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Analysis and Design of Mobile Tower using ETABS

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Abstract:
Telecommunication towers are classified among the tallest man-made structures and can be discovered standing high on each piece of the globe with various statures and purposes. Towers are the tall steel structure development utilized for various purposes, for example, correspondence tower, radio transmission, and power transmission aviation authority and so forth. The supporting individuals are orchestrated in numerous structures, which convey exclusively strain, or on the other hand pressure and pressure. Towers are subjected to gravity burdens and even loads. The higher the structure, the more it is presented to horizontal loads, for example, twist stack, since it tends to influence. In this venture investigation of Mobile pinnacle with various supporting design is done. The significant burdens considered for plan of these towers are self-weight, wind stack, seismic load, reception apparatus stack, stage stack, steel stepping stool stack and so on. In the present examination a steel correspondence tower is intended for a tallness of 30m. The pinnacle is given three unique sorts of bracings, X Bracing, Inverted V Bracing and K Bracing. The reaction of the pinnacle for both breeze and seismic tremor loads is considered with various bracings. A Comparison of part powers in the three pinnacle models demonstrate that the part powers in K supporting pinnacle is slightest, and the X propping model shows more part powers. From the outcomes it can be reasoned that the Tower setup with K bracings is superior to the pinnacle with X and V bracings, from economy and configuration perspective

Keywords: wind loads, displacement, bracings, types of bracings

I. INTRODUCTION

The four legged self-supporting towers are generally utilized worldwide for the media transmission purposes. The correspondence ventures have seen a colossal increment in most recent couple of years which have brought about establishment of substantial number of towers to build the scope zone and system consistency. In remote correspondence organize these towers assume a critical part henceforth disappointment of such structure in a fiasco is a noteworthy concern. In this way most extreme significance ought to be given in thinking about all conceivable outrageous conditions for planning these towers. In this undertaking investigation of Mobile pinnacle with various supporting design is done. Diverse loadings, for example, reception apparatus, stepping stool, and so forth are considered. Likewise the breeze stack investigation according to IS 875 Part 3 is considered. The steel structure is to be outlined according to IS800-2007. The ETABS programming is utilized for the examination and configuration reason.

II. LITERATURE REVIEW

Akash. D. Pathrikar, Prof. L. G. Kalurkar [1]
In this investigation conduct of structures with rooftop top pinnacle in case of an Earth Quake utilizing STAAD professional. A commonplace private building is considered for the investigation. Three towers with stature 9m, 18m, and 27m is considered for the examination. The building is broke down by utilizing distinctive kinds of supporting framework for individual statures. A similar seismic investigation between structures with rooftop top towers is done to discover the best supporting framework as diversion. The finish of the investigation are ; X supporting is practical up to the tallness of 55m from over the ground level and if the stature builds then X propping demonstrates uneconomical and K supporting demonstrates conservative.

Jithesh Rajasekharan1, S Vijaya [2] In this investigation model of shifting statures with various supporting is dissected for seismic power alongside the breeze impact. The breeze impact on the structure is examined by utilizing the blast factor technique and the seismic impact on the structure is considered via doing the modular investigation and reaction range examination. From their examination it is reasoned that the breeze is the prevail factor in the pinnacle displaying than the seismic powers however the seismic impact can't be completely ignored as seen from the results.The vertical individuals are more noticeable in taking the heaps of the pinnacle than the even and corner to corner part, the part supporting the reception apparatus structures at higher height are probably going to have vast effect on the conduct of the pinnacle.

III. METHODOLOGY

1. **Modeling of Towers**: Fixing the Geometrical Parameters such as height, width, bracing system and initial member sections.Modeling the Tower in the ETABS software. The tower is provided with three different types of bracings,

a. X Bracing,
b. V Bracing and
c. K Bracing.

These three models were modeled in ETABS Software as follows.

- Define Storey data like storey height, no. of storey etc.
- Define material properties.
- Define Frame Section from Define menu like members and bracings.
- Define Slab Section.

- Draw building Elements from draw menu.
- Give Support Conditions.
- Define Load cases and Load combinations.
- Assign gravity Load (As per clause IS 875:1987 part1 and Part2).
- Assign wind Load (As per clause IS 875: 1987 part3).
- Assign seismic Load (As per clause IS 1893: 2002).

2. Calculation of Loads Acting on Tower: Different load acting on the tower such GSM, Antenna, ladder, etc.

3. Calculation of Wind Load: The breeze stack on the pinnacle structure is figured by utilizing IS 875 (section 3): 1987.

4. Studying about **Equivalent static method** as per IS 1893-2002. The diverse parameters in the stacking were characterized and the Earthquake Load is given to the models.

5. Analysis of the different model with different bracing configuration such X bracing, K bracings, V bracing Etc.

6. Tower model are designed as per IS 800:2007 using ETABS. The members were checked for passing. If failed, sections property were changed and analyzed and redesigned.

7. Comparison of the analysis result such as top deflection, Stress for various configuration of the bracing.

Based on the comparison good bracing system has to be finalized.

IV. SPECIFICATION OF TOWER MODEL

The features are as given below:

1. Details of tower

Utility of Tower: Mobile tower.
Type of constructions: Steel framed structures.
Tower height: 30.3 m.
Slant portion height: 14.5m.
Straight portion height at top of tower: 15.8m.
Base width: 8m.
Top width: 2m.

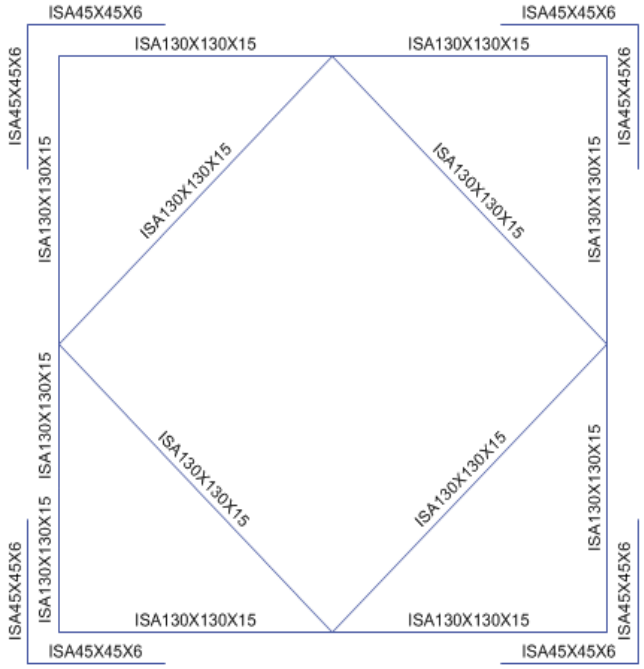
2.Materials

Grade of Structural Steel: Fe 250.

3.Member details of tower

Designed Member Section For Tower With K Bracings.

Tower with X Bracings	0 - 11.75m	11.75 - 19.4m	19.4 - 30.3m
	ISA sections used		
Main Leg	130x130x15	110x110x12	100x100x12
Horizontal member	130x130x15	110x110x12	100x100x12
Bracings	130x130x15	80x80x8	70x70x10



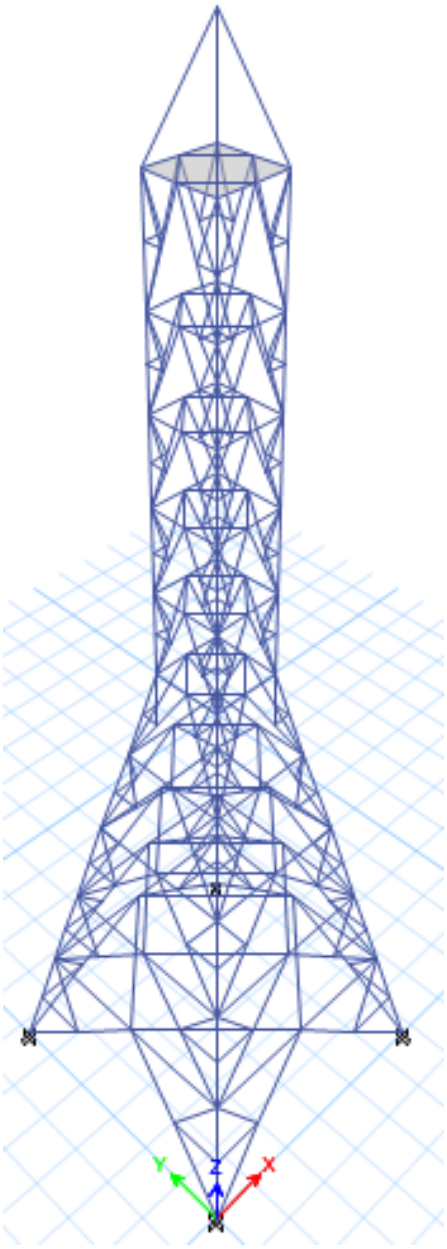


Figure.1. Isometric view and plan of Tower with K bracings.

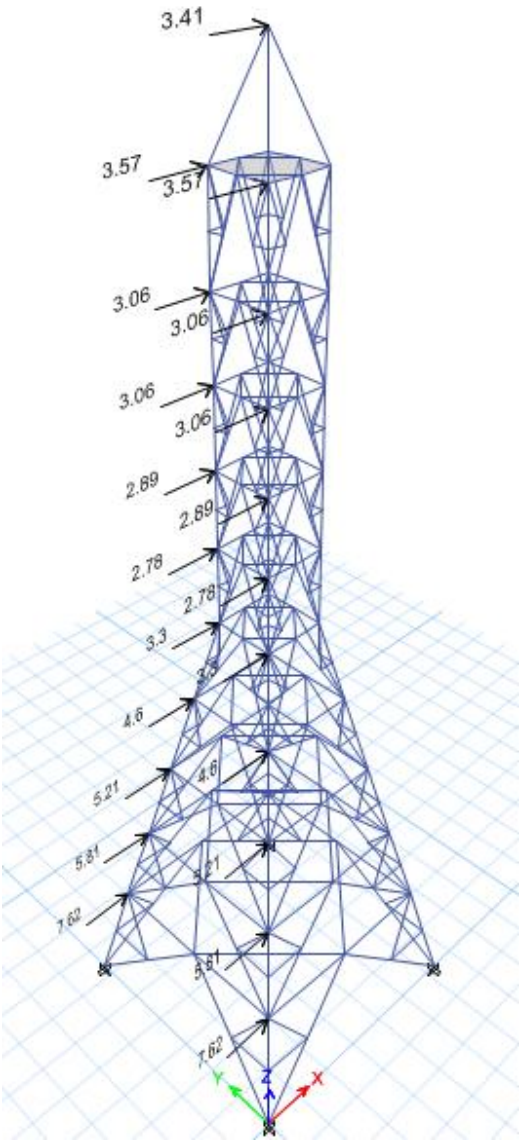


Figure.2. Wind Loads Applied On Tower With K Bracing

25 load combinations are defined as follows.

1. 1.5D.L+1.5L.L
2. 1.2D.L+1.2L.L+1.2EQx
3. 1.2D.L+1.2L.L-1.2EQx
4. 1.2D.L+1.2L.L+1.2EQy
5. 1.2D.L+1.2L.L-1.2EQy
6. 1.2D.L+1.2L.L+1.2W.Lx
7. 1.2D.L+1.2L.L-1.2W.Lx
8. 1.2D.L+1.2L.L+1.2W.Ly
9. 1.2D.L+1.2L.L-1.2W.Ly
10. 1.5D.L+1.5EQx
11. 1.5D.L-1.5EQx
12. 1.5D.L+1.5EQy
13. 1.5D.L-1.5EQy
14. 1.5D.L+1.5W.Lx
15. 1.5D.L-1.5W.Lx
16. 1.5D.L+1.5W.Ly
17. 1.5D.L-1.5W.Ly
18. 0.9D.L+1.5EQx
19. 0.9D.L-1.5EQx
20. 0.9D.L+1.5EQy
21. 0.9D.L-1.5EQy
22. 0.9D.L+1.5W.Lx
23. 0.9D.L-1.5W.Lx
24. 0.9D.L+1.5W.Ly
25. 0.9D.L-1.5W.Ly

V. MOBILE TOWER WITH K BRACING

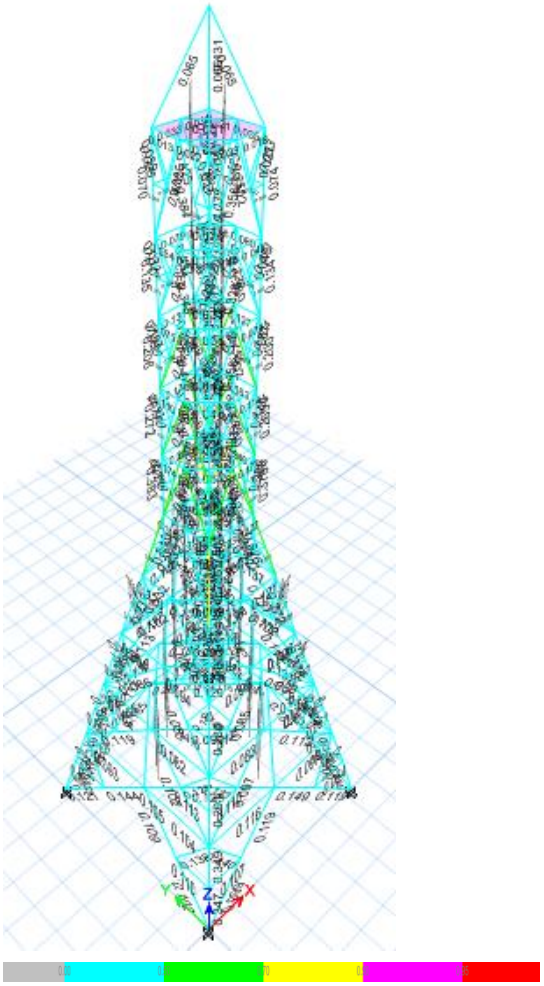


Figure.3. Utility ratio in members

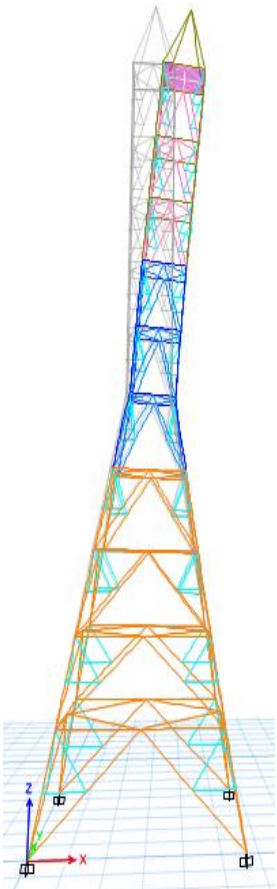


Figure.4. Displacement due to wind X

VI. RESULTS AND DISCUSSION

Displacement:
Displacement in the towers when subjected to wind loads is tabulated and graphically represented below.

Table.1. Displacement in the X direction for wind load

STOREY	**K bracing**(mm)
BASE	0
STOREY 1	0.1
STOREY 2	0.5
STOREY 3	1
STOREY 4	1.8
STOREY 5	2.9
STOREY 6	5.7
STOREY 7	8.9
STOREY 8	12.4
STOREY 9	16
STOREY 10	20.6
STOREY 11	24.9

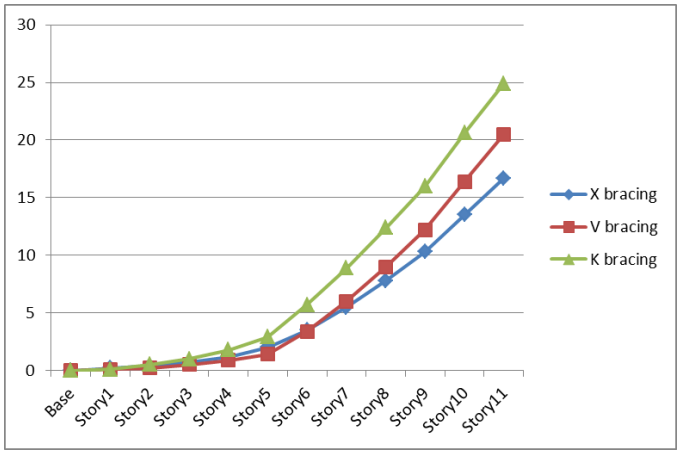


Figure.5. Displacement in the X direction for wind load

VII. CONCLUSION

1. The weight of tower with X bracing is found to be more than tower with V bracing and K bracing. The weight of tower with K bracing is found be least. However, the weight of tower with X bracing and V bracing are almost comparable.
2. The models when subjected to wind loads, displacement in tower with X bracing is found to be least and that in tower with K bracing is found to be more. This is because, stiffness is found to be higher in tower with X bracing due to more structure weight as compared to other models.
3. The tower's displacement with K bracing is least when subjected to earthquake loads, since the seismic weight of the structure is less and attracts less force.
4. Comparison of member forces in the three tower models show that the member forces in K bracing tower is least, and the X bracing model shows more member forces.

Thus, from the results it can be concluded that the Tower configuration with K bracings is better than the tower with X and V bracings, from economy and design point of view.

VIII REFERENCE

[1].Akash D. Pathrikar, Prof. L.G. Kalurkar, "ANALYSIS OF TELECOMMUNICATION TOWER WITH DIFFERENT BRACING SYSTEM", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 14, Issue 2 Ver. VI (Mar. - Apr. 2017), PP 59-64.

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