A Review on Analysis and Design of transmission tower And Monopole by Using Manual Calculation and Software

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Abstract: ***This research work is focused on comparison of transmission tower and monopole tower for different parameters viz. different height and different loading combinations. The comparative analysis is carried out with respect to axial force deflection maximum sectional property and critical load conditions. The transmission tower and monopole are design by manually by using limit state method based on IS 800, IS 802 IS 875 and gust factor method. Based on steps and formulas involved, a design program will be prepare in MS-EXCEL. The veracity of program will be check by first designing the manually designed transmission tower and monopole using the software and compare results. Wind analysis is carried out using standard codes and software. The behaviour of tower and pole is analysed for different load combination. The maximum displacement values, shear forces and bending moments are obtained. Therefore, transmission tower and monopole should be designed considering both structural and electrical requirements for safe and economical design as per Indian code. It is concluded from past study that transmission tower have lower lateral displacement as compared to monopole. This is because they have higher stiffness. Transmission tower carry heavy electrical transmission conductor at sufficient and safe from the ground than monopole The idea is to reach a definite conclusion regarding the superiority of two structure.***

Keywords – Transmission tower, monopole, manual design

I. INTRODUCTION

In last several studies have been performed in the area of analysis and design of metallic towers. The electric transmission is the process by which large amounts of electricity produced at power plants is transported over long distances for use by consumers. Usually steel transmission towers and monopoles are used to transmit the electric power. This is in view of non-availability of adequate land for installation of conventional lattice type tower. To overcome these practical difficulties, a new concept of transmission line is being used world-wide, called monopole. The cost of transmission tower constitutes about quarter to half of the cost of transmission line and hence optimum tower design will bring in substantial savings. The transmission tower are designed and constructed in wide variety of shapes, types, sizes, configuration and material. The supporting structure type used in transmission line generally fall into one of the three categories: lattice, pole guyed. According to IS 800-07, the wind forces are much prominent on the tower, conductors and insulators, besides the self weight. Tower structural calculations include applied loads like wind load, dead load, seismic load and design strength of structural steel member on superstructure including connection and foundation. From safety considerations, along the route of the transmission line clearances above open countries, roads, rivers, railway tracks, tele-communication lines, other power lines, etc. up to conductor needs to be maintained. The basic function of the tower is to isolate the conductors from their surroundings, including other conductors and the tower structure. . An alternative to the transmission tower, the monopole tower, is also used in this power corridor. In this case, the monopole supports much lower voltage conductors for distribution to industrial customers and substations. The voltages required for economical transmission of electric power exceeds the voltages appropriate for distribution to customers.

Figure. 1 showing transmission tower

Figure. 2 showing monopole

II. REVIEW OF LITERATURE :

There are several studies done on the design and analysis of transmission tower and monopole by using software. This literature review reveals the amount of research work done in India.

Sai Avinash, and Rajasekhar Analysis and design of transmission tower by using Staad.Pro.v8i. this work is focused in optimising the transmission tower with employing the X and K bracings, and by varying the sections, using static analysis. They concluded that the

transmission tower modelled with X bracing required lesser percentage of steel i.e. 6% when compared to K bracing. In design aspect it reveals that by providing unique sectional property throughout the transmission tower leads to uneconomical design.

Shivam Panwar, Yogesh Kaushik This research work an attempt has been made to compare the same transmission towers with same bracing system at different wind zone viz. zone II and zone IV located at Delhi and Panjim. The conclusion are drawn on the basis of the research and analysis done through the Staad.Pro.V8i. There is large difference in the bending moment forces on the members and there is huge change in axial force in cross arms members of tower.

D.B. Sonowal, J.D. Bharali This work focused on Analysis and design of 220kV transmission line tower (conventional method of analysis and Indian code based design) The transmission line tower is a statically indeterminate structure and the manual analysis of such a structure is very complex. This paper considering linear behaviour with two dimensional approaches gives satisfactory results which should be further verified with advanced software like Staad.Pro, Ansys etc. As per the design concern all section we consider are found safe against worst condition.

M. Pavan Kumar, P. Markandeya Raju This research work presents a comparison between monopole and self-support type towers with different heights for basic wind speed. This study was concluded that self-supporting towers have lower lateral displacements compared to monopole towers of same height and same amount of loading due to the fact that they have higher stiffness. But due to their rigidity, self-support tower have more load carrying capacity than monopoles for towers of height less than or equal to 40M, Monopoles may be preferred but with increase in height above 50M self-supporting towers are more suitable. This is because, during unexpected higher wind speeds due to cyclones (like hud hud), the structural rigidity will be intact and the cost of damage and the repair of the structure may not be so high unlike monopole

Riya Joseph and jobil Varghese This project work deals with analysis of monopole mobile towers. Analysis is done using ANSYS finite element software. These have smaller plan dimension and are composed of only few component's. These are more economical considering the cost of land. Displacements were obtained within the permissible limits. The variation in the result with change in thickness was studied. Wind effect was studied by analyzing the same structure to an increased wind load. Towers of two different height were taken for the study.

M. Natu, P.T. Mestri This research work demonstrate the design of geometry of cross arm and diamond shape monopole. Comparison between diamond shape monopole and regular tower. Diamond shape monopole helps to overcome the critical drawbacks of more height and footprint requirement associated with conventional lattice towers. Moreover, the dangers of faults associated with lighting will be reduced due to reduced in height of structure.

Gopi Sudam Punase In this work Analysis and Design of narrow based Transmission Tower (using Multi Voltage Multi Circuit) is carried out keeping in view to supply optimum utilization of electric supply with available ROW and increasing population in the locality of India. Using STAAD PRO v8i analysis and design of tower has been carried out as three dimensional structure. This study was concluded that the tower with angle section and X-bracing has the greater reduction in weight after optimization. Total weight of tower considering weight of nut bolts, anchor bolts, hardware etc. works out to 30 to 35 tonne.

III. OBJECTIVE:

Current study focused on the analysis and design of transmission tower and monopole by using manual calculations and software.

1. The main objective of this research work is to analyse and design of transmission tower and monopole.
2. To compare and check wind performances in Amravati region.
3. To check the variations in lateral displacement and stiffness.
4. To check the tensions for the conductors and ground wire.
5. To check the variations in stresses or forces in cross arms members in tower and monopole.
6. To check the effects of different loads on transmission tower and monopole.
7. To check the strengths of transmission tower and monopole.
8. To check whether the transmission tower and monopole should be used in future.

IV. METHODOLOGY:

The transmission tower and monopole are design by manually by using limit state method based on IS 800, IS 802, IS 875 and gust factor method. Based on steps and formulas involved, a design program will be prepare in MS-EXCEL. The veracity of program will be check by first designing the manually designed transmission tower and monopole using software and compare a results. An identicle procedure will be followed for both. The program for designing the same will develop by using MS-EXCEL and its fidelity will check by first solving manually also in software and then comparing results. The transmission tower and monopole will design for height 15M to 40M. 4-legged transmission tower and 16 sided polygonal shape monopole will design for 220kV to 400kV power capacity and also check the effect of wind pressure.

V. CONCLUSION :

1. From past study it is concluded that transmission tower have lower lateral displacement as compared to monopole. This is because they have higher stiffness.
2. Transmission tower can carry heavy electrical transmission conductor at sufficient and safe height from the ground than monopole.
3. Loads acting on the tower and monopole are wind load, dead load of structure, braking load of conductor, and earthquake load are much prominent as per Indian standard code.
4. The steel quantity required for transmission tower is approximated two times more than monopole.
5. The idea is to reach a definite conclusion regarding the superiority of two structure.

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