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Structural Weight Optimization of Transmission Line Tower

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ABSTRACT: Transmission Line Towers represent approximately 28 to 42 percent of the cost of the transmission line. The growing demand for electrical energy can be met more economically through developing exceptional mild weight configurations of transmission line towers. In this paper an attempt has been made to make the transmission line more cost effective with three different types of configurations and analysed and designed as a three dimensional structure in stadd pro software. In addition to the configuration system the tower is analysed for various trial angle section and the section which gives optimum result is selected.

KEYWORDS: Base width, configuration, weight optimization, section sizes.

I. INTRODUCTION

India is a hugely populated country and the electric power supply need of the population creates requirement of a huge transmission and distribution system. Also, the disposition of the primary resources for electrical generation viz., coal, hydro capacity, is quite uneven, thus, again adding to the transmission requirements. Transmission line is an integrated system which includes conductor subsystem, ground wire subsystem and one subsystem for every category of support structure.

Mechanical support of transmission line constitutes an enormous portion of the price of the line and that they play an important role in the reliable power transmission. They are designed and constructed in wide variety of shapes, types, sizes, configurations and materials. The supporting structure types used in transmission lines generally fall into one of the three categories: lattice, pole and guyed. The supports of EHV transmission lines are normally steel lattice towers. The cost of towers constitutes about 28 to 42 percent of the cost of transmission line and hence optimum tower design will bring in substantial savings.

The efficient design of the transmission line towers is based on both electrical and structural considerations. The general shape and height of the tower is based on the electrical aspects and so the optimization can be performed to reduce the weight and to arrive at the best geometry shaping. Optimization is the process of finding the best solutions from which a designed can derive maximum benefit from available resources. It also enables the construction of efficient structures and also maintains safety and reliability.

Fig. Guyed tower

Fig. Self supporting tower

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II. METHODOLOGY

Total six number of towers are modelled for different configuration and different height and configuration with optimum weight is selected.

III. MODELLING AND ANALYSIS

Modelling and analysis is done in stadd pro software. Dead load, wind load and load combinations are applied. The following procedure to any analysis the tower using STAAD Pro software are:

- Basic structure of the tower is prepared using simple beam method.
- Nodes and beams are created.
- Section property is applied to various members of the tower.
- Various joint loads that we have calculated in manual method are applied on nodes of corresponding points.
- After applyingloads analysis is done and result is obtained.

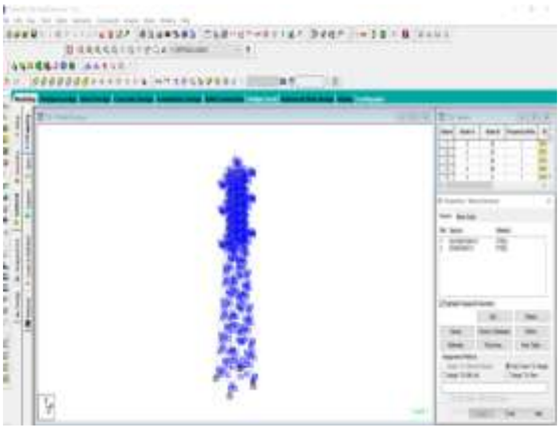

Fig. Assign properties

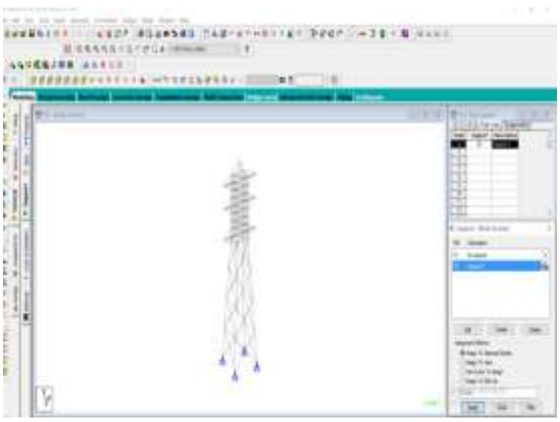

Fig. Assign support

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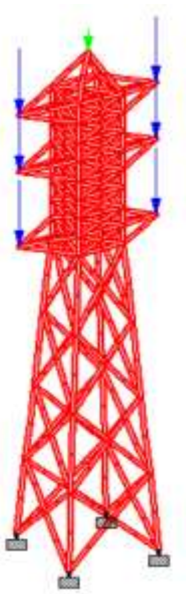

Fig. Assign dead load

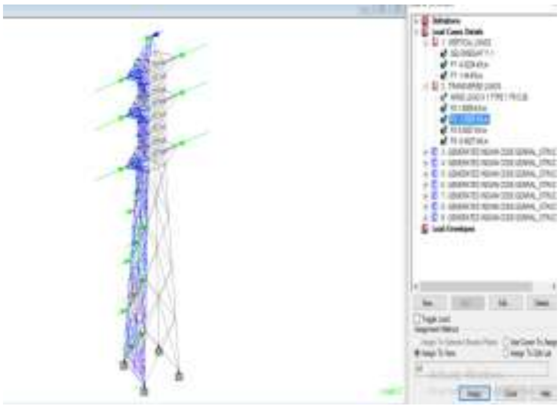

Fig. Assign wind load

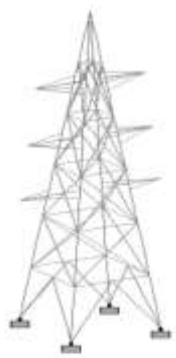

Fig. Configuration I
(Height= 26m)

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Fig. Configuration II
(Height =26m)

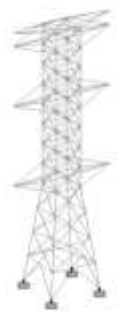

Fig. Configuration III
(Height =26m)

Fig. Configuration IV
(Height = 30m)

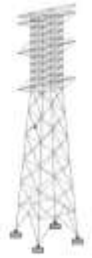

Fig. Configuration V
(Height =30m)

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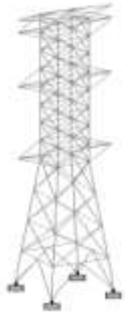

Fig. Configuration VI
(Height =30m)

IV. RESULTS AND DISCUSSION

Height of tower	Configuration	Weight (kN)
26	I	41.941
	II	64.727
	III	63.145

Height of tower	Configuration	Weight (kN)
30	IV	41.941
	V	64.727
	VI	63.145

V. CONCLUSIONS

Optimization of Transmission Line Tower is aimed at achieving low cost, high performance, better and more reliable design strength. It is observed from the analytical work that the weight of tower with Optimized base width, Pattern Geometry, Base Configuration and section size optimization shows an economical construction.

This work attempts to optimize the transmission line tower structure for a 132 KV double circuit quad conductor, regarding base configuration, section size and pattern geometry as variable parameters. Due tomultiple loading conditions, each member subjected to maximum stress under any of the loading conditions is assigned an angle size considering the strength factor of 1.08 to 1.1. This work has focused on economic analysis and design of transmission line tower structure.

1. Effect of wind is predominant at greater height. Hence, when height of tower increases deflection of tower is observed at cross arms due to swinging effect of conductor wires.
2. Width of the tower is generally kept as one sixth of the height of tower.
3. It is also found that for height of tower 26 m and 30m configuration I gives optimum weight.
4. In the region where wind effects are severe and also when towers are constructed in the proximity of traffic, diaphragm can be provided either partial or throughout the height of tower to cope up with lateral earh pressure.

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