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Influence of Hoarding Frame on Response of Metal Framed Host Structure: A Review

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Abstract. *The integration of hoarding frames with metal-framed host structures is an essential aspect of temporary construction setups, especially in urban environments. These frames, often used as protective barriers around construction sites, can influence the structural response of the host framework, particularly during environmental loading such as wind and seismic events. This study investigates the impact of hoarding frames on the structural behavior of metal-framed buildings, with an emphasis on load distribution, dynamic response, and overall stability. Finite element analysis (FEA) and experimental validation are employed to assess the changes in stress distribution, deflection patterns, and vibration characteristics when hoarding frames are present. Results indicate that the presence of hoarding frames can lead to both positive and negative effects on the host structure, depending on factors such as the hoarding's material properties, connection stiffness, and geometry. The findings suggest that, under certain conditions, the hoarding frame can act as a wind or seismic shield, reducing the overall loading on the host structure. However, improper design or installation may introduce additional forces that could compromise structural integrity. Recommendations for optimizing hoarding frame design to mitigate adverse impacts and enhance structural performance are also discussed.*

***Keywords:* -** FEA, Frames, Hoarding, Vibration, Deflection, Stiffness**.**

I. Introduction

Hoardings can be all around mounted, detached on a plinth or raised on a tower to see from a flyover. (Showcasing) an expansive board utilized for showing publicizing blurbs, as by a street. Additionally called (esp US and Canadian): announcement. (Building) a transitory wooden wall raised cycle a building or destruction site. Wind is air in movement with respect to the surface of the earth. The essential driver of wind istraced to earth's revolution and contrasts in physical radiation. The radiation impacts are fundamentally in charge of convection either upwards or downwards. The twist for the most part blows even to the ground at high wind speeds. Since vertical segments of air movement are generally little, the expression "wind" means only the level wind, vertical winds are constantly recognized in that capacity. The wind rates are evaluated with the guide of anemometers or anemographs which are introduced at meteorological observatories at statures by and large shifting from 10 to30 meters over the ground. Exceptionally solid winds (more prominent than 80 km/h) are by and large connected with cyclonic tempests, rainstorms, dust storms or enthusiastic storms. A component of the cyclonic tempests over the Indian zone is that they quickly debilitate in the wake of intersection the coasts and move as despondencies/lows inland. The impact of a serious tempest in the wake of striking the coast does not; all in all surpass around 60 kilometers, however some of the time; it might stretch out even up to 120 kilometers. Short span sea tempests of high wind speeds called KalBaisaki or Norwesters happen decently much of the time amid summer months over North East India. The wind speeds recorded at any area are greatly variable and notwithstanding enduring wind whenever, there are impacts of blasts which might keep going for a few moments. These blasts cause increment in pneumatic force however their impact on steadiness of the building may not be so imperative; regularly, blasts influence just part of the building and the expanded nearby weights might be more than adjusted by a transient diminishment in the weight somewhere else. As a result of the inactivity of the building, brief period blasts may not bring on any obvious increment in anxiety in principle parts of the building in spite of the fact that the dividers, rooftop sheeting and individual cladding units (glass boards) and their supporting individuals, for example, purlins, sheeting rails and coating bars might be all the more truly influenced. Blasts can likewise be critical for configuration of structures with high slimness proportions. The obligation of a working to high wind weights depends not just upon the land area and closeness of different checks to wind current additionally upon the attributes of the structure itself. The impact of wind on the structure all in all is controlled by the consolidated activity of outer and interior weights following up on it. In all cases, the computed wind loads act typical to the surface to which they apply. The solidness figuring's all in all should be done considering the joined impact, and also isolate impacts of forced loads and twist loads on vertical surfaces, rooftops and other part of the working above general rooftop level. Structures might likewise be planned with due consideration regarding the impacts of wind on the solace of individuals inside and outside the structures.

II. Literature Review

William H. Greene (1985) A system is depicted for mechanized measuring of the individuals and determination of demand qualities for guyed receiving wire towers. The tower comprises of a triangular cross area, tubular part pole bolstered by various arrangements of claim folks. The measuring method utilizes a nonlinear limited component investigation coupled to a nonlinear numerical programming based streamlining agent. Numerical studies were performed on an average VLF radio wire arrangement to get least weight tower plans. Different stacking conditions, tower statures, and tower materials were considered. [1]

Reginald T. Nakamoto, Arthur N. L. Chiu10 (1985), Full-scale wind speed and auxiliary reaction information from a tall guyed tower have been broke down to acquire data concerning wind qualities and element reaction. Anemometers and accelerometers were introduced at five stations along the stature of the tower, and orthogonal parts of wind speeds and tower increasing speeds were recorded. Plan rules indicate 1/7 as the force law type for wind profiles in waterfront locales. Be that as it may, information from this task, however constrained in number of tests and conditions, show a mean type of 0.287. Computerized connection and ghastly examination are connected to the tower speeding up information to get evaluations of thunderous frequencies and basic damping proportions.[2]

Mehran Keshavarzian8 (2003) Depending on the application, self-bolstered tubular steel post (cantilever) structures in the United States are intended for amazing wind loadings in view of either ASCE 74 (for electric utility applications), ANSI/TIA/EIA 222 (for reception apparatus applications), AASHTO (for thruway sign and activity signal applications), or ASCE 7 (for general applications, for example, stadium announcements). This paper analyzes the edges of wellbeing of self-upheld tubular steel structures intended for compelling wind loadings taking into account ASCE 74, TIA/EIA, AASHTO and ASCE 7. Taking into account this examination, a basic survey of the ASCE productions and their individual configuration prerequisites and security elements are displayed. [3]

Eric James Sullins, Dr. Hani Salim (2006) TheMoDOT radio correspondence tower system was made in the 1950s and 1960s. There is a need to evaluate the state of the towers in the system furthermore to figure out whether they are breakthrough with current codes. A condition indexing (CI) framework is a dependable evaluation device. In any case, a systematic technique for deciding the information parameters for the CI should be resolved. Thusly, the target of this exploration is to build up a methodical investigative strategy for foreseeing the reaction of the towers under regular perils. In this venture, a guyed and an unattached tower were displayed utilizing ERITower and SAP2000 under wind, ice, and seismic burdens. The impact of decay on the reaction of the towers was assessed utilizing a parametric study. The slanting bracings controlled the limit of the towers under wind and ice stacking, while the folks were the most touchy to crumbling under seismic burdens. The consequences of this task show that a few segments of the towers are basic and could control disappointment. It is suggested that definite investigation of the towers'critical parts be performed to add to a nitty gritty danger evaluation of the towers.[4]

Amiri G., Massah S.R., A. Boostan1(2007), Telecommunication tower is a vital part of the fundamental foundation of correspondence frameworks and in this way saving them in occasions of common calamities -, for example, a serious seismic tremor - is of high need. In past studies, analysts have for the most part considered the impacts of wind and quake incited loads on 3-legged (triangular cross-area) self-supporting steel telecom towers. In this study, the seismic affectability of 4-legged telecom towers is explored in light of modular superposition examination. For this reason, ten of the current 4-legged self-supporting telecom towers in Iran are contemplated under the impacts of wind and tremor loadings. To consider the wind impacts on the models, the procurements of the TIA/EIA code are utilized and the wind is dealt with as a static burden all through the investigation. Furthermore, to consider the tremor consequences for the models, the standard outline range in light of the Iranian seismic code of practice and the standardized spectra of Manjil, Tabas and Naghan quakes have been connected. Since Iran is thought to be situated in a high seismic danger area, a base outline increasing speed of A = 0.35 g is utilized for standardization of the spectra. It was watched that on account of towers with rectangular cross area, the impact of concurrent tremor stacking in two orthogonal headings is imperative. Toward the end, various experimental relations are exhibited that can help originators to rough the dynamic reaction of towers under seismic loadings.[5]

FarzadFaridafshin, et al (2008) Tall telecommunication masts are slender structures whose lateral resistance is provided by clusters of guycables anchored to the ground at several support points. The main goal of this study is to demonstrate the importance of considering realistic threedimensional ground motion with asynchronous input when evaluating the seismic response of these tall multisupport structures. Three existing masts with heights of 213, 313 and 607 m and different guy cable arrangements have been modeled and investigated in detail with three classical historical earthquake records using a commercial finite element program (ADINA). Both synchronous and asynchronous ground shaking were considered. The effect of asynchronism in multiple support excitations was studied by varying the shear wave velocity of the surface traveling wave corresponding to different degrees of soil stiffness. The three towers have shown sensitivity to asynchronous shaking of their supports. More severe response was obtained for softer soil conditions, and the 607 m mast was sensitive even for relatively stiff soils.[6]

Siddesha.H (2010) Open latticed steel towers are used widely in a variety of civil engineering applications. Theangle sections are commonly used in microwave antenna towers. This paper presentstheanalysis of microwave antenna tower with Static and Gust Factor Method (GFM). Thecomparison is made between the tower with angle and square hollow section. Thedisplacement at the top of the tower is considered as the main parameter. The analysis is alsodone for different configuration by removing one member as present in the regular tower atlower panels.[7]

NitinBhosale,b et al (2012) In the contemporary era, the telecommunication industry plays a great role in human societies andthus much more attention is now being paid to telecommunication towers than it was in the past. As telecommunication tower are the only means of enhancing both the coverage area and network reliability more and more telecommunications tower are installed nowadays. The direction and height of tower along with the antennas mounted on it is completely governed by the functional requirements of network. The most ideal place for tower is on ground but in urban areas the availability of land which would be most ideal is extremely limited giving no alternative but to adopt rooftop tower with marginal adjustment in terms of position. In this present study, the seismic analysis of 4 legged angled section rooftop telecommunication tower has been studied under the effect of design spectrum from Indian seismic code of practice for zone-iii along with wind analysis as per IS 875 (part 3) 1987. The analysis has been performed on tower located on roof of host structure by varying the positions of tower in Etabs software. The stresses in beam grid of rooftop tower foundation, stresses in host structure, retrofitting in host structure, axialforces in tower are the main parameters considered for the study. The host structure also analyzed with flexible base, to see the effect of flexibility of soil on host structure and tower response.**[8]**

Shaikha Al-Sanad **et al (2023)** Having an optimal design of the wind turbine tower, with a minimum mass (cost) while fulfilling multiple design constraints, plays an important role in ensuring an economic and safe design of the wind turbine. During the design of wind turbine towers, partial safety factors (PSFs) are currently commonly used to account for the uncertainties in the loads and material properties due to its easy implementation. The values of PSFs given in design standard are generic and are not derived for a specific design. For a site-specific design of wind turbine towers, the details of the load parameters, such as the type of distributions and the coefficient of variation, can be obtained through the condition monitoring system. With these information, the PSFs can be calibrated based on the reliability method, meeting the target reliability index and avoiding over or under engineering of wind turbine tower structures. In this work, a parametric finite element analysis model is integrated with a genetic algorithm to develop a structural optimisation model of wind turbine towers. The optimisation framework minimises the tower mass under multiple design constraints. The optimisation model has been applied to a representative 2.0 MW onshore wind turbine tower. PSFs are calibrated on the basis of reliability. The optimal tower design with calibrated PSFs is compared against the design with un-calibrated PSFs. Results indicate that the tower design with calibrated PSFs achieves a mass reduction of 2.9% in comparison to the design with un-calibrated PSFs **[9]**

Anand Valiavalappil et al (2019) This paper presents a simulation study on a fiber-reinforced polymer (FRP) light pole that is being used in Yanbu Industrial City, Saudi Arabia. The light poles in this area are subjected to cyclic wind load blowing from the Red Sea. It is of great interest to re-investigate the strength and integrity of the structure for future improvement. A three-dimensional numerical simulation has been performed to analyze the effect of wind velocity over the FRP pole. The pole is conical in shape, having a circular hollow cross-section in both the ends and tapered uniformly. The pole considered for simulation is having a height of 6 meters and have conicity of 18 mm/m. The FRP pole is a combination of unsaturated polyester, vinyl ester, epoxy, phenolic, polyurethane, and glass fibers, which are reinforced by the centrifugal process. The computational fluid dynamics (CFD) simulation results are validated with the mathematical calculation. The adopted method is fluid-structure interaction (FSI) with SST k-ω (shear stress transport) turbulence model, which is used to simulate the wind velocity over the FRP pole using ANSYS Fluent. The velocity of air considered for simulation ranges from 10 to 50 m/sec. The study provided a good correlation between mathematical calculation and the CFD simulation for each air velocity. The study revealed maximum deflection and equivalent stress occurred at the top and bottom end, which are 217 mm and 85 MPa respectively. The exact region of crack is also predicted for different wind velocity. This method can also be adopted for any FRP poles available.**[10]**

Edgar Tapia-Hernández (2016) causing substantial damage to local steel pole structures (light poles and electricity poles). Based on the failure characteristics observed on such poles, this paper develops an analytical study aimed at evaluating the wind-excited inelastic response of slender vertical cantilever structures. Displacement-controlled pushover analyses are performed in OpenSees. The research pretends to establish a reference of the deformation limit for the serviceability limit state in order to contribute to make conservative decisions in the design phase of steel poles.**[11]**

Mitchel, D et al (2003) The current seismic design of bridges is based on a well-known principle, i.e., capacity design, in which the superstructure should remain elastic during earthquake events while the nonlinear deformation (i.e., plastic hinges) should occur in the substructure and should be ductile in term of flexure. Given this, the Canadian Highway Bridge Design Code (CHBDC) allows reducing the demands for the design of substructure elements (mainly columns) by a response modification factor R. Since the R-factor will affect the design forces significantly, the objective of the study is to determine its value from detailed finite element analyses, and evaluate its dependency on the ductility and bridge dominant period. For the purpose of the study, eight existing typical highway bridges in Montreal are examined including slab type bridges, slab-girder type bridges, and box-girder bridges. The substructure of the bridges consists of multiple columns from two to four. Nonlinear time-history analyses are conducted on each bridge model using IDARC. Thirty simulated accelerograms are used as input for the seismic excitations, and they are scaled to three intensity levels based on the first mode period of the bridge, namely, 1.0Sa(T1), 2.0Sa(T1), and 3.0Sa(T1). It is found in the study that the configuration of the substructure affects the R-factor, such as, number of columns in the bent, using of crush stru**. [12]**

Manisha Pradhan et al (2022) Fencing poles are one of the most widespread manmade features on Earth, and they May out stretch roads by an order of magnitude. One of the most durable and Efficient RCC fencing poles is constructed with the help of concrete. Properly made Reinforced concrete pole .The essential requirements for the protection of Poles for general purposes, we conducted impact test on the protection of reinforced Concrete poles by changing the height of the post & it\'s position to decreases the effect of impact energy. Fences have eluded systematic study for so long for good reasons. Fencing has become more popular architecture in many disciplines, from ecology to computing. Fences are globally everywhere used & they are often discussions of evaluation. For designing a RCC pole one has to consider all the possible loading and see that the Structure is safe against all possible loading condition.**[13]**

Jonal Medney (1982) A fiberglass pole suited for used in electric transmission systems & reinforced against flexural stress includes a plurality of reinforcing regions parametrically disposed & selectively placed there on. The regions are integral with the pole & are formed of composite material that includes a plurality of pre stressed longitudinally disposed fibers & a bonding agent embedding the fibers & structurally joining the same to the pole. Thin invention relates to provide a composite structural element high dielectric properties, that is resistant to corrosive environmental properties, that is resistant to corrosive environmental agents.[14]

William H. Greene (1985) Construction of Building Fencing Regarding preparation of a structure that encloses an area, outdoors, connected by boards. Fences are also essential to permit grazing of pastures, down land, heaths and other semi-natural areas. [15]

M. SzocinskiK. Darowicki (2016) Auschwitz Birkenau concentration & RCC fencing poles & exposure.[16]

J. Paul Guyer. (2020) Construction of security fencing Determining & installation of security fencing.**[17]**

III. Future Scope

Research on sustainable materials and reusable hoarding systems that have minimal environmental impact and are easy to remove after use without leaving structural damage or residue.

Benefit: Developing reusable, eco-friendly hoarding systems would contribute to green building initiatives and reduce construction waste, while also maintaining the structural performance of the host structure.

IV. Conclusion

In applications where resistance to vibration is critical (such as poles subjected to wind loads or machinery vibrations), the Square Pole would be the best choice due to its high stiffness. The Cylindrical Pole might be suitable for environments where a balance between flexibility and rigidity is needed. The Multi-Fillet Pole would be more appropriate where flexibility and reduced stress concentrations are important, though care must be taken in environments where dynamic loads could induce resonance or excessive vibration.

References:

[1] Amiri G., Massah S.R. and A. Boostan, “Seismic response of 4-legged self-supporting telecommunication towers”, International Journal of Engineering Transactions B: Applications, vol.20, no. 2, pp. 107-126,2007.

[2] Eric James Sullins and Dr. Hani Salim , "Analysis Of Radio Communication Towers Subjected To Wind, Ice And SeismicLoadings" Thesis Report In Department Of Civil And Environmental Engineering, University Of Missouri – Columbia,2006.

[3] FarzadfFaridafshin, S. Ali GhafariOskoei and Ghyslaine McClure, "Response of tall guyed telecommunication masts to seismic wave propagation" The 14th World Conference on Earthquake Engineering, Beijing, Chin, 2008.
[4] IS 456: 2000, "Indian standard plain reinforced concrete – code of practice", Bureau of Indian standards, New Delhi.

[5] IS: 800:2007, "Indian standard Code of practice for General construction in Steel", Bureau of Indian standards, New Delhi.

[6] IS: 875 (part 1), "Indian Standard Code of practice for Design loads for buildings and structures, Dead load", Bureau of Indian standards, New Delhi.

[7] IS: 875 (part 2), "Indian Standard Code of practice for Design loads for buildings and structures, imposed load", Bureau of Indian standards, New Delhi.

[8] IS: 875 (part 3), "Indian Standard Code of practice for Design loads for buildings and structures, Wind load", Bureau of Indian standards, New Delhi.

[9] Mehran Keshavarzian , "Extreme Wind Design of Self-Supported Steel Structures: Critical Review of Related ASCE Publications" American society of civil engineers, Practice Periodical on Structural Design and Construction, Vol. 8, No. 2, pp. 102-106, 2003.

[10] NitinBhosale, Prabhat Kumar and A. D. Pandey, "Influence Of Host Structure Characteristics On Response Of Rooftop Telecommunication Towers" International Journal Of Civil And Structural Engineering Volume 2, No 3, pp. 737-748, 2012.

[11] Reginald T. Nakamoto and Arthur N. L. Chiu, "Investigation Of Wind Effects On Tall Guyed Tower "American society of civil engineers, journal of structural Engineering, Vol.111, No. 11, pp. 2320-2332, 1985.

[12] Siddesha. H,"Wind Analysis of Microwave Antenna Towers" International Journal of Applied Engineering Research, Dindigul Volume 1, No 3, pp. 574-584, 2010.

[13] William H. Greene, "Minimum Weight Sizing of Guyed Antenna Towers" American society of civil engineers, Journal of Structural Engineering, Vol. 111, No. 10, pp. 2121-2137, 1985.

[14] Shaikha Al-Sanad , Jafarali Parol , Lin Wang ,∗ , Athanasios Kolios"Design optimisation of wind turbine towers with reliability-based calibration of partial safety factors" ScienceDirect Energy Reports**,** 2023

[15] Anand Valiavalappil "INVESTIGATION OF FLUID STRUCTURE INTERACTION (FSI) EFFECT ON A FRP (FIBER REINFORCED POLYMER) POLE USING ANSYS **"**Yanbu Journal of Engineering and Science Vol. 17 (2019)

[16] Edgar Tapia-Hernández " TUBULAR STEEL POLES UNDER LATERAL LOAD PATTERNS" Advanced Steel Construction Vol. 12, No. 4, pp. 428-445 (2016) 428

[17] Edition of the National Building Code of Canada", Canadian Journal of Civil Engineering, 2003, Vol. 30. pp.308– 327.

[18] Sulthan Erfemli Gunaslan, Abdulhalim Karasin and M.Emin Oncu (2014). Properties of FRP material for Strengthening, page 656-660

[10] Cagri Uzay, Mete Han Boztepe and Needet geren (2016). Impact Energy Absorption capapcity of fiber reinforced polymer matrix (FRP) composites. Page no. 211-219

[20] User, S. (n.d.). Home. Retrieved April 28, 2019, from https://www.autonational.com/filamentwinder/markets/utility-poles.html

[21] Campobasso, M., Yan, M., Bonfiglioli, A., Gigante, F., Ferrari, L., Balduzzi, F., & Bianchini, A. (2018). Low-speed preconditioning for strongly coupled integration of Reynolds-averaged Navier–Stokes equations and two-equation turbulence models. Aerospace Science and Technology 77, 286-298. doi:10.1016/j.ast.2018.03.015

[22] http://alshair.com.sa/index.php/subsidiaries/industrial-division/shairco-fiberglass.Website Title AlShair Group, Article Title Al Shair Group, Date Accessed January 10, 2019

[23] http://www.performancecomposites.com/aboutcomposites-technical-info/122-designing-with fiberglass.html Website Title Fiberglass and Composite Material Design Guide Article Title performance composites Date Accessed January 10, 2019

[24] Versteeg, H. K., & Malalasekera, W. (2011). An introduction to computational fluid dynamics: The finite volume method. Harlow: Pearson Education.