important roles, towers should preserve their immediate occupancy level when strong ground motion happen. Fastest growing telecommunication market has increased the demand of steel towers. The major loads considered for design of these towers are self-weight, wind load, seismic load, antenna load, platform load, steel ladder load etc. Failure of towers is generally due to high intensity winds. Several studies have been carried out by considering wind and earthquake loads. A failure of a telecommunication tower especially during a disaster is a major concern in two ways. Failure of telecommunication systems due to collapse of a tower in a disaster situation causes a major setback for rescue and other essential operations. Also, a failure of tower will itself cause a considerable economic loss as well as possible damages to human lives. Hence, analysis of telecommunication towers considering all possible extreme conditions is of utmost importance. The tubular sections are more efficient sections which are adoptable to many different situations. The tubular section cannot be surprised in its efficiency by other sections.

Fig 1 Telecommunication Towers

Tube Structure

The tubular sections are used as structural component since along. A large no of tubular structures have been constructed in the past. The tubular section are effectively used in large space frame, lattice structures for antennas, stadium exhibition hall, where appearance as well as weight become an important design consideration. The mast and transmission towers are other examples where

tubular section are utilized effectively. In the past, the use of tube was hampered because of connection details.
The tubular sections are more efficient sections which are adoptable to many different situations. The tubular section cannot be surprised in its efficiency by other sections.

Modeling and Loading Details:

A.Structural data

Ht of tower	58m	66m	74m
Base width	4.1m	4.6m	4.8m
Top width	1m	1m	1.2m

B. Wind data (As per IS:875-1987)

1) Wind speed: 39 m/s
2) Terrain category: 4
3) Structure class: c
4) Risk Coefficient k: 1
5) Topography factor k3: 1

C. Loading data

Live load: 1 KN/m (Only one side of tower)

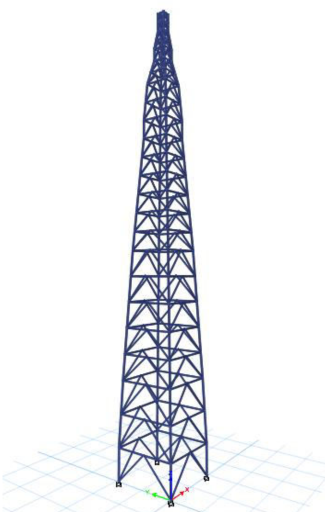
Anteena load:

Items	CDMA	CDMA	GSM	GSM
Quantity	2	2	2	2
Size	0.26X2.5	0.26X2.5	0.3X2.6	0.3X2.6
Weight (kg)	20	20	25	25
Total Load (KN/m^2)	0.615	0.615	0.641	0.641

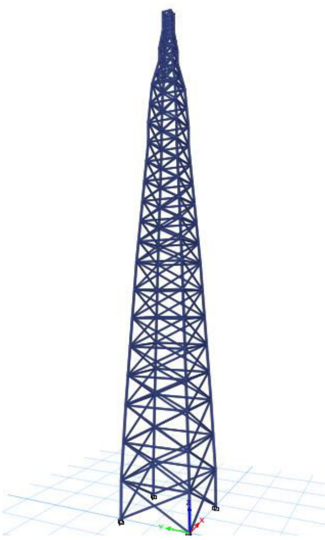
Table 1

Static equivalent loads EQX & EQY are applied in ETABS. Also Response spectrum cases SPEC X & SPEC Y are applied in ETABS

D. Modeling of Tower structure



Tower with Inverted V Bracing
Fig 2



Tower with X Bracing
Fig 3

Earthquake Analysis for Tubular Telecommunication Tower

wind analysis for X bracing			
Tower Ht.	58m	66m	74m
Story Displacement	35.5	50.9	85.9
Base Shear	78.863	94.2145	113.0253

Table 2

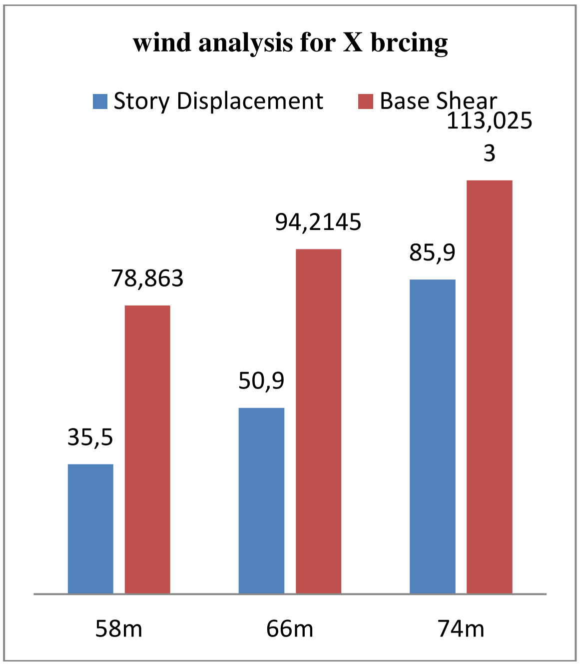


Fig 4 Comparison between story displacement & base shear for inverted V bracing

wind analysis for X bracing			
Tower Ht.	58m	66m	74m
Story Displacement	30.9	42.7	66.6
Base Shear	67.7916	79.7234	93.5808

Table 3

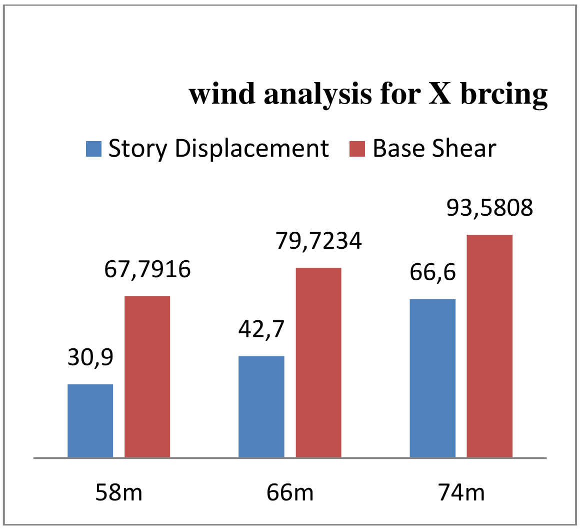


Fig 5 Comparison between story displacement & base shear for X bracing

Conclusion:

1. The lateral displacement goes on increasing as the height of tower increases.
2. The base shear goes on increasing as the height of tower increases.
3. The inverted V bracing has less displacement as compare to X bracing.
4. Inverted V bracing is efficient than X Bracing under the wind loading.

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