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REVIEW-ANALYSIS OF ROOFTOP TELECOMMUNICATION TOWER OVER BUILDING IN EARTHQUAKE PRONE AREA

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Abstract: The increasing demand for telecommunication infrastructure has led to the widespread installation of rooftop towers on buildings. These structures, often located in earthquake-prone areas, impose additional dynamic loads on the building during seismic events. This paper provides a comprehensive review of studies analyzing the impact of rooftop telecommunication towers on buildings subjected to seismic forces. The key focus is on performance parameters such as storey drift, node displacement, shear force, and axial force. Insights into modeling techniques, material properties, and design considerations are also discussed, highlighting strategies to enhance structural resilience.

Keywords: *Rooftop Telecommunication Tower, Axial Force, Storey Drift, Nodal displacement, Shear Force*

I.INTRODUCTION:

The placement of telecommunication towers on building rooftops has become a common practice, particularly in urban areas. However, these towers can significantly alter the seismic response of the building due to their mass and dynamic characteristics. In earthquake-prone regions, the additional loads and potential amplification effects necessitate detailed analysis and design considerations. The rapid growth of telecommunication infrastructure has been instrumental in meeting the increasing demands for connectivity in urban and rural areas alike. Rooftop telecommunication towers, commonly installed on residential, commercial, and industrial buildings, serve as pivotal nodes in communication networks. However, their integration with buildings in earthquake-prone regions introduces significant structural and safety challenges. Seismic events impose dynamic forces that interact with the mass and stiffness of a building. The addition of a rooftop telecommunication tower alters the building's mass distribution and dynamic characteristics, potentially exacerbating seismic vulnerabilities. Key concerns include amplified inertial forces, increased stress concentrations at structural interfaces, and the possibility of torsional effects due to asymmetric tower placement. These factors can compromise the structural integrity of buildings, leading to severe damage or even collapse during earthquakes. Despite these risks, the design and placement of rooftop telecommunication towers are often guided by functional requirements rather than structural considerations. Many existing buildings with such towers were not originally designed to accommodate the additional loads and dynamic effects imposed by seismic activity. Furthermore, while international and regional codes address general seismic design principles, they provide limited guidance on the integrated behavior of buildings and rooftop structures during earthquakes.

II. OBJECTIVE

The objective of this research is as follows:

- Analyze the seismic impact of rooftop telecommunication towers on buildings in earthquake-prone areas.
- Evaluate critical performance parameters, including storey drift, node displacement, shear force, and axial force.
- Summarize existing modeling techniques and design considerations.
- Identify strategies for mitigating adverse seismic effects to improve structural safety and resilience.

III. LITERATURE REVIEW

[1] Shantilal Katare et.al (2024), Different reviews are based on tower analysis alone and focus on the response of the host structure on which the tower rests. Valuable insights and conclusions are provided by this literature review to identify the problems associated with the placement of telecommunication towers over buildings and the locations where they need to be placed. From this study, it is to be noted that previous studies were based on the location that was optimal for the host structure, but the worst-case scenario of tower placement was not used till date if it was necessary to provide it at that location. As a result, the conclusive outcome is known to aim at providing technical insights and recommendations for future research in this area.

[2] Malavathu Prasanna Lakshm et.al (2022), In this present study, a G+6 building (ZONE V) is considered. The seismic behaviour of the building with the rooftop telecommunication tower is analyzed and compared with that of the building without the tower. Then the building is retrofitted properly and the seismic behaviour of it is analyzed. A three legged telecommunication tower of height 15m is considered and the analysis is done using ETABS Software.

[3] Yogesh B. Zala et.al (2020), In the present work an attempt has been made to study the behavior of buildings with roof top tower in the event of an Earth Quake using STAAD pro. A typical commercial building is considered for the analysis. Four towers with height 15m and 30m is considered for the study.In this Paper We have presented the results of(G+5) commercial buildings of various plot area with telecommunication tower mounted on its rooftop.

[4] Ashok Meti et al (2017), Most of the researches have been studied for 3-legged triangular cross section and wind analysis for different heights and bracing systems. But in this dissertation have considered 4-legged self-supporting telecommunication tower with viscous fluid damper is incorporated for controlling the response of the tower structure and study includes 56m height of two tower models without and with damper was prepared using SAP2000 of version 18. Various analysis techniques such as static, response spectrum and time history analysis was done for different soil types and seismic zones, El-Centro data was used for time history analysis. After completion of analysis part, comparative study was made for without and with damper with respect to modal time periods,modal frequencies, base shear and joint displacement in static analysis whereas joint displacement in response spectrum and peak displacement and peak acceleration in time history by taking El- Centro earthquake data.

[5] Faria Aseem et al (2017), As per the authors point of view, increase in demand of telecommunication towers caused due to technological advances with the compulsion to provide efficient communication. Consequently, telecommunication sector in the country has expanded rapidly. In today's era the mobile sector is growing dynamically and trend of mobile communication is increasing day by day. Generally for telecommunication purpose, the four legged supporting tower are used widely. Nowadays mostly the telecommunication towers as we see are mounted on rooftops of structures like commercial buildings, hotels and etc. In this paper we have presented the results of design of (G+3) commercial building of plot area 144 sq.m with telecommunication tower mounted on its rooftop. Tower is of height 12m and the loads which are considered are dead load, live load and wind load. The concrete design was carried out by IS 456-2000, SP-16 & the steel design was carried out by IS 800-2007 by using STAAD PRO software. The design with chosen structural sections found to be safe and the structure withstand all the above mentioned design loads.

[6] Drisya S et al (2016), the author wants to suggest and express his thoughts by express the usage of mobile phones. In the present study, seismic analysis of a low rise commercial building with towers of height 9m, 15m, 21m and 27m is performed with SAP2000 software. The most favourable position of tower on the roof is identified by placing the tower at different positions. Stresses and axial forces in the top storey structural members and the influence of tower height on building are studied. The results obtained from modal analysis and response spectrum analysis of the structure are tabulated, compared and conclusions drawn. From the results it is concluded that the building need to be designed for resisting earthquake loads. And as the height of tower on rooftop increase there is considerable decrease in building frequency. The minimum displacement in the host structure is found when the tower was placed at the centre of the building roof, making it an optimal position for placing the tower.

[7] Sourabh Rajoriya et al (2016), the earthquake effects are considered as per author for diverse types of soils and after that we considered the location of tower at the top most roof top of structure where it had placed and it was detected that the movement at numerous height of the structure that is the displacement was maximum at the top most level of the height of tower and minimum at the building height. The numerous consequences attained from the above examination are then tabulated and then compared and after than conclusions were drawn which were detected the displacement was minutest when we were discussing about soft soil as well as displacement is minimum when we are talking about the position of the tower was at the center of building construction. On the rooftop, the tower was placed at 3 different locations. The investigation was carried out for a total of 4 seismic zones and 3 types of soils.

[8] Keshav Kumar Sharma et al (2015), As per author, the growing demand for wireless and broadcast communication has spurred a dramatic increase in communication tower construction and maintenance over the past 30 years. Failure of such structures is a major concern. In this paper a comparative analysis is being carried out for different heights of towers using different bracing patterns for Wind zones I to VI and Earthquake zones II to V of India. Gust factor method is used for wind load analysis, modal analysis and response spectrum analysis are used for earthquake loading. The results of displacement at the top of the towers and stresses in the bottom leg of the towers are compared.

[9] C. Preeti et al (2015), Studied the analysis of 4 legged angular self-supporting telecommunication towers is performed. Assessment is done based on modal analysis, by comparing the results of roof top tower and ground based tower. In support of this intention, two 4 legged self-supporting telecommunication towers of 24m and 21m are modeled on roof top of a building and on the ground, considering the effects of wind loads as per Indian condition. Effects of wind on towers are employed from the IS 875 (Part 3)-1987 by using STAAD pro finite element software. The tower and building is analysed by placing towers at centre of roof. Axial forces experienced by the structures too have been obtained.

[10] Shailesh S. Goral et al (2015), studied thoroughly the performance of telecommunication tower for diverse arrangement and its examination for seismic effect. In this research, earthquake along with wind examination of telecommunication towers was carried out. These with different arrangements and different configurations such as square plan, with gravity loading check along with different bracing systems are designed. Using STAAD Pro software, the same models are then modeled. These towers are examined by most popular method known as non-linear dynamic method. The consequences obtained from this method are compared on the basis of a range of constraints.

[11] Sumit Pahwa et al (2014), the author's paper describes about an analytical comparative study on 1S2 transmission tower under wind and earthquake loads considering optimization technique. The optimization of wind and earthquake load is carried out by plotting graphs between earthquake forces with height, wind forces with height and tower with X and K bracing under wind and seismic load. All the calculation and analysis is carried out using STAAD PRO software and EXCEL spreadsheet.

[12] Jithesh Rajase kharan et al (2014), the author wants to show the examination of response of a total of four towers of varying height, each having different bracing systems. Using the most common used software SAP version 2000, dynamic analysis along with static analysis was carried out by them. The time history analysis method was also taken into account with respect of the bhuj earthquake & the analysis of its response was successfully done.

IV. CONCLUSIONS

The addition of telecommunication towers significantly affects the seismic performance of buildings in earthquake-prone areas. Parameters such as storey drift, node displacement, shear force, and axial force must be carefully evaluated to ensure safety and compliance with design standards. Future research should focus on advanced modeling techniques and innovative mitigation strategies to enhance the resilience of these integrated structures.

V.REFERENCES

1.Shantilal Katare, Prof. Prachi Chincholikar (2024) “A Review on Buildings having Telecommunication Tower at Roof” International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 12 Issue II Feb 2024.

2.Malavathu Prasanna Lakshmi1 , K. Krishna Bhavani Siram2 (2022) “SEISMIC EVALUATION AND RETROFITTING OF BUILDING WITH ROOFTOP TELECOMMUNICATION TOWER” Dogo Rangsang Research Journal UGC Care Group I Journal ISSN : 2347-7180 Vol-12 Issue-02 No. 02 February 2022.

3.Yogesh B. Zala1, Ashutosh D. Patel2 (2020) “SESMIC ANALYSIS OF ROOFTOP MOUNTED TELECOMMUNICATION TOWER” International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-

0056 Volume: 07 Issue: 04 | Apr 2020 p-ISSN: 2395-0072

4.Ashok Meti, Vinayak Vijapur (2017), “ Seismic Analysis of Telecommunication Tower Using Viscous Damper”, International Research Journal of Engineering and Technology, ISSN 2395-0056, Vol. 4, Issue 6, pp. 2799-2805.

5.FariaAseem, Abdul Quadir (2017), “Effect of Rooftop Mounted Telecommunication Tower On Design Of The Building Structure”, International Research Journal of Engineering and Technology, ISSN 2395-0056, Vol. 4, Issue 11, pp. 10-15.

6.Drisya S., Joshma M (2016), “Seismic Analysis of Low-Rise Commercial Building with Roof Top Telecommunication Tower”, SSRG International Journal of Civil Engineering (SSRG– IJCE), ISSN 2348-8352, Vol. 3, Issue 8, pp. 9-12.

7.Sourabh Rajoriya, K.K. Pathak, Vivekanand Vyas (2016), “Analysis of Transmission Tower for Seismic Loading Considering Different Height and Bracing System”, International Journal for Research in Applied Science & Engineering Technology, ISSN 2321-9653, Vol. 4, Issue 9, pp.108-118.

8.Keshav Kr. Sharma, S. K. Duggal, Deepak Kumar Singh and A. K. Sachan (2015), “Comparative Analysis of Steel Telecommunication Tower Subjected To Seismic & Wind Loading”, Civil Engineering and Urban Planning: An International Journal (CiVEJ), Vol. 2, Issue 3, pp.13-31.

9.C Preeti, Sankara Ganesh Dhoopam (2015), “ Comparative Study of Four Legged Self- Supported Angular Telecommunication Tower on Ground and Mounted on Roof Top”, International Journal of Research in Engineering and Technology, ISSN 2319-1163, Vol. 4, Issue 10, pp. 111-118.

10.Shailesh S. Goral, Prof. S. M. Barelikar (2015), “Influence of Structure Characteristics on Earthquake Response Under Different Position of Rooftop Telecommunication Towers”, International Journal of Engineering Sciences & Research Technology, ISSN 2277-9655, Vol. 4, Issue 10, pp. 73-78.

11.SumitPahwa, Vivek Tiwari, Harsha Jatwa (2014), “ Analytical Study of Transmission Tower Subjected to Wind and Seismic Loads Using Optimization Technique”, International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Vol. 4, Issue 9, pp.375-383.

12.JitheshRajasekharan, S Vijaya (2014), “Analysis of Telecommunication Tower Subjected to Seismic & Wind Loading”, International Journal of Advancement in Engineering Technology, Management & Applied Science, ISSN 2349-3224, Vol. 1, Issue 2, pp. 68-79.

13.Hemal J shah, Dr. Atul K Desai (2014), “Seismic Analysis of Tall TV Tower Considering Different Bracing Systems”, International Journal of Engineering, Business and Enterprise Applications, ISSN 2279-0039, Vol. 14, Issue 178, pp. 113-119.

14.GholamrezaSoltanzadeh, Hossein Shad, Mohammadreza Vafaei, Azlan Adnan (2014), “Seismic Performance of 4-Legged Self-supporting Telecommunication Towers”, nternational Journal of Applied Sciences and Engineering Research, ISSN 2277-9442, Vol. 3, Issue 2, pp. 319-332.

15.Patil Vidya M., Lande Abhijeet C. (2013), “Structural Response of Lattice Steel Masts for Seismic Loading”, IOSR Journal of Mechanical and Civil Engineering, ISSN 2278-1684, pp. 36- 42.