Comparative Study on Telecommunication Towers with Different Configurations Using ETABS

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***Abstract*- The increasing trend of mobile communications has seen exponential growth in the last three years. Increased competitions among mobile operators also have contributed to the installation of many towers to enhance both coverage area and network reliability. The tower locations as specified in terms of latitudes and longitudes with the height of mounted antenna dictated by functional requirements of the network. The availability of land which satisfies ideal installation conditions in urban areas is extremely limited. As a result the construction of tower requires exquisite engineering Skills Failure of such tower in a disaster like an earthquake and lateral wind load is major concern mainly in two ways. One is the failure of communication facilities will become a major setback to carry out rescue operations during disaster while failure of tower will itself cause a considerable economic loss as well as damages to human in most of the cases. Therefore, design of telecommunication towers considering possible extreme conditions is of utmost importance and a good design can considered as a step towards a greater degree of sustainability Their dynamic analyses are performed by ETABS software. The axial forces of the tower members are considered as the main parameter.**

1. INTRODUCTION

The increasing trend of mobile communications has seen exponential growth in the last three years. Increased competitions among mobile operators also have contributed to the installation of many towers to enhance both coverage area and network reliability. The telecommunication has become the main source of communication all over the world. Mobile is the main media for communication and the growth of mobiles all over world is increasing day by day. The growth of mobile users in India is shown in the graph shown above. India is one of the most rapidly growing telecom industries in the world. For telecommunication frequency is must and for transmission of these frequency antennas mounted on high towers is must. As a consequence the there is a rapid growth of telecommunication towers in India. This sets the base for our project.

Telecommunication towers are tall structure usually designed for supporting parabolic antennas which are normally used for microwave transmission for communication, also used for sending radio, television signals to remote places and they are installed at a specific height. These towers are self-supporting structures and categorized as three legged and four-legged space trussed structures. The self-supporting towers are Square or triangular in plan and are supported on ground or on building they act as cantilever trusses and are designed to carry wind and seismic loads. These towers even though demand more steel but cover less base area, due to which they are suitable in many situations.

The availability of land which satisfies ideal installation conditions in urban areas is extremely limited giving no alternative but to adopt roof top towers (with marginal adjustment in position but not in height). The various bracing patterns are available but most Common brace patterns are ne chevron and the x-bracing. Most or the researches mainly done on 3-legeed self-supporting towers and very limited attention have been paid to the dynamic behaviour of 4-Iegged self-supporting telecommunication towers.

The rapid development need of the telecommunication towers in our country. Therefore an advanced technique for the erection of these towers is needed to be developed. The various challenges faced in the design of Telecommunications towers are its construction requires exquisite engineering skills and advanced methodology. There are many problem faced in the construction of these towers like lover base area available for its construction is one of those challenges. The height of the telecommunication tower is itself a big hurdle for its design. At such great heights, these towers are subjected to high wind loads which is other low height structures doesn't play big role. Also during earthquake the lateral load that acts upon these towers pose great threat to their safety. There are many methods for design of this tower, like STAAD PRO, SAP2000 but here we are going to use here ETABS.

2. Types of Telecommunication Tower:

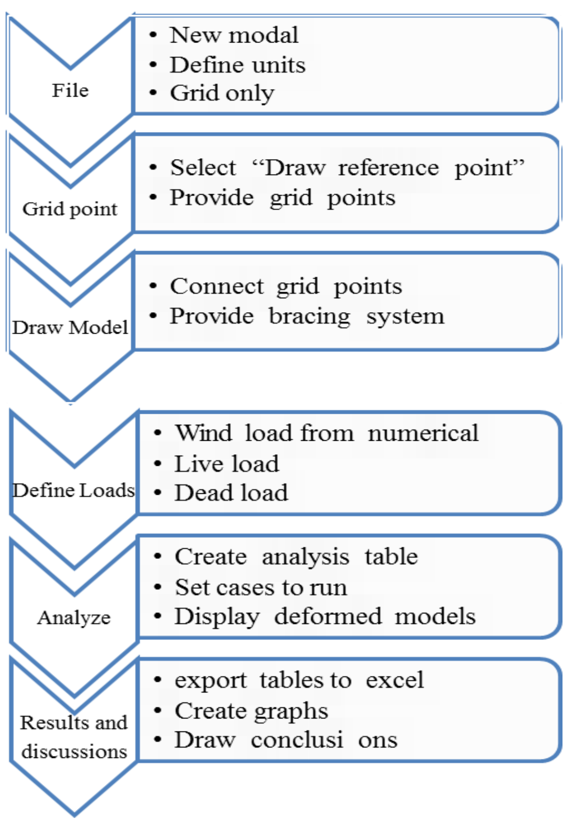
1. Based On Structural Section:

a. Self-Supporting
b. Monopole
c. Guyed Must

2. Based On Build Up Section:

a. Triangular (3- legged)
b. Square (4- legged)
c. Hexagonal
d. Circular

2. METHODOLOGY



3. DIFFERENT IS CODES USE FOR MAKING TOWERS

1. IS-CODES:

IS-CODE 875(PART 1):

IS-CODE 875(PART 2):

The above two codes are used for the calculation of wind load acting on the telecommunication towers.

IS-CODE 802(PART 1):

IS-CODE 802(PART 2):

The above two codes are used the selection of proper steel material for the construction of telecommunication of towers.

2. Some Important Content for Calculation Wind Load:

1. Basic Wind Speed (Vb)
2. Risk Coefficient (K1)
3. Terrain Factor (K2)
4. Topography Factor (K3)
5. Importance Factor (K4)

3. Different Loads on Towers:

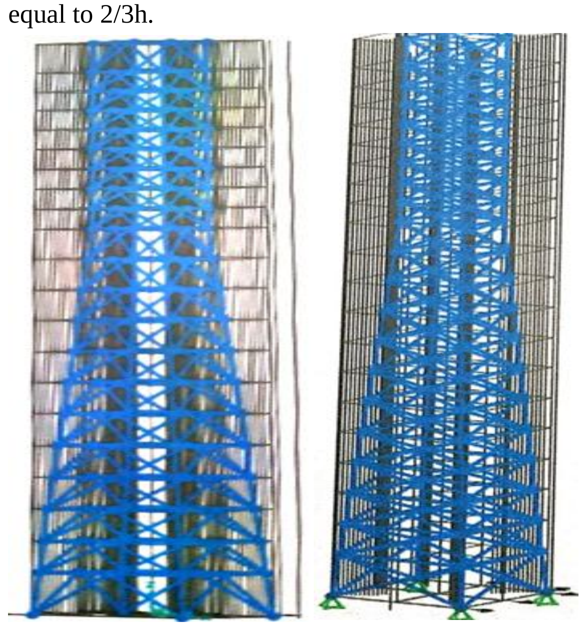
1. Wind load:

The wind load on the tower structure is calculated by using IS 875 (part 3): 1987 and IS 802 (Part 1: Sec 1) 1995.

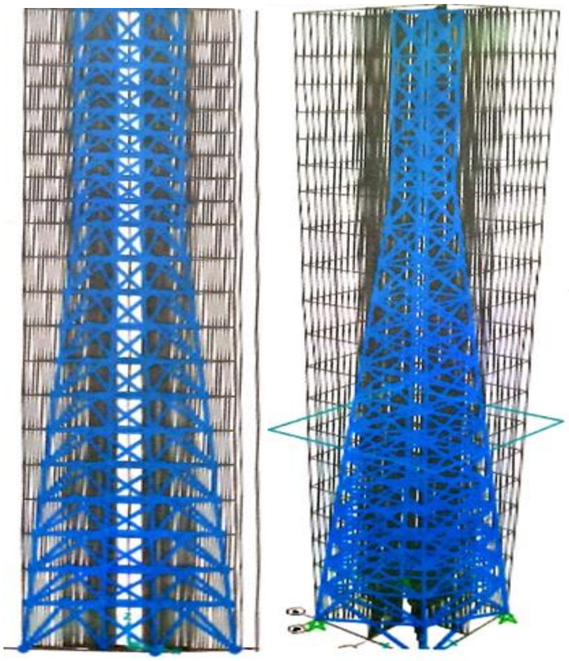
2. Gravity Load
3. Live Load
4. Seismic Load

4. MODELS IN ETABS

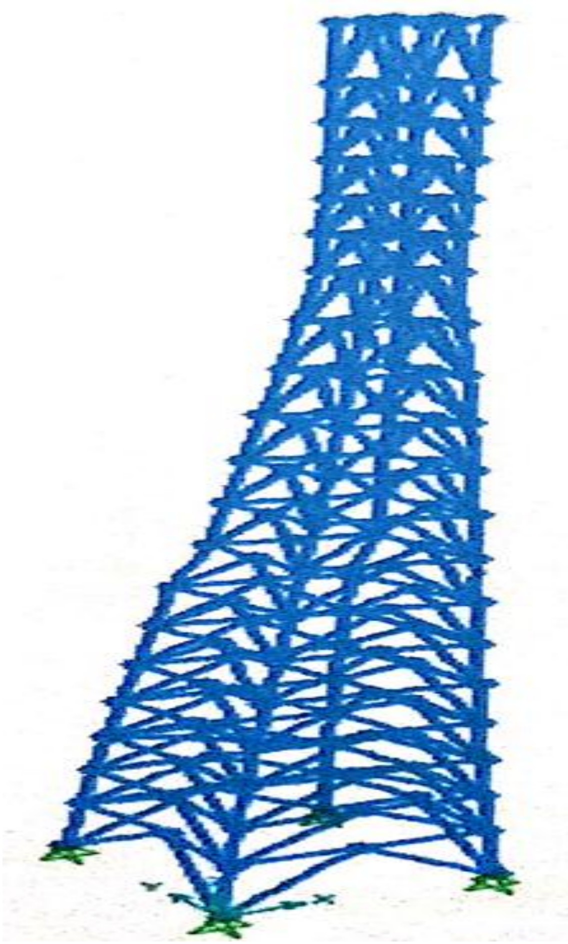
1. 8m K and X Bracing Tower with tapered section equal to 2/3h.



2. 8m K and X Bracing Tower with tapered section equal to 3/4h.

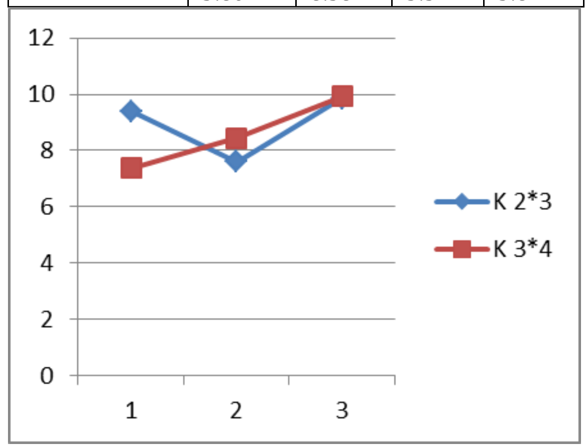


3. DISPLACEMENT OF 8m TOWER

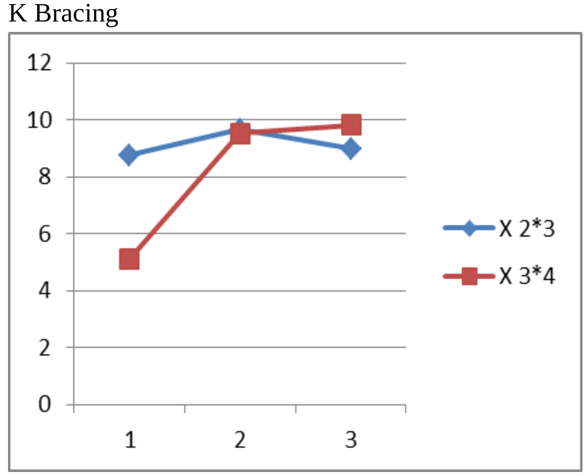


5. DISPLACEMENT GRAPHS

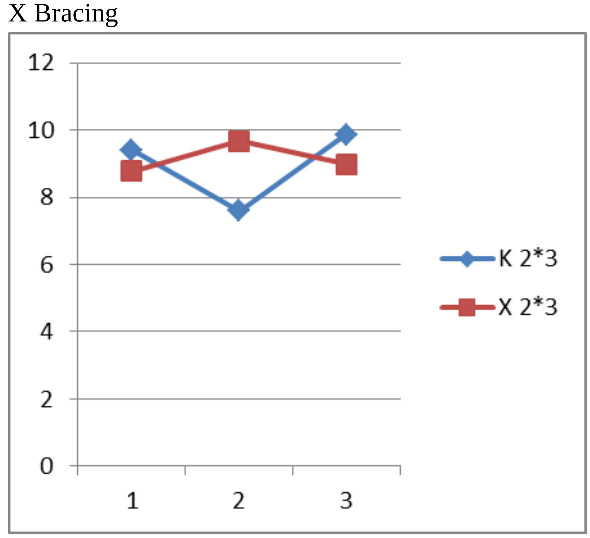
TOWER	2*3		3*4	
BASE	K 2*3	X 2*3	K 3*4	X 3*4
8	9.4	8.77	7.36	5.12
10	7.6	9.67	8.45	9.53
12	9.86	8.98	9.92	9.82



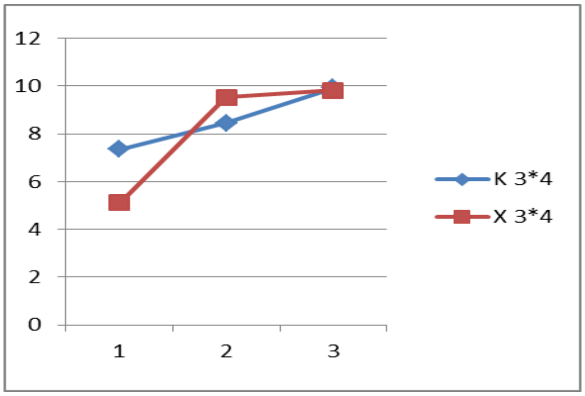
K Bracing



X Bracing



Tapered 2*3 for both bracing



Tapered 3*4 for both bracing

6. CONCLUSIONS

From the above analysis it can be concluded that the wind is the predominate factor in the tower modelling than the seismic forces but the seismic effect cannot be fully neglected as observed from the results.

There is gradual decrease in the period 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 period of the structure.

From the analysis of the joint displacement of the towers it is concluded that towers with K bracing system gives less average joint displacement than X bracing system.

From the analysis of the joint displacement of the towers it is concluded that towers with 3/4h tapered section gives less average joint displacement than towers with 2/3h tapered section.

From the analysis of the joint reaction of the towers it is concluded that towers with tapered section equal to 3/4h gives less joint reactions when compared to towers with tapered section 2/3h.

For same tapered section if comparison between X and K bracing is done than it is clear that K bracing system gives less joint displacements.

From the study of frequency of towers it is clear that K bracing system is more stable than X bracing system as frequencies of X bracing system changes drastically as base are increases.

7. ACKNOWLEDGEMENTS

Behind every success there are lot many efforts, but efforts are fruitful due to some hands making passage smoother. We express our deep sense of gratitude for hands of some people extended to us during our work.

Research brings about dramatic changes in the traditional look out of science & technology. It is continuous phenomenon undertaken by each and every throughout the world. It has widened our vision, opened newer avenues and lightened the dark obscure facets of mysteries of universe. The work depicted in this project is a bucketful of contribution to the large oceans of research occurring globally.

As one flower makes no garland, this presentation not has taken shape without wholehearted encouragement and live involvement of some general souls.

We express a deep sense of gratitude to my guide Mr. KISHAN RANA, Civil Engineering Department, Bhagwan Mahavir college of engineering and technology for his constructive support, constant encouragement, guidance and challenging our efforts in right direction without which this project would not have attained the present form.

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