COMPARITIVE STUDY ON PERFOMANCE OF LATTICE TOWERS WITH DIFFERENT TYPES OF CONFIGURATION OF BLOCKING RESTRAINT BRACING

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Abstract - *An Increased demand for electricity, as well as changes in global weather, have resulted in an increase in the use of lattice towers. Many older lattice towers are built with a tension bracing system and a thin diagonal member. The collapse of a single tower can quickly spread along the lines, causing widespread damage that costs governments and private companies millions of dollars.This research looks at the behaviour of a lattice tower under lateral load, with different base widths, different bracing systems, and different tower heights being used and analyse to look at lateral displacement, shear force, and bending moment, among other things. The collapse of a tower will spread quickly along the leg and braced members of the tower, causing serious damage with high costs.*

***Key Words*: Lattice Tower, Staad ProV8i, Displacement, Dynamic Analysis, Wind Analysis**

1. INTRODUCTION

The growth of telecasting and broadcasting networks has continued to increase their use in every region. Because of the low base of telecasting and television networks in developing countries, the rate of growth is higher.Lattice Towers are commonly used in transmission to hold high-voltage electric power lines, provide cell signals, radio signals, or provide power.A Lattice Tower is a tall steel building, and a Lattice Tower is a free-standing vertical Frame Work.

1.1. TYPES OF LATTICE TOWER

1. Self Supporting Tower
2. Conventional Guyed Tower
3. Monopole Tower

1.1.1. SELF SUPPORTING LATTICE TOWER

Lattice towers, also known as self-supporting towers, have a square plan and are supported by four legs that are attached to the roof. The towers are balanced on the ground and act as vertical cantilever trusses when exposed to wind or seismic forces. T.V., microwave transmission, flood light holding, and power transmission are all common uses for freestanding towers. The application of self-supporting lattice.

Fig:1- Self Supporting Tower

1.1.2. CONVENTIONAL GUYED TOWER

Masts are traditional guyed towers with three or four legs and a triangular or rectangular plan arrangement. Normally, these towers are guyed on three sides. These towers are much lighter than self-supporting lattice towers, but they do need a lot of open space for the guy wires to be anchored. Guyed towers can be used if there is a lot of open space. This tower necessitates more room.

Fig:2- Conventional Guyed Tower

1.1.3. MONOPOLE TOWER

When the number of antennae needed is less than 10m and the height required is less than 10m, it is a single self-supporting pole that is typically mounted over the roof of high-rise buildings.

Fig:3- Monopole Tower

2. OBJECTIVES

(i) To examine various cases of lattice tower bracing, as well as the displacement of the tower due to wind load and storey displacement.

(ii) Aim my work is Comparative study on Lattice Tower for different bracing patterns.

(iii) Using dynamic wind load analysis, determine the shear force, bending moment, lateral displacement, frequency, wind force, and weight of the structure.

3. LITERATURE VIEW

Keshav.Kr.Sharma,S.K.Duggal,DeepakKumar,A.K.Sachan (2015)Is investigated the Comparative Analysis of steel -telecommunication Tower Subjected To Seismic & Wind load.In this research paper The use of bracing systems in -Rcc structures is extremely rare in this research. The research compares and contrasts the Rcc and steel bracing systems. The seismic response of both Rcc and Steel models is discussed in this paper.As a result of this study, we can conclude that displacement increases as wind speed increases. The maximum displacement is achieved by w bracing, while the minimum displacement is achieved by v bracing.

Jemel Bedane Halkiyo,Sultan Bedane Halkiyo,Yemsrach Mulugeta,Dr Rajeshekhar Angadi (2015) is investigated Study of transmission Tower and Proper Selection In Terms of Its Effectiveness , Behavior , Deflection , And Economic Evaluations.The aim of this research paper is to examine various cases of tower behaviour in terms of displacement caused by wind loads. In addition, there is a material coast relation. In staad pro v8i, the models are analysed. Check the displacement of the tower stories from the wind survey, as well as the displacement of the tower at all heights.

Priya Dhillon, Raghvenda singh, PB Murnal (2019) is investigated Structural Analysis of Transmission Tower state of act.In this research paper To verify the displacement of a lattice tower, conduct a comparative study of two towers that are commonly used.A basic model for wind analysis was created using a lattice framework. This illustrates the displacement of the bracing, thighs, and other parts of the body.Transmission towers are commonly used to transmit radio signals and electrical power. The structural integrity of these towers is critical in the event that electricity is interrupted.

Bharat Koner , Priya Surpur , dr.m.t.Venuraju (2018) Design Optimization of Free Standing Communication Tower Using Genetic Algorithm.In this research paper In this article, genetic algorithms are used to analyse the bracing mechanism. Genetic algorithms examine the availability and cost of a high-speed machine The aim of the study or the purpose of the paper is to understand the weight of the Tower.It was discovered in this paper that the evolved GA produces more optimal results than the other methods. The GA approach is used to determine a problem's benchmark.

N. Mahesh,V. Ranga Rao (2017) is investigated Design and Estimation Of Electric Steel Tower.The key study and design of an electrical steel tower are presented in this paper. The cost of building an electric tower was 40 percent to 45 percent of the overall cost of the lines. The use of staad pro software to analyse and design steel lattice towers for any magnitude is discussed in this paper. For the design of Structure buildings that recognise strength requirements, the working stress method was used.This paper provides information on the amounts of earthwork, excavation, concrete, reinforcement, and other materials required, as well as the possibility of constructing a foundation on a rock base surface. Wind load, dead load, and other forces acting on the tower can be resisted by a steel lattice tower with a narrow foundation.

4. METHODOLOGY

In present work,The dynamic wind load is applied to a tower using the gust factor method in the current work in an attempt to carry out a comparative analysis for lattice towers under the influence of lateral loading. The steel contact tower would reach a height of 80 m. The tower's base widths are 5m, 10m, and 15m. X bracing, k bracing, y bracing, and XB bracing are the four types of bracing use for tower analysis.

To use the staad Pro v8i programme, first set the base width and height, then add the steel material properties, and finally apply the load condition to the tower. After that, check for bracing failure, if there is any, adjust the bracing material, if more changes are needed, apply them.

4.1. PRELIMINERY DATA

Model X-bracing, K-bracing, Y-bracing, and XB-bracing are used in an 80m high lattice tower. Preparing worksheet for calculate dynamic wind load and stress.

4.1.1. TOWERS INFORMATION & WIND DATA

Geometry	Square
Height of Tower	80m
Base Width	5m,10m,15m
Location	Mysore
Basic Wind Speed	33 m/s
Topography	Flat
Terrain Category	1.0
Risk Coefficient K1	1.05
Important Factor K4	1.3
Wind Factor Kc	0.9
Damping Coefficient β	0.9

Table -1: Preliminary Data Of Tower

4.1.2. MATERIAL PROPERTIES

Structural Steel Grade	Fe : 250

Table -2: Material Properties Of Tower

4.1.3. ISA SECTION DETAILS OF TOWER

Main Leg	200x200x18,150x150x18
Horizontal Member	80x80x10,60x60x10
	70x70x6
Primary Bracing	110x110x15,100x100x12
	80x80x10,60x60x10
Secondary Bracing	80x80x10,70x70x60x6
	60x60x10
Horizontal Bracing	70x70x6,60x60x10
	60x60x10

Table -3 :ISA Section Details Of Tower

4.2. LOAD CASE CONSIDER FOR STUDY

4.2.1. DEAD LOAD

The self-weight of structural elements such as bracing, etc. which varies depending on the form of structural steel used in the tower, is one of the dead loads acting on the structure.

4.2.2. LIVE LOAD

For towers used for maintenance, live or forced loads involve the platform loads of the tower, which are usually spaced at 10m intervals.

4.2.3. WIND LOAD

IS: 875 (Part 3) 1987 [24] divides the country into zones and prescribes basic wind speed in each zone.into six distinct wind zones IS: 875(Part 3)-1987 [24] specifies the design wind strength. 5.4 Clause.

4.3. LOAD COMBINATION AS PER IS CODE

1. 1.5 (Dead Load + Live Load)
2. 1.5 (Dead Load + Wind Load in + X)
3. 1.5 (Dead Load + Wind Load in - X)
4. 1.5 (Dead Load + Wind Load in + Z)
5. 1.5 (Dead Load + Wind Load in - Z)

4.4. ELEVATION OF TOWERS AND 4 BRACING SYSTEMS

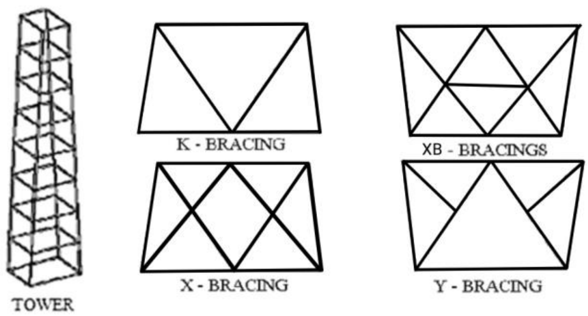

Fig:4- Tower Elevation And Bracing System

4.5. DYNAMIC WIND LOAD

Panel from Top	Level	Design Wind Pressure (N/M^2)	Dynamic Wind Load (KN)
1	80.021	945.5624	17.248
2	75.025	921.2562	16.427
3	70.015	820.5246	19.248
4	64.890	806.2548	21.992
5	60.315	792.3598	25.485
6	53.245	778.2356	31.245
7	48.564	760.9024	39.987
8	44.254	744.2645	30.803
9	37.265	724.2359	34.157
10	32.562	701.2548	35.895
11	26.048	675.2487	36.451
12	21.263	642.2580	37.254
13	15.752	603.2581	34.754
14	10.265	551.1784	40.356
15	5.356	466.3024	35.280

Table -4: Load Of Tower

5. RESULT AND DISCUSSION

For a tower of height 80m with different bracing systems, joint displacement at the top of the tower and stress in the bottom leg of the tower were measured.

Tower Height(M)	Displacement (MM)			
	X-Bracing	K-Bracing	Y-Bracing	XB-Bracing
5	1.428	3.988	3.546	1.052
10	3.562	8.624	8.995	2.456
15	5.648	12.956	12.986	4.125
20	7.648	17.056	18.235	5.248
25	9.245	20.457	21.564	7.547
30	10.256	25.235	26.235	9.365
35	29.024	29.356	30.245	25.236
40	35.689	36.256	38.265	33.245
45	37.235	38.265	40.245	36.245
50	43.245	45.238	48.265	43.568
55	55.254	58.236	60.487	54.289
60	65.262	66.235	70.489	63.254
65	70.002	73.978	75.258	68.265
70	80.235	81.234	80.245	109.235
75	105.235	106.356	120.356	130.256
80	110.235	113.256	126.652	149.256

Table -5: Displacement Due To Wind Load

6. RESULT COMPARISON

6.1. DISPLACEMENT

6.1.1 DISPLACEMENT OF X-BRACING TOWER

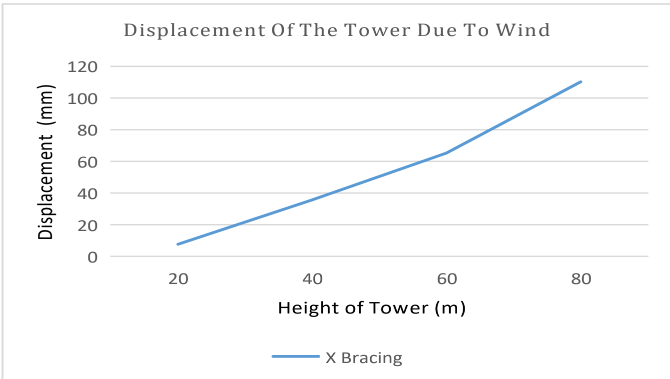

Chart -1: Overall Displacement of X-Bracing Tower

6.1.2. DISPLACEMENT OF K-BRACING TOWER

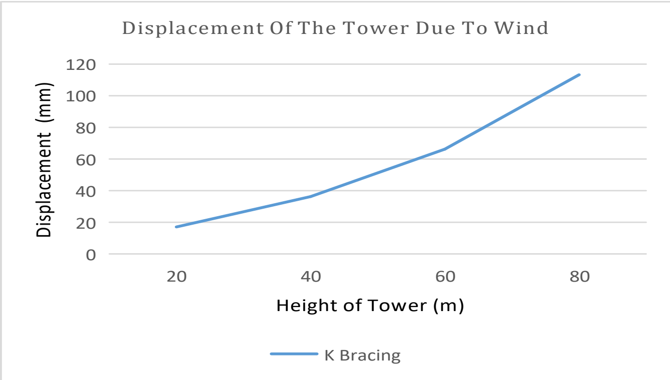

Chart -2: Overall Displacement of K-Bracing Tower

6.1.3. DISPLACEMENT OF Y-BRACING TOWER

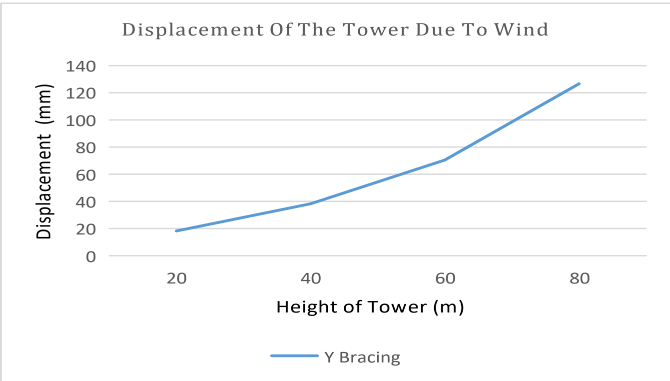

Chart -3: Overall Displacement of Y-Bracing Tower

6.1.4. DISPLACEMENT OF XB-BRACING TOWER

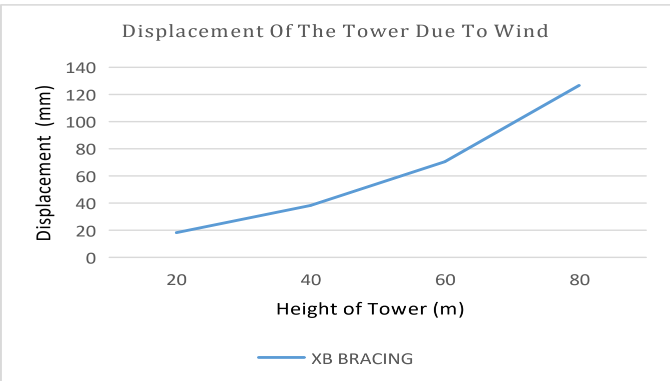

Chart -4: Overall Displacement of XB-Bracing Tower

6.2. WEIGHT OF TOWER

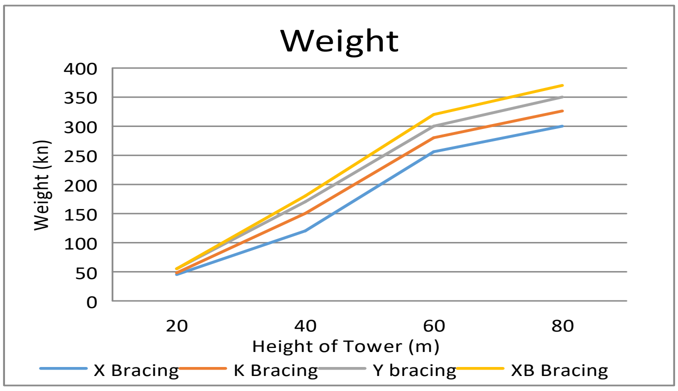

Chart -5: Comparison Of Different Tower Overall Weight

6.3. STRESS

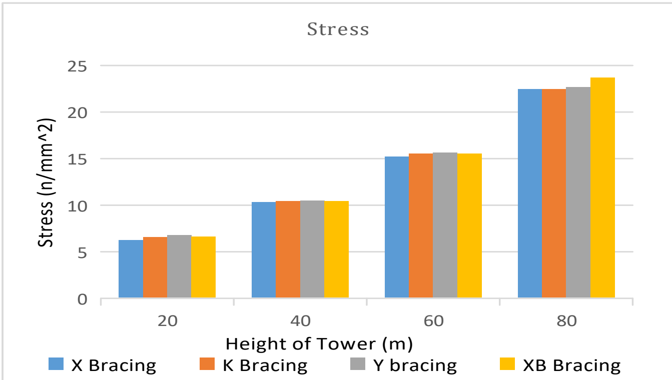

Chart -6: Comparison Of Stress In Different Height Of Tower Overall Weight

7. CONCLUSIONS

The results of a dynamic loading study of a lattice tower were extracted and compared in the form of parameters such as natural frequency, gust factor, displacement, wind force, tension, and tower weight.

- The structural strength and cost of estimation are determined by the displacement of various lattice towers.
- Different bracing towers have been analyzed for different loads, and the critical loading are taken in consideration.
- According to the findings, the different bracing systems have a significant impact on the behaviour of the lattice tower.
- The tower has the appearance of a cantilever structure that is set at base level.
- From the results, x bracing tower displacement is lower than the other three bracing system towers.
- According to the findings, the k bracing tower is lighter than the other bracing system towers.

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