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# The Response of High Power Transmission Tower under Lateral Loads

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**ABSTRACT**: Transmission towers play a vital role within the operation of a reliable power system that's thought of as a lifeline system. It constitutes about 28 to 42 percent of the cost of the transmission power line project. In this study an attempt is made to model, analyse and design a 136KV transmission line tower using manual calculations. The tower is designed in wind zone – II with base width 1/5thof total height of the tower. The model is created with the manual design of the tower. The height of the tower is design on basis of the code IS: 800, IS: 801. This objective is made by choosing a 136KV single circuit transmission line carried by square base self-supporting tower. Using STAAD PRO v8i and ETABS analysis and design of tower has been carried out as a three dimensional structure. This study characterizes the loads of the High power transmission tower and to check the behaviour of the specimen under dynamic loading. Structure is made determinate by excluding the horizontal members and axial forces are calculated using method of joints and design is carried out as per IS 800:20

**KEYWORDS**: Transmission towers, Wind Load, Finite element analysis.

### I. INTRODUCTION

Transmission tower is that the name for the structure employed in the business within the uk, us and alternative English speaking countries. A Transmission tower may be a tall structure, sometimes a steel lattice tower, accustomed support associate overhead power cable they're employed in high voltage AC and DC systems and come in a good form of shapes and sizes. Typical height ranges from 15 to 55 m (49 to 180 ft.), though the tallest are the 370 m (1,214 ft) towers of a 2700-meter-long span of Zhoushan Island Overhead Power line Tie.

**A.N Swaminathen, P.Sankari (2017)** Experimental Analysis of Earthquake Shake table made of wooden material is being used for seismic analysis. The observations are contained as resulted. The concept of shake table provides the stability on application of it in structure against earthy movements. This table may be a tool in creator that monitors the motion of the world and its impact. This paper opens up the need of consideration of seismic activities and its solution to its best. The stability of the structure once it's subjected to unstable forces was analyzed with tiny model shake table.

**Gopi Sudam Punse** (2014) Analysis and Design of Transmission line Towers constitute about 28 to 42 percent of the total cost of the Transmission Lines. The increasing demand for electrical energy can be met more economical by developing different light weight configurations of transmission line towers. The objective of this analysis is met by selecting a 220KV and 110KV Multi Voltage Multi Circuit with slender based mostly Self Supporting Lattice Towers with a read to optimize the existing geometry. Using STAAD professional v8i analysis and style of tower has been distributed as a 3 dimensional structure. Then, the tower members are designed.



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#### **II. SOFTWARE ANALYSIS USING STADDPRO**

Software have become a very integral part of structural engineering. They help us to design safe & well engineered structures as the software does most of the tedious work & the engineer has more time to look into the conceptual part. STAAD pro can be used to design/analyse RCC and steel structures according to the relevant country code. It helps in analysis and designing structures like towers, buildings, bridges, transportation facilities, utility and industrial structures. Designs will embody building structures incorporating culverts, organic compound plants, bridges, tunnels, piles; and construction materials like timber, steel, concrete, metal and cold-formed steel.



Fig-.1. Tower model



Fig-2. Bending moment and Deflection

These figures show that the Beam stress, Bending Moment and the Deflection acts all over the structure. The beams at the lower portion of the tower are weak when compared to other beams over the structure.



Fig-3. Instability

Fig-4. Reactions

This figure shows that the circled joints are seems to be weak and those beams are also weak. Those points are instable. This figure 4 shows that the circled joints are seems to be weak and those beams are also weak. Those points are instable. This figure shows that the reactions at all the four supports. The table in the figure shows the reactions of all the supports with both the load cases. The modelling of the tower is done by the STADD pro



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design software in which we can design and analyse the model. The model is created with the manual design of the tower. The height of the tower is design on basis of the code IS: 800, IS: 801. The wind pressure and wind load is calculated manually by the codes. Then the model is analysed with the dead load and the wind load. The dead load is the self-weight of the tower and wind load is calculated by the design of the tower.

Table-2.1. Number	of beams	and nodes
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No. of Beams	288
No. of Nodes	111

SI.No	Bean	Nod	L/C	Axial	Shear		Torsio Ben		nding
				Fx Fx Fx		Mx	My	Mz	
				(kN)	(kN)	(kN)	(kNm)	(kNm)	(kNm
Max Fx	68	44	1:LOAD CAS	5.557	-0.01	-0.000	-0.000	-0.000	-0.000
Min Fx	258	46	1:LOAD CAS	-0.331	-0.02	-0.000	-0.000	-0.000	-0.000
Max Fy	138	78	1:LOAD CAS	-0.177	-0.17	0.000	0.000	0.000	0.000
Min Fy	138	81	1:LOAD CAS	0.167	-0.17	-0.000	-0.000	-0.000	-0.000
Max Fz	5	46	1:LOAD CAS	0.183	0.017	0.000	0.000	0.000	0.000
Min Fz	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000
Max M	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000
Min My	5	46	1:LOAD CAS	0.183	0.017	0.000	0.000	0.000	0.000
Max M	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000
Min My	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000
Max M	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000
Min Mz	5	46	1:LOAD CASI	0.183	0.017	0.000	0.000	0.000	0.000

Table-2.2. Summary and beam end force



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Graph 1-Beam End Force

#### **III. SOFTWARE ANALYSIS USING ETABS**

ETABS is an engineering product that caters to multi-story building analysis and style. Modelling tools and templates, code-based load prescriptions, analysis ways and resolution techniques.For a classy assessment of seismic performance, modal and direct-integration time-history analyses may couple with P-Delta and Large Displacement effects. ETABS might be a programme for linear, nonlinear, static and dynamic analysis, and also the style of building systems. From AN analytical posture, multi-storey buildings constitute a very special class of structures and therefore deserve special treatment.



Fig-5.. Modelling

Modelling of tower is done but Etabs software based on the code 800,801. The materials defined here are manually designed.



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Fig-7.Load Transfer in Beams

The wind load is various from different height of the tower so the load is transferred through the nodes, which is calculated from the codes 801 part 2

Case	Mode	Rx	Ry	Rz	Sum Rx	Sum Ry	Sum Rz
Model	1	0.9609	0	0.0246	0.9609	0	0.0246
Model	2	0	0.9875	0	0.9609	0.9875	0.0246
Model	3	0.0006	0	0.4875	0.9615	0.9875	0.5121
Model	4	0	0.0125	0	0.9615	1	0.5121
Model	5	0.0385	0	0.4879	1	1	1
Model	6	0	0	0	1	1	1
Model	7	0	0	0	1	1	1
Model	8	0	0	0	1	1	1
Model	9	0	0	0	1	1	1
Model	10	0	0	0	1	1	1

Table:3.1	Mass	ratio	values
1 4010.3.1	1via SS	rano	varues



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### **IV.EXPERIMENTAL INVESTIGATION**

### 4.1. SHAKING TABLE

Shaking table could be a machine which will perform realistic simulation of earthquakes or the other dynamic loading obligatory to the check model or structures. There area unit many sorts of shaking table however it are often classified to its technique of vibration deed by electrically driven, hydraulically driven and manually driven shaking table. It is related to earthquake since much of its parameter is custom designed to the earthquake's parameter such as acceleration, displacement, frequency and stroke. Shaking table is used to test any structure under seismic or other types of dynamic loading such as step load, sinusoidal varying force or random load. Therefore, shaking table check is AN experimental approach so as to assure the validity of theoretical estimation of the response of the structure with the precise dynamic characteristics so to develop the safety margin of design for the structure.

### 4.2.OPERATION OF SHAKING TABLE

The test specimen is placed on the table and it is fixed by mechanical fastener or artificial soil compacted on the table. Then the structure will experience the shaking process at a certain frequency values until a certain time limit set by the operator.

### **4.3.FABRICATION WORKS**



Fig-9. Shaking table Setup



Fig-10. Experimental Setup

#### 4.4. BEHAVIOR OF TOWER

The casted specimen is placed over the shaking table; the base plate in the tower is attached in the shake table by using the winding wires. The wind response of the tower is checked by the acceleration calculator (Mobile App)

#### 4.5. ACCELEROMETER

An measuring device could be a device that measures correct acceleration. Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers area unit parts of direction systems for craft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery



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#### **V. CONCLUSION**

- The power transmission tower is analysed and designed using STAAD pro. There is no failure in the model some nodes are instable near the ground level, but this is not an issue in the structure.
- The power transmission tower is analysed and designed using ETABS. There is no failure in the structures, some nodes and beams are instable, but this is not an issue in the structure.
- The power transmission tower in analysed and design in both STAAD pro and ETABS which results the same as no failure in the structure and it is safe.
- The acceleration of the tower while applying the lateral load, initially the movement is less and it gradually increased for a segment and again it decreased for a constant level of acceleration.

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<sup>6.</sup> IS 800 general construction in steel.

<sup>7.</sup> IS 801 code of practice for use of cold formed light gauge steel structural members in general building construction.