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Comparative Study & Structural Behavior of Telecommunication Monopole Towers with and without Camouflaged under the Influence of Wind load

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Abstract— *The* **purpose of the proposed research is to study the structural behavior of monopole towers with and without camouflaged with different heights of towers 30m and 35m for the basic wind speed of 44.44m/s,39m/s as per latest current code ANSI/TIA 222-H.Most studies and research have shown only structural behavior of monopole towers with other type of lattice towers. Proposed research is very important due to the fact that the structural engineer faces the challenging job of designing and constructing telecommunication towers to support all loads in open weather with high degree of reliability. Free standing lattice towers are generally used in all over the world. As per the recent surveys, mobile towers in the world are likely to grow very fast due to the introduction of 5G technology which requires more antennas on the towers, with existing monopole towers already occupied with lot of antennas with no structural capacity to withstand extra load on towers. New camouflaged designs in monopole are going to study in this research to improve monopole structural capacity and structural behavior to withstand new loads. Environmental and economic pressures have initiated to seek improved design approaches to make communication towers more environmentally acceptable and cost effective. Since monopole structures have smaller dimension and require lesser space for installation, they can be used as a suitable alternate for lattice towers. Some researchers observed in their study that monopole towers have higher lateral displacements and lesser monopole structural capacity than self supporting towers. In this proposed research a new camouflaged technical design is developed to study the structural behavior of monopole towers. This research shall be helpful for determining lateral displacement(tilt)of monopole, monopole capacity and effect of wind speeds for different heights of monopole towers with and without camouflaged under the influence of wind load.**

Keywords **Staad Pro V8i, monopole tower, antenna loads, basic wind speed, lateral displacement (tilt), monopole capacity, camouflaged cladding.**

I. INTRODUCTION

With the sudden and exponential growth in cell phone use, the telecommunication industry and telecommunication towers have received a lot of publicity in recent years. Nowadays, everybody has a cell phone, and the need for telecommunication services has risen. Telecommunication towers are the only way to increase network reach and reliability. The towers that protect the panel antennas, telecommunication devices, platforms, and their foundations are analyzed and designed by civil engineers. Many of the devices, such as mounts, antennas, and other components, are installed on the tower, which necessitates civil engineering experience. Applied loads such as wind load, dead load, and construction strength of structural steel members on superstructure, including ties and base, are used in tower structural estimates. Telecommunication towers are divided into various categories depending on their structural action, cross-section, section types utilized, and tower placement. Based on their structural action, they are known as Monopole, Self-Support, or Guyed Towers. Monopoles are the most cost-effective for heights under 55 meters and are a feasible alternative for room constraints. As a result, monopole towers are in high demand in the telecommunications industry.

Most previous study has focused on structural activity of 3-legged and 4-legged lattice towers, guyed towers, and researchers have not given Monopole towers enough time. Owing to the current difficulties in locating land for the construction of traditional lattice towers, monopole towers are gaining prominence for connectivity purposes around the globe, and its study is critical in the current scenario.

Monopole towers will accommodate both antennas at heights of 30 to 50 meters, extending the structure's reach. Monopole towers are versatile among structures due to their multipurpose use in contact, lighting, and other fields. Structure research can help a structure work better and last longer. A thorough examination of a monopole using modern technologies will result in an improvement in its structural capability.

II. LITERATURE SURVEY

Following are some theories and researches carried out till now:

- Riy Joseph ISSN2395-0095 & jobil vargese 2005 observed in their study that Telecommunication towers are tall structures installed at a specific height usually designed for supporting parabolic antennas. The structure engineer has the difficult task of planning and installing telecommunication towers that can reliably accommodate all loads in open air. Lattice towers that stand alone are often seen all around the world. According to recent surveys, the number of cell towers will possibly exceed 5 lakh by 2020. Land for the construction of these traditional lattice towers is very challenging to come by in densely populated metropolitan areas. The steep rise in land valuation has necessitated the creation of an environmentally friendly alternative to traditional lattice towers. Environmental and economic stresses have prompted researchers to look for new ways to build contact towers that are both environmentally friendly and cost efficient. Monopole systems may be seen as a better alternative to lattice towers since they have reduced dimensions and need fewer room for construction. The study of monopole mobile towers is the focus of the study.ANSYS finite element program is used for the study. The ANSYS model is used to predict monopole behavior when they are used as a coordination tower. The efficiency of the monopole tower is assessed using finite element results.

REVIEW ON PREVIOUS RESEARCH

There is currently a lack of studies available concerning the monopole structural behavior and capacity to withstand new loads with new camouflaged technology this subject requires more in-depth analysis which is to be researched upon.

- M.Pavan kumar,P.Markhandrya Raju,M.Navyal and GT Naidu(2017): The two popular forms of telecommunication towers used in the building industry are monopole and self-supporting towers. For simple wind speeds of 33m/sec, 47m/sec, and 55m/sec, this paper compares Monopole and Self-Support style Towers with different heights of 30m, 40m, and 50m. STAAD(X) Tower program, which is specifically designed for analyzing Telecommunication Towers, is used to accept dead loads and wind loads when examining the antenna. Self-Support Towers have smaller lateral displacements than Monopole Towers of the same height with the same volume of building, according to this report. This is due to their increased stiffness. However, for a given tower height, wind speed, and loading, the steel quantity needed for Self-Support Towers is roughly 2 times that of Monopole Towers. However, due to their rigidity, Self- Support Towers have more load carrying capacity than Monopoles. For towers of height below or equal to 40m, Monopoles might be preferred. But, with the increase in height beyond 50m, Self-Support Towers are recommended. This is because, in case of any unexpected and abnormally high wind speeds during cyclones, the structural rigidity will be intact.

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III. AIM & OBJECTIVES OF THE PROPOSED RESEARCH

The aim of the proposed research is to review the comparative study & structural behavior of telecommunication monopole towers with and without camouflaged under the influence of wind load.

To achieve such aim the following objectives have been considered for the research work.

1. The first part studies which includes:
(a) To design the sectional properties of monopole for the analysis and design of monopole structure with and without camouflaged.
(b) Analyze towers using latest code ANSI/TIA-222-H for structural standards and for the analysis and design of telecommunication monopole structure with and without camouflaged.
(c) Design of camouflaged portion.

2. The second part studies are the analysis and design of camouflaged monopole structure which includes:
(a) To develop a finite element model for the analysis of monopole structure with and without camouflaged using staad pro v8i structural analysis software.
(b) Analysis and design of monopole are going to performed for two different heights with two different wind speeds and compared.
(c) The problem is assumed to be a linear-static problem and analysis are going to performed for basic wind speeds of 44.44m/sec, 39m/sec and heights of 30m and 35m.

3. The third part provides to validate the results by a suitable software simulation/statistical package.

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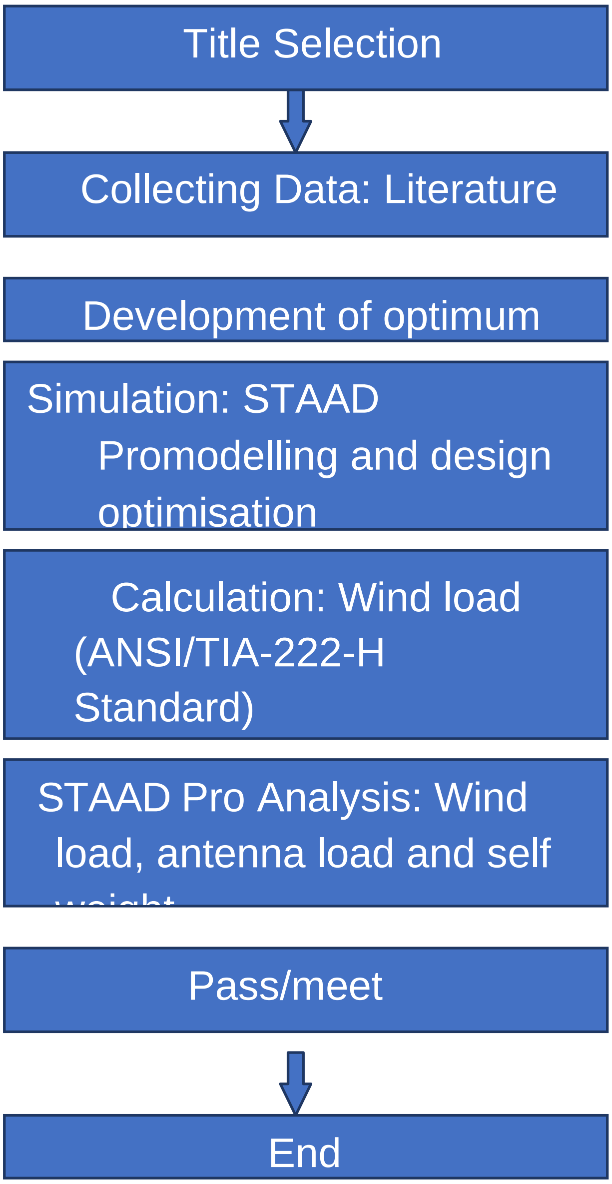
IV. RESEARCH METHODOLOGY



V. RESEARCH DESIGN

Step 1: to conduct literature review on structural behavior of monopole with and without camouflaged after referring many journals and internet references.

Step 2: to investigate the structural behavior of telecommunication monopole towers that have been camouflaged and those that have not. STAAD PRO V8I structural analysis software was used to create 3D computer models for each structure, and these models were used to analyze towers under wind loads.

Step 3: Following the preparation of two versions, wind analysis will be carried out using the most recent code for antenna towers, ANSI/TIA-222-H Structural Standard for Antenna Supporting Structures and Antennas, which is highly respected and widely utilized by both local and international tower designers for their designs and structural parameters.

1) Basic wind speed = 160 Km/hr. (3sec-Gust).
2) Limiting Monopole deflection to 1.0 degree under operational wind speed = 120 Km/hr.(3sec-Gust).
3) Exposure category: C.
4) Structural class: II.
5) Topographic Category: I.

Load Combination

1) According to ANSI/TIA-222-H, Minimum design load combinations for structures
2) 1.2 D.L + 1.26 W.L (for section design)
3) 1.0 D.L + 1.0 W.L (for serviceability)

Wind load

Wind load on the camouflaged monopole structure concealing the following Loads

- Loads:

1) 6 Nos. of Octaband antennas (2.769 x 0.369) at Top.
2) 3 Nos. 5 G Antennas (0.860 x 0.395x 0.190) at Top.
3) 24 Nos. RRUs as mentioned in STA.
4) 2 Nos. of 0.60 Dia MW antennas at Top.

was used for the structural analysis and design of towers under wind loadings. And design of steel member as per LRFD.

Step 4: comparative study is evaluated after analyzing two models with and without camouflaged to investigate the lateral displacement (tilt of monopole) and monopole structural capacity finally, the results of analysis under wind loads were compared.

VI. IMPORTANCE OF THE PROPOSED RESEARCH

The proposed study is critical since structural engineers face the difficult task of building and building telecommunication towers that can accommodate all loads under all environmental conditions with a high degree of durability. Lattice towers that stand alone are often seen all around the world. According to recent surveys, the world's mobile towers are expected to grow very quickly as a result of the introduction of 5G technology, which necessitates more antennas on the towers, with existing monopole towers already occupied with a large number of antennas and no structural capacity to withstand additional load on towers. New camouflaged designs in monopole are going to study in this research to improve monopole structural capacity and structural behavior to withstand new loads. Environmental and economic stresses have prompted researchers to look for new ways to build contact towers that are both environmentally friendly and cost efficient. Since monopole frameworks are smaller and take up fewer room to erect, they can be seen as a viable alternative to lattice towers

VII. CONCLUSIONS

- Steel monopole systems are found in a variety of applications.
- This has a narrower plan dimension and is made up of a limited number of elements. In terms of property costs, they are more cost-effective. STAAD PROV8I was used to model the structure. The ANSI TIA/EIA 222-H code was used to calculate the load. Displacements and pressures may be investigated. Variation of findings with changes in model and the addition of camouflaged would be investigated. For the analysis, two different-height towers were used.
- Analysis and design of new monopole with camouflaged is a challenge.

VIII. ACKNOWLEDGMENT

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IX. REFERENCES

[1] CSC Siting Council of Connecticut. Facilities for Telecommunications. Version II, USA; 2017.
Saeed Alsamhi. Alsamhi. Service quality enhancement techniques in high altitude communication networks (HAP). Indian Technology Institute (Banaras Hindu University) Varanasi, India; 2015.
[2] Government of NSW. Telecommunications structure guidelines. Telco Authority, United States; 2015.

Masts and Towers. Ulrik Støttrup-Andersen. Department Head of Market, Denmark, 2009. 2009.

Florea Dinu. Sustainable buildings amid natural hazards and disaster. European Erasmus [3] Universitatea Politechnica Timisoara, Master, Lecture 18: Towers, chimneys; 2014.

[4] The past, present and future of Smith BW and Støttrup-Andersen U. Tourers and masts. IASS Conference, Madrid, Spain; 1997. 1997.

[5] U. Masts and Towers for the UMTS network in Sweden, Støttrup-Andersen. Euro Steel, Netherlands Maastricht; 2005.

[6] Stott up-Andersen U. Masts and Tower Analysis and Design. Structural International Congress, San Francisco, USA; 1998. [7] IE 1991-1-4: 2007 [7] Eurocode 1: Structure activities — General actions Part 1-4: wind measures (EC1-1-4). United States; 2010. 10.

[8] EN 1993-3-1: Eurocode 3 - Structures of steel - Part 3-1: Towers, masts and fireplaces - Towers and masts. United States; 2009.

[9] EN 1993-1-1: Steel structure design Part 1-1: general construction regulations and guidelines. United States; 2005.

CHS versus different cross-section performance assessment. USA; 2016. Ferreira. Chapter 3.

[10] Nielsen MG. Benefits from the use of telecommunications structure tubular profiles. 11th Tubular Structures International Symposium, Quebec, Canada; 2006.

[11]B.M. Broderick, Department of Civil, Structural, and Environmental Engineering at Trinity College, Dublin, April 18, Simple models for natural frequencies, and mode forms of utility towers.

B.Lanier, —Compliance with CFRP high module steel monopolies in the field of materials in Germany, Journal of thin walled structures, 2009.

[12] Bryan Keith, Study: The Improvement of Strength and Stiffness Capabilities of steel multi-sector monopoly towers using reinforced carbon fiber polymers as a retrofitting mechanism, North Carolina, State University, Southern Carolina,

[13] Daniel Horn, â Monopole Bases design in English, Technical Guide 1, AISC. [13]

Boulder, C., Personal Communications, Kaufman, Rocky Mountain Research Laboratories, 1992. Jeneevan: — Steel Towers Subject Strength Assessment, Civil Engineering Department, 2011 C.J. Kaufman.

[14] R. P Rokade, Journal for Research into Structural Engineering, 5 August 2011. Comparative studies of traditional monopolies and the microwave in towers every day.

[15] Shen-En Chen, â Two Pole Operating Power Transmission Modal Features from North Carolina University, 2010 Civil and Environmental Engineering Department.