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Comparative Analysis of Transmission Line Tower with Different using Conventional Angle Section and Closed Hollow Section

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Abstract—*Transmission line towers are one of the most vital life-line structures so it is important to develop more and more economical and light-weight geometry and configuration to meet the increasing demand for electrical energy. In this present study, self-supporting transmission line tower carrying 400kV single circuit with different configuration i.e. four legged tower and three legged tower has been made. The type of transmission tower considered is suspension tower having 2˚ deviation situated on unadorned area with minimum or relatively no obstructions. Using STAAD.PRO v8i, analysis of these four legged and three legged towers have been carried out as a three-dimensional structure under wind, snow and earthquake loading. The structural behavior of all the towers in terms of top deflection has been looked upon. Then, designed has been done for all the tower members using angle section and optimizing all the member section for all wind, snow and earthquake load combination. And, the comparison between self-supporting four legged and three legged tower is done in terms of top deflection and overall cost.*

1. INTRODUCTION

Self-supporting transmission structures are widely used for various civil engineering applications, most common is to support transmission phase line that transmit and distribute electricity to the sub-station. The usual practice for analyzing the transmission line tower is to assume linear-elastic behavior and to treat the angle members as pin-ended truss elements. The second thing is to meet the necessary ground clearance according to the electricity rule, where the cable has the maximum sag. Transmission of tower consists of several types i.e. four legged and three legged and designed in accordance with the tower height and capacity of lower support load from the conductor, compressive load, wind load, vertical load, and longitudinal load. The cost of transmission tower constitutes 28 to 42 percent of the total cost of transmission line tower. So, it is necessary to optimize the tower by considering different geometry and configuration.

2. METHODOLOGY

STAAD.PRO is a structural analysis and design computer program originally developed by Research Engineers International in Yorba Linda, CA. In late 2005, Research Engineers International was bought by Bentley Systems. In this present study, STAAD.PRO is used for modeling a four legged and three legged transmission tower. For all the dimension from tower height to different stages an elevation is made in Auto-cad. Then the wind load on tower body, conductor, ground-wire, insulator are calculated manually using IS 802 Part 1, Sec 1 and it is being applied to the model generated in STAAD.PRO. The earthquake load is applied according to IS 1893 Part 4 and similarly the snow load is also applied according to IS 875 part 4. Different load combination is developed as are mention in Indian Standard and analysis is carried out. The deflection for top node for both four legged and three legged transmission tower are calculated.

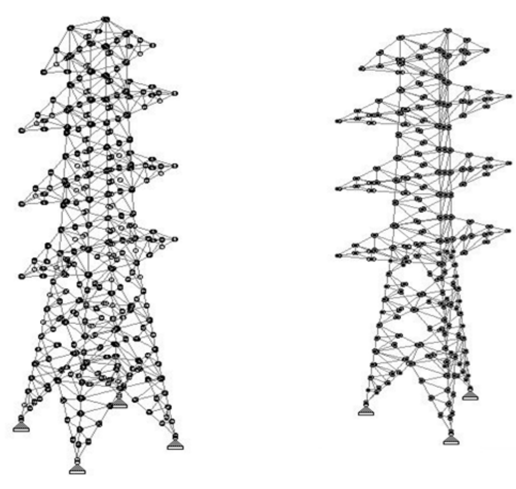

Fig. 1: Four legged and three legged tower

3. RESULTS

The table and *Fig.* shows the deflection of top node of the transmission line tower for four legged and three legged tower. The deflection due to snow load is very small as compared to wind and earthquake load.

Table 1: Deflection of the top node for both configurations

	Deflection of top node (mm)	
	Wind Load	**Earthquake Load**
Four Legged tower	89.65	28.5
Three Legged tower	145.19	50.47

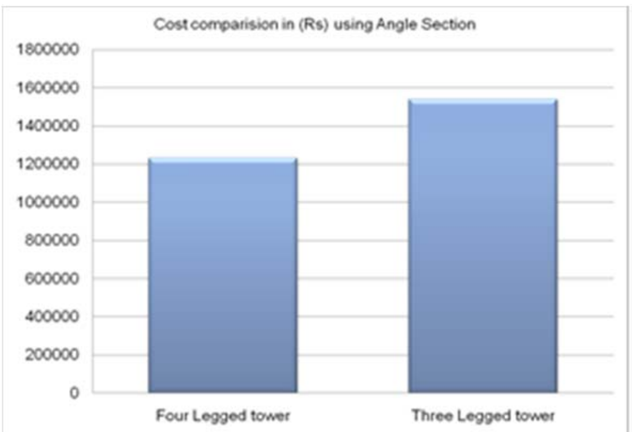

Fig. 1 Graph of Configuration v/s Deflection

Table 2: Cost comparison for both configuration

	Weight(kN)	Cost(Rs/kg)	Total(Rs)
Four Legged tower	**189.260**	**65**	**1230190**
Three Legged tower	**236.595**	**65**	**1537870**

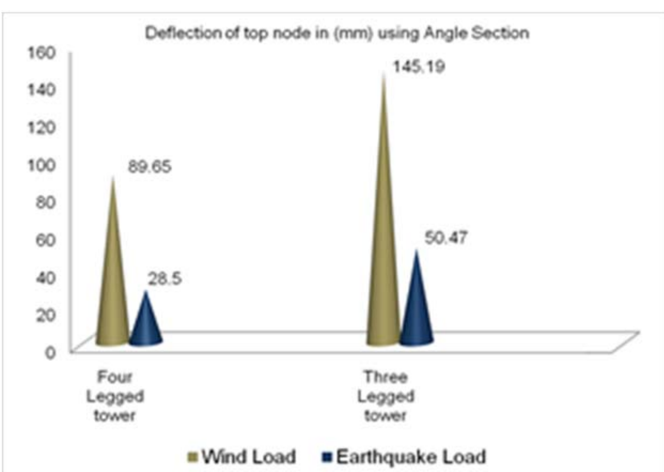

Fig. 2: Graph of Configuration v/s cost

4. DISCUSSION

From this present study, we can say that the deflection analysis of top node of transmission line tower for four legged has lesser value than the three legged tower. The permissible deflection for all transmission line towers for wind loading is restricted to H/100 or 1% of total height and for earthquake loading the maximum permissible deflection is restricted to,

$D_{max} = 0.003 \times h$ Where, h = height of the tower

Due to three leg in three legged tower axial force in the member, bracing, cross-arm comes out to be higher than the four legged tower. So, higher member section is selected for permissible deflection criteria but the overall weight of the structure increases so as well the cost also increases as compared to the four legged transmission line tower.

5. CONCLUSION

- The optimizations in terms of deflection at the top and material cost are obtained in the case of four legged tower as compared to the three transmission tower.
- The deflection for top node of the transmission tower for both configurations during wind load has greater impact than that of earthquake load. So, wind load case governs more for structural design as compared to the earthquake load.
- The deflection of the top most nodes comes out to be in permissible limit for three legged tower but cost-wise it is uneconomical whereas the four legged tower top deflection is in permissible limit as well as economical.
- The deflection of top node for Geometry-2 under wind load using conventional angle section for four legged transmission line tower is 68.20 % more than earthquake load.
- The deflection of top node for Geometry-2 under wind load using conventional angle section for three legged transmission line tower is 65.24 % more than earthquake load.
- The deflection of top node under wind load using angle section for three legged tower is 38.25 % more than the four legged tower for Geometry-2.
- The deflection of top node under earthquake load using angle section for three legged tower is 43.50 % more than the four legged tower for Geometry-2.
- The cost of three legged transmission tower is 20 % more as compared to four legged tower for Geometry-2 using angle section.

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REFERENCES

[1] Budhi Man Shingdan (2014) “Dynamic Analysis Of Transmission Tower” *National Institute Of Technology, Rourkela-769008, Odisha, INDIA.*

[2] Gopi sudam punse (2014) “Analysis and design of transmission tower” *International Journal Of Modern Engineering Research.*

[3] Ph.D Sun Jianmei and Yang Fuga (2010) “Seismic Behaviour Analysis of Long Crossing Transmission Tower and Tower-line System” *International Conference on Intelligent System Design and Engineering Application.*

[4] Y. M. Ghugal, U. S. Salunkhe (2011) “Analysis and Design of Three and Four Legged 400KV Steel Transmission Line Towers: Comparative Study ” *International Journal of Earth Sciences and Engineering 691 ISSN 0974-5904, Volume 04, No 06 SPL, October 2011, pp 691-694.*

[5] G.Visweswara Rao (1995) “ Optimum Designs For Transmission Line Towers” Computer & Structures vol.57.No.1.pp.81-92.

[6] Indian Standards,” Use of structural steel in overhead transmission line tower”, IS 802 part 1, Sec 1, 1992, (Material and loads) Bureau of Indian Standards, New Delhi.

[7] Indian Standards,” Use of structural steel in overhead transmission line tower”, IS 802 part 1, Sec 2, 1992, (Permissible stress) Bureau of Indian Standards, New Delhi.

[8] Indian Standard,” Criteria for earthquake resistant design of structures”, IS 1893 part 4, 2005, (Industrial structures including stack-like structures) Bureau of Indian Standards, New Delhi.