Design and Analysis of Transmission Tower using Staad-Pro

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Abstract- *Transmission line towers carry heavy electrical transmission conductors at a sufficient and safe height from ground. additionally to their self-weight they need to face up to all forces of nature like strong wind, earthquake and snow load. Therefore cable towers should be designed considering both structural and electrical requirements for a safe and economical design. This study focuses Estimation of a feasible transmission line tower for various wind speed by designing transmission line tower with hot rolled sections and compare three sorts of bracings. For this purpose, 220 kV double circuit self- supporting transmission towers having square base is used. Analysis of this transmission tower is administered using STAAD PRO subjected to wind load for Zone-II,III,IV. Load calculation for the analysis is administered consistent with IS 802:1995. Finally, the optimal design of transmission tower using hot-rolled steel is compared for wind speed.*

Keywords- Transmission Line Tower, STAAD PRO

I. INTRODUCTION

In every country, the need of electric power consumption has continued to increase, the rate of demand being greater in the developing countries. Transmission tower lines are one of most important structures.

Transmission line towers contribute nearly 40 percent of the cost to the transmission line project. The selection of an optimum outline together with right type of bracing system contributes to a large extent in developing an economical design of transmission line tower.

There are some factors which decide the design of towers and foundations are The cross-section of conductors, the spacing between conductors, and the location of ground wires with respect to the conductors. The conductors, ground wires, insulation, towers and foundations are the major components of a transmission line. Mostly transmission lines are designed for wind and ice in the transverse direction. However, In India there is severe earthquakes therefor seismic loads may be important because the transmission line towers and the cables may be subjected to higher force and stressed during ground motion.

II. OBJECTIVES OF THE PROJECT

Following are the objectives of the proposed dissertation work:

- To analyse and design of self-supporting transmission line tower with different types of bracings using hot-rolled steel sections.
- To study the analysis and design of transmission tower using STADD Pro software.
- To compare different towers for its structural stability with different wind speed.

III. SCOPE OF THE STUDY

Estimation of a feasible transmission line tower for different wind speed by designing transmission line tower with hot rolled sections and compare three types of bracings.

IV. LITERATURE REVIEW

Gopi Sudam Punse (Analysis and Design of Transmission Tower) In this thesis Analysis and design of narrow based Transmission Tower (using Multi Voltage Multi Circuit) is administered keeping in sight to provide optimum utilization of electrical supply with available ROW and growing population within the locality, in India. Transmission Line Towers constitute about 28 to 42 per cent of the entire cost of the cables. The growing demand for electricity is often met more economical by developing different light weight configurations of transmission towers. In this project, a struggle has been made to form the cable more cost effective keeping in sight to supply optimum electric supply for the specified area by considering unique transmission tower structure. The target of this research is met by choosing a 220KV and 110KV Multi Voltage Multi Circuit with narrow based Self Supporting Lattice Towers witha view to improve

the prevailing geometry. Using STAAD PRO v8i analysis and style of tower.

Tanvi G. Londhe, Prof. M.S.Kakamare(Comparative Study of Dynamic Analysis of Transmission Towers) This paper describes the estimation of possible solution to optimize transmission line tower for weight parameter. the value of transmission line towers is about 35% to 40% of the entire cost of the transmission tower. But lesser study is administered within the field of minimizing weight of transmission line tower, also less literature is out there on transmission tower with cold form sections. Analysis of cable tower administered as per standard codes, also comparative study is carried on the idea of various sorts of bracing systems (warren, horizontal, diagonal and diamond) and materials like hot rolled and cold form sections. By designing cable tower with hot rolled sections using STAAD pro, hot rolled sections gives light weight design.

(Qianjin Shua et al. 2018) Two 1:2 scaled substructure models for typical 110KV transmission tower were designed and fabricated. The models were tested for movements of the horizontal ground surface under different wind load conditions. The wind load speed is used in the study as 15m/s and 30m/s respectively. The finite element model was developed by using ANSYS and validated by test data. Results of the present study indicated that wind load has a significant unfavorable influence on the resistance of transmission tower subjected to ground motion.

V. Lakshmi1, A. Rajagopala Rao "EFFECT OF MEDIUM WIND INTENSITY ON 21M 132kV TRANSMISSION TOWER" In this paper the performance of medium wind intensity is observed. The Recommendations of IS 875-1987, Effect of height above ground terrain and Basic wind speeds, , Design wind pressure, Design wind force, Design wind speed, is clarified in detailed. A study is administered for the tower and therefore the reform the performance of the tower and the member forces altogether the vertical, horizontal and diagonal members are evaluated. The critical elements among each of three groups are identified. In following chapters the performance of tower under abnormal conditions like localized failures are evaluated. The small print of load calculation, modeling and analysis are discussed. The wind intensity converted into point loads and loads are applied at panel joints.

V. TRANSMISSION LINE TOWER PARAMETERS

single web diagonal pattern bracing	Leg members	ISA 200×200×16 LD
	Horizontal members	ISA 180×180×20
	Bracings	ISA 150×150×10
single web horizontal bracing	Leg members	ISA 200×200×16 LD
	Horizontal members	ISA 180×180×20
	Bracings	ISA 150×150×10
Warren type bracing	Leg members	ISA 200×200×16 LD
	Horizontal members	ISA 180×180×20
	Bracings	ISA 150×150×10

Table 1: steel sectional properties

The maximum voltage in the tower	220 KV
Type of transmission tower	Self-supporting, Type 'A'
Deviation Angle of line	$0\text{-}2^0$
Terrain type	plain
Return period	150 years
Terrain category	two
Wind zone	II,III,IV
Wind speed	39,44,47 m/s
The geometry of the tower	Square base

Table 2: Parameters of Transmission Line Tower

A. Loads on staad pro models of transmission tower

Self-Weight of Tower
Dead Load on Conductor
Dead Load on Ground Wire
Wind Load on Ground Wire
Broken Wire Condition on Conductor
Wind Load as Per IS 875 Part 3
Maximum Temperature Effect on Tower

B. Geometry of Tower

Description	Length
Ground clearance	7.1m
lower conductor wire sag	8.19m
Distance between the two conductors	4.979m
Distance between the top conductor and earth wire	8.339m
The entire height of the tower	33.86m
Square base width	6m
Cross arm from edge of the lower leg	4.29m
Span length between two towers	320m

VI. RESULTS AND DISCUSSION

Analysis of tower is administered by considering all kinds of loading, differing types of bracings systems. All loads are calculated manually as per IS 802 (part 1 and 2): 1995, IS 5613 (part 2): 1985, IS 875- 2015. The tower is analyzed and designed using STAAD Pro.

NO'S	TYPE OF STRUCTURE	FAILED MEMBERS	FEAILD SECTIONS
01)	Single web horizontal bracing	00	-
02)	Single web diagonal pattern bracing	00	-
03)	Warren type bracing	20-leg members 6-bracings	180x180x20 200x200x16 150x150x10

Table 3: For wind speed 39 m/s

NO'S	TYPE OF STRUCTURE	FAILED MEMBERS	FEAILD SECTIONS
01)	Single web horizontal bracing	00	-
02)	Single web diagonal pattern bracing	00	-
03)	Warren type bracing	13-leg members 6-bracings	180x180x20 200x200x16 150x150x10

Table 4: For wind speed 44 m/s

NO'S	TYPE OF STRUCTURE	FAILED MEMBERS	FEAILD SECTIONS
01)	Single web horizontal bracing	00	-
02)	Single web diagonal pattern bracing	01	200x200x16
03)	Warren type bracing	20-leg members 6-bracings	180x180x20 200x200x16 150x150x10

Table 5: For wind speed 47 m/s

REFERENCES

[1] Mahami,M.(2015)."NonlinearAnalysisofSteelTransmissionTowers "Research Gate.

[2] Mortazavi, M., Sharafi, P., Ronagh, H., Samali, B., and Kildashti, K. (2017). "Lateral behaviour of hybrid cold-formed and hot-rolled steel wall systems: Experimental Research.

[3] Punse, G. S. (2014). "Analysis and Design of Transmission Tower " International Journal of Modern Engineering Research (IJMER)

[4] Qianjin Shua, Zhaohui Huangb, Guanglin Yuana, Weiqing Mac, and Zhoud, S. Y. a. J. (2018). "Impact of wind loads on the resistance capacity of the transmission tower subjected to ground surface deformations." Thin-Walled Structures.

[5] Raghavendra, M. T. (2012). "Computer Aided Analysis and Structural Optimization of Transmission Line Tower " International Journal of Advanced Engineering Technology, E-ISSN 0976-3945

[6] Sai Avinash P, Rajasekhar P, Siddhardha R, Harinarayanan R, and Chamandeep (2016). "Analysis and Design of Transmission Tower Using STAAD.PRO." International Journal oI'kzrth Sciences and Engineering, Volume 09, No. 03(ISSN 0974-5904).

[7] Shehata, Damatty, A. Y. E., and Savory, A. A. (2005). "Finite element modeling of transmission line under downburst wind loading." Finite Elements in Analysis and Design, 42(1), 71-89.

[8] Swapna Channagoudar, and Prabhakara, D. H. R. (2014). "seismic response of transmission