Analysis of Twisted G+50 Buildings with Three Different Rotation Angles- A Review

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Abstract: The evolution of high-rise buildings with complex geometrical configurations has led to the increasing adoption of twisted or rotated structural forms in modern urban skylines. Twisted buildings, characterized by progressive floor rotation along the height, offer architectural distinction and potential aerodynamic advantages. However, such configurations introduce significant structural challenges due to torsional irregularity, non-uniform stiffness distribution, and complex load transfer mechanisms. This review paper critically examines nine previous research studies related to the seismic and wind performance of twisted tall buildings, with emphasis on rotation angles, torsional response, lateral displacement, storey drift, base shear, and time-period variation. The reviewed studies include numerical analyses, wind tunnel experiments, soil–structure interaction considerations, and evaluations of different structural systems such as shear walls, outriggers, and diagrids. Based on the synthesis of existing literature, key limitations and unresolved issues are identified. The review highlights a clear research gap in the systematic analysis of G+50 twisted buildings with multiple rotation angles under combined lateral loading conditions. The findings of this review establish a strong foundation for future analytical and parametric studies aimed at optimizing twist angles while ensuring seismic safety and structural efficiency.

Keywords: *Twisted Buildings, G+50 High-Rise Structures, Rotation Angle, Torsional Irregularity, Seismic Response, Lateral Loads.*

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I. INTRODUCTION

Rapid urbanization, continuous population growth, and the acute scarcity of available land in major metropolitan regions have significantly accelerated the development of tall and super-tall buildings across the world. As cities expand vertically to accommodate residential, commercial, and mixed-use demands, there has been a parallel shift in architectural philosophy toward innovative and visually striking structural forms that contribute to city identity and skyline aesthetics. In this context, twisted or helical high-rise buildings have emerged as a prominent architectural solution, offering a departure from conventional rectilinear forms. These buildings are characterized by a gradual rotation of each successive floor slab with respect to the one below, resulting in a continuous geometric transformation along the height of the structure. Such twisting not only enhances the visual dynamism of tall buildings but also introduces functional benefits such as improved daylight penetration, optimized views, and potential reductions in wind-induced vibrations due to disruption of coherent vortex shedding patterns around the building envelope.

Despite their architectural and aerodynamic advantages, twisted buildings pose significant challenges from a structural engineering perspective. The introduction of rotation along the height fundamentally alters the distribution of mass, stiffness, and strength within the structural system. Unlike regular buildings, where load paths are relatively straightforward and symmetrical, twisted configurations generate eccentric mass distribution and non-uniform stiffness profiles, leading to complex three-dimensional behaviour. These characteristics amplify torsional effects and induce coupled translational–rotational responses when subjected to lateral loads such as wind and earthquakes. Under seismic excitation in particular, the presence of geometric irregularity can lead to increased storey displacement, higher inter-storey drift, concentration of stresses in structural members, and uneven demand on lateral load-resisting systems. As the height of the building increases, these effects become more pronounced, making tall structures such as G+50 storey buildings extremely sensitive to twist-induced torsional irregularities and dynamic amplification.

Conventional structural design methodologies and codal provisions have largely been developed for regular, prismatic buildings with uniform geometry and predictable load transfer mechanisms. When applied directly to twisted buildings, these approaches often fail to capture the true structural response, potentially leading to unsafe or overly conservative designs. The interaction between rotation angle, building height, lateral stiffness, and dynamic characteristics such as natural time period and mode shapes requires detailed three-dimensional modelling and advanced dynamic analysis techniques. Furthermore, the selection of appropriate rotation angles plays a crucial role in balancing architectural intent with structural safety, serviceability, and economic feasibility. Small variations in rotation angle can significantly influence torsional response, lateral deformation, and seismic demand, particularly in very tall buildings.

In this background, it becomes essential to critically examine existing research on twisted high-rise buildings to understand how different rotation angles affect their structural performance under seismic and wind loading. A comprehensive synthesis of previous studies is necessary to identify prevailing trends, limitations, and unresolved issues in the analysis and design of twisted buildings. Therefore, this review paper aims to consolidate and critically evaluate existing literature related to twisted building configurations, with a specific focus on G+50 storey structures and varying rotation angles. By identifying key research gaps and shortcomings in current studies, the review seeks to establish a clear basis for future analytical and design-oriented research aimed at developing safer, more efficient, and code-compliant twisted high-rise buildings.

II. LITERATURE REVIEW

Several researchers have explored twisted buildings from architectural, structural, seismic and aerodynamic perspectives.

➢ *[1] Design of Twisted-Form Buildings: Correlation between Architecture and Structure (2024)*

- *By: Yiğit Erkoç & Necdet Torunbalcı*

This state-of-the-art review examines the rapid global rise of twisted-form buildings, driven by advancements in computational modelling, drawing technologies, high-performance materials, and modern construction techniques. The paper discusses how twisting occurs when each successive floor slab rotates relative to the previous one, creating diverse geometrical configurations and complex structural behaviours. The authors explore architectural motivations—such as aesthetic appeal, skyline identity, wind load reduction, and façade optimisation—while also highlighting challenges such as increased torsion, nonlinear load paths, and construction complexity. Multiple structural systems used in twisted buildings are compared, detailing how designers resolve torsional forces, ensure lateral stiffness, and maintain stability in tall rotating structures. Through several case studies, the review presents real-world challenges encountered during analysis and construction, including slab-to-core load transfer, alignment accuracy, façade fabrication, and formwork difficulty. The study concludes that designing twisted buildings requires a holistic approach where architecture and structural engineering must progress together, integrating geometry, sustainability, code compliance, and constructability. The review offers valuable insights for engineers, architects, and contractors in handling the multidisciplinary complexities of twisted-form skyscrapers.

➢ *[2] Comparison Between Seismic Analysis of Twisting and Regular 52-Story Towers Considering Soil–Structure Interaction (2024)*

- *By: Mohamed Naguib Abouelsaad, Mohammed Shaaban, Salah El Bagalaty & Mohamed E. El Madawy*

This study presents a comparative seismic evaluation of a twisting high-rise tower and a regular high-rise tower, with a special focus on the role of soil–structure interaction (SSI). Both towers consist of reinforced-concrete structural systems supported on a piled-raft foundation and are analysed using a single-step full 3D finite-element model with Midas GTS NX. The twisting tower configuration is modelled on the geometric behaviour of the Evolution Tower in Moscow. The soil profile consists of layered strata representing the ground conditions of New Mansoura City, Egypt. Seismic performance was examined under three recorded earthquake inputs, and dynamic responses were analysed for key parameters including natural vibration period, storey drift, and base shear. The results reveal that SSI significantly affects the dynamic behaviour of high-rise structures, leading to elongation of natural periods and increased lateral deformations and base shear for both regular and twisting towers. Comparative findings indicate that twisting geometry amplifies seismic response more noticeably than regular geometry, causing higher drift concentrations in upper storeys. The research concludes that SSI must be carefully incorporated in seismic design of high-rise buildings, particularly for twisting structures that experience amplified dynamic demands due to combined geometry-induced torsion and foundation flexibility.

➢ *[3] Analysis and Design of RCC Twisted Building Using ETABS Software (2023)*

- *By: Mr. Sidharth Aher, Mr. Nikhil Bagul, Ms. Vidhi Bhusare, Mr. Nikhil Chavhan & Prof. Rupali Jagtap*

This research investigates the structural performance of high-rise reinforced cement concrete (RCC) twisted buildings subjected to seismic loading. The study focuses on evaluating how different twisting rates affect lateral behaviour when analysed using ETABS software. Two twist configurations—1.5° and 3.5° per storey—were modelled to assess variations

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in structural response across multiple storeys. Key seismic parameters including storey displacement, storey drift, and base shear were extracted and compared. The results indicate that increasing the twisting rate causes higher torsional effects and lateral deformation, particularly in upper storeys, thereby demanding greater stiffness and resistance measures. The comparative analysis highlights that excessive twist angles significantly increase drift values and may compromise seismic performance, while lower twist angles present better stability without major sacrifice in architectural aesthetics. The research identifies an optimum twist range by balancing deformation control, seismic safety, and architectural feasibility. Overall, the study demonstrates the effectiveness of ETABS in modelling complex geometries and provides practical insights for safer and more efficient design of RCC twisted structures.

- *[4] Wind Tunnel Investigation of Twisted Wind Effect on a Typical Super-Tall Building (2022)*

- *By: Bowen Yan, Yanan Li, Xiao Li, Xuhong Zhou, Min Wei, Qingshan Yang & Xu Zhou*

This study examines the influence of twisted wind fields (TWFs) on the wind-induced pressures and dynamic responses of super-tall buildings through wind tunnel experiments. A 500-meter-tall square-plan skyscraper was tested under two twisted wind field scenarios, defined by vertical variation in wind direction with maximum yaw angles of approximately 30° and 20° near ground level. Using a guide vane system, the twisted wind fields were generated and compared against conventional wind fields (CWFs) with constant wind direction. The analysis focused on cladding pressure distributions, extreme local wind pressure, correlation and coherence of fluctuating wind loads, and the influence of vortex shedding mechanisms. Results revealed that TWFs cause significantly different wind pressure patterns on the windward and side façades relative to CWFs, and strongly alter the vortex shedding behaviour responsible for dynamic excitation. However, despite substantial changes in pressure distribution, the maximum wind load amplitudes in TWFs did not exceed those observed in CWFs. The findings provide crucial insights for wind-resistant design of future tall buildings, particularly in regions where twisted wind fields are expected due to topographic or climatic conditions.

- *[5] Analysis of Twisted Tall Structure Considering Lateral Load Using ETABS (2022)*

- *By: Zuber Ali Shah & Rahul Satbhaiya*

This research examines the seismic and wind performance of RCC twisted tall buildings subjected to dynamic lateral loads. The study models and analyses twisted structures using ETABS to compare the structural response at different twist rates—10°, 12.5°, and 15° applied at the building centre. Load cases including dead load, live load, wind load, and seismic load were applied, and the Response Spectrum Method was used to evaluate dynamic behaviour as per Indian Standard codal guidelines for seismic Zone V. Parameters such as storey displacement, storey drift, time period, and base shear were used to assess performance. The results revealed that increasing the angle of twist led to higher lateral displacement, time period, and drift, indicating amplified torsional effects and structural vulnerability. Among all configurations, the 10° twist demonstrated the most efficient performance with lower lateral deformation and better seismic resistance compared to 12.5° and 15° twists. The study concludes that although twisted buildings are structurally feasible under seismic and wind loads, precise control of the twist angle is essential for achieving optimal performance under lateral loading conditions.

- *[6] Optimum Torsion Axis in Multistory Buildings Under Earthquake Excitation: A New Criterion Based on Axis of Twist (2021)*

- *By: Vasiliki G. Terzi & Asimina Athanatopoulou*

This research introduces a new analytical criterion for determining the optimum torsion axis in multistory buildings subjected to seismic loading, addressing the limitations of conventional methods that primarily rely on static load assumptions. In traditional seismic design, the optimum torsion axis is defined by minimizing the sum of squared floor rotational angles under lateral static forces. However, this approach becomes insufficient for most multistory buildings where eccentric mass distribution and height variation result in complex torsional behaviour. The present study proposes a new concept based on the "axis of twist," defining the optimum torsion axis as the location where cumulative translational displacements of floors are minimized. Mathematical formulations are developed for both static torsional moments and dynamic torsional ground motion excitation. The findings reveal that the static optimum torsion axis depends on the distribution of torsional moments across the building height, while the dynamic optimum torsion axis is influenced only by floor mass moments of inertia and remains independent of base torsional excitation. The authors demonstrate that the proposed method can be implemented efficiently using data from common structural analysis software, making it practical for real seismic design applications. This criterion enhances understanding of torsional behaviour and supports more accurate modelling of buildings with eccentricity, irregular geometry, or twisting configurations.

- *[7] Analysis and Design of Twisted Building by Using STAAD. Pro V8i (2019)*

- *By: E. Srinivasulu, K. S. Subrahmanyam, L. Manikanta, Ch. Satish & Divya Anusha Naidu*

This research focuses on the structural behaviour and design requirements of high-rise twisted buildings, where geometric rotation introduces additional torsional forces and complexity. A G+10 twisted building model was analysed and designed using STAAD. Pro V8i to compute shear forces, bending moments, deflection, and reinforcement detailing of major structural elements including beams, columns, and slabs. The study highlights the significant influence of twisting geometry on load distribution, where the rotation of the structure (total twist of 30° across 10 storeys) caused non-

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uniform lateral displacement and torsional effects. To address this, gravity load components were resolved horizontally through slab action and transferred to core shear walls acting as the main vertical load-resisting system. The remaining torsional forces were countered using a composite system comprising concrete shear walls and link beams. The structural analysis demonstrated that an optimized section design is essential for ensuring stability and cost efficiency in twisted buildings. Overall, the study emphasizes that STAAD.Pro V8i can effectively simulate complex geometries and support economic and safe design of twisted high-rise structures under service and extreme loading conditions.

- *[8] Study of Torsion Effects on Building Structures Having Mass and Stiffness Irregularities (2015)*

- *By: Rajalakshmi K. R., Harinarayanan S., Jiji Anna Varughese & Girija K.*

This study focuses on the seismic behaviour of buildings with structural irregularities, particularly mass and stiffness variations along the height, which significantly influence torsional response under earthquake loading. The paper emphasizes that modern architectural trends often generate irregular structures, making their seismic design more challenging for structural engineers. A nonlinear dynamic analysis approach was adopted to evaluate the displacement response and damage patterns in such structures. The results showed that buildings with mass and stiffness irregularities exhibit greater lateral displacement, increased torsional rotation, and localized damage near discontinuity regions when compared to regular structures. This research highlights that torsional effects become more pronounced in high-seismic zones, and inadequate design consideration may lead to severe structural vulnerability during strong ground motion. The authors recommend adopting careful design strategies, including appropriate lateral force distribution, enhanced stiffness at irregular regions, and the use of advanced time-history analysis for assessing seismic performance. Overall, the study underlines the importance of thorough evaluation of torsional effects to ensure safety and performance of irregular architectural forms.

- *[9] Seismic Performance Evaluation of Twisted Outrigger System (2012)*

- *By: D. H. Lee, E. S. Kim, D. E. Kang & T. Kim*

This study investigates the seismic performance of a 60-storey twisted high-rise structure featuring an outrigger system, focusing on how varying twist angles influence structural response. The research highlights that twisted architectural forms provide aerodynamic advantages against wind loads; however, their effects on seismic behaviour require deeper evaluation. To address this, six prototype buildings were analysed—three located in high-seismicity zones and three in low-seismicity zones—with different degrees of twist implemented for comparative assessment. The seismic analysis demonstrated that the twist angle substantially affects structural parameters such as storey drift and demand–capacity ratio (DCR). Buildings situated in high-seismicity areas exhibited a significant increase in lateral deformation and DCR with higher twist angles, indicating reduced seismic efficiency. The results show that while twisted outrigger systems can enhance stiffness and energy dissipation, excessive twisting reduces structural safety under earthquake loading. The study suggests that seismic design of twisted tall buildings must ensure balanced integration of geometry and outrigger configuration, with optimum twist angles and structural bracing essential for improved performance.

III. RESEARCH GAP

A critical examination of the nine reviewed studies reveals several important limitations and unresolved issues that clearly indicate the need for further focused research in the field of twisted high-rise buildings. One of the most significant gaps identified is the limited attention given to very tall structures such as G+50 storey buildings. The majority of existing studies concentrate on low- to medium-rise buildings or moderately tall structures, typically ranging from G+10 to G+30 storeys. While these studies provide valuable preliminary insights into the behaviour of twisted geometries, their findings cannot be directly extrapolated to G+50 or taller buildings, where structural behaviour is governed by more complex dynamic effects, higher mode participation, increased flexibility, and amplified torsional response. As building height increases, the interaction between geometric irregularity and lateral loads becomes increasingly nonlinear, making it essential to conduct dedicated studies on very tall twisted buildings rather than relying on conclusions drawn from shorter structures.

Another major research gap lies in the inconsistent and fragmented evaluation of rotation angles across existing literature. Different researchers have adopted varying twist configurations, such as rotation per storey, total twist across the height, or arbitrary angular increments, often without a standardized basis for comparison. As a result, it becomes difficult to draw generalized conclusions regarding the influence of rotation angle on structural performance. Moreover, very few studies have undertaken a systematic comparison of multiple rotation angles within the same structural model. In particular, a comprehensive investigation involving three distinct rotation angles applied to a single G+50 building configuration is largely absent. Such a parametric approach is essential to clearly understand trends in lateral displacement, storey drift, base shear, time period, and torsional response as the degree of twist increases, and to establish rational limits for acceptable rotation angles in tall buildings.

The review also highlights a notable gap in the combined assessment of wind and seismic loading effects. Many existing studies analyze wind loads and seismic loads independently, focusing on one hazard at a time. While this approach simplifies analysis, it does not realistically represent the actual loading conditions experienced by tall buildings during their service life. Twisted buildings, in particular, are highly sensitive to both wind-induced and earthquakeinduced forces due to their complex geometry and torsional characteristics. The lack of integrated studies considering the combined influence of wind and seismic actions restricts the ability to accurately evaluate overall structural performance, serviceability, and safety. This gap is especially critical for G+50 buildings, where wind effects may dominate serviceability criteria, while seismic effects govern strength and ductility requirements.

Furthermore, although torsional irregularity is widely acknowledged as a key concern in twisted buildings, its quantitative evaluation remains inadequate in existing research. Most studies qualitatively report increased torsional effects with higher twist angles, but few provide a detailed assessment of how torsion varies along the height of the building or how it evolves with changes in rotation angle. Parameters such as torsional moment distribution, rotational displacement, torsional amplification factors, and coupling between translational and rotational modes are often not comprehensively investigated. This lack of detailed torsional quantification limits the understanding of critical zones within the structure and hinders the development of effective design strategies to control torsional response in tall twisted buildings.

Another important limitation identified is the lack of rigorous code-based performance assessment. While several studies report structural response parameters such as storey displacement and storey drift, only a limited number explicitly evaluate these results against the permissible limits prescribed by seismic design codes. Compliance with codal provisions related to drift limits, torsional irregularity, and performance objectives is essential for practical implementation of twisted building designs. The absence of systematic code-based evaluation creates uncertainty regarding the feasibility and safety of proposed twisted configurations, particularly in high seismic zones.

Finally, the literature reveals a clear need for optimization-oriented studies aimed at identifying an optimum rotation angle for very tall twisted buildings. Existing research often concludes that excessive twisting adversely affects seismic performance, yet it does not define a clear threshold or optimum range of rotation angles that balances architectural expression with structural efficiency and safety. There is a lack of studies that integrate architectural requirements, structural response, serviceability criteria, and seismic performance into a unified optimization framework. Addressing this gap is essential for developing rational design guidelines that allow architects and engineers to exploit the benefits of twisted forms while ensuring reliable and economical structural performance for G+50 and taller buildings.

Collectively, these research gaps strongly justify the need for a comprehensive analytical study focused on G+50 twisted buildings with three different rotation angles, incorporating detailed torsional assessment, combined lateral loading, and code-compliant performance evaluation. Such a study would significantly contribute to advancing the understanding and practical design of twisted high-rise structures.

IV. OBJECTIVES

➢ *The Specific Objectives are:*

- To develop three structural models of a G+20 twisted RC building with varying rotation angles applied per floor.
- To analyse the seismic behaviour of each configuration using ETABS/STAAD software as per Indian Standard codal provisions (IS 1893:2016, IS 456:2000).
- To compare the structural response in terms of:

✓ Storey displacement
✓ Storey drift
✓ Torsional rotation
✓ Base shear
✓ Modal time period
✓ Mode shapes

- To identify the twist angle that provides optimum performance without compromising safety or stability.
- To provide design recommendations for structural engineers involved in twisted high-rise buildings.

V. CONCLUSION

This review paper presents a comprehensive synthesis of nine previous studies related to twisted tall buildings, emphasizing their structural behaviour under seismic and wind loads. The literature confirms that twisted geometries significantly influence torsional response, lateral displacement, and overall seismic performance, particularly in tall structures. While architectural and aerodynamic benefits are evident, excessive twisting can compromise structural safety. The identified research gaps highlight the need for a detailed analytical study on G+50 twisted buildings with multiple rotation angles under realistic loading conditions. Addressing these gaps will contribute to the development of safer, optimized, and code-compliant design strategies for twisted high-rise buildings in seismic regions.

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REFERENCES

[1]. Srinivasulu, E., Subrahmanyam, K. S., Manikanta, L., Satish, Ch., & Naidu, D. A. (2019). Analysis and Design of Twisted Building by Using STAAD.Pro V8i. Journal of Emerging Technologies and Innovative Research (JETIR), Volume 6, Issue 4, ISSN: 2349-5162.
[2]. Erkoç, Y., & Torunbalcı, N. (2024). Design of Twisted-Form Buildings: Correlation between Architecture and Structure. Journal of Architectural Engineering, 30(3). https://doi.org/10.1061/JAEIED.AEENG-1729
[3]. Aher, S., Bagul, N., Bhusare, V., Chavhan, N., & Jagtap, R. (2023). Analysis and Design of RCC Twisted Building Using ETABS Software. International Journal of Creative Research Thoughts (IJCRT), 11(5), ISSN: 2320-2882.
[4]. Shah, Z. A., & Satbhaiya, R. (2022). Analysis of Twisted Tall Structure Considering Lateral Load Using ETABS. International Journal of Scientific Research in Civil Engineering (IJSRCE), 6(1), 66–75. ISSN: 2456-6667.
[5]. Lee, D. H., Kim, E. S., Kang, D. E., & Kim, T. Seismic Performance Evaluation of Twisted Outrigger System. Chang Minwoo Structural Consultants, Inc., Seoul, Korea.
[6]. Abouelsaad, M. N., Shaaban, M., El Bagalaty, S., & El Madawy, M. E. (2024). Comparison Between Seismic Analysis of Twisting and Regular 52-Story Towers Considering Soil–Structure Interaction. Earthquake Engineering and Engineering Vibration, 23, 663–675.
[7]. Terzi, V. G., & Athanatopoulou, A. (2021). Optimum Torsion Axis in Multistory Buildings Under Earthquake Excitation: A New Criterion Based on Axis of Twist. Engineering Structures, 249, 113356. https://doi.org/10.1016/j.engstruct.2021.113356
[8]. Rajalakshmi, K. R., Harinarayanan, S., Varughese, J. A., & Girija, K. (2015). Study of Torsion Effects on Building Structures Having Mass and Stiffness Irregularities. International Journal of Engineering Research & Technology (IJERT), 4(6). https://doi.org/10.17577/IJERTV4IS061059
[9]. Yan, B., Li, Y., Li, X., Zhou, X., Wei, M., Yang, Q., & Zhou, X. (2022). Wind Tunnel Investigation of Twisted Wind Effect on a Typical Super-Tall Building. Buildings, 12(12), 2260. https://doi.org/10.3390/buildings12122260
[10]. Mr. A. P. Patil, Mr. A. A. Choudhari 2017, Design & Analysis of Multi Storeyed Building (G+10) By Using Stadd Pro, International Journal of Advanced Engineering, Management and Science (IJAEMS) [Vol-3, Issue-3].
[11]. Deevikrishnachaitanya, & Santhosh kumar 2017, Analysis and design of a (g + 6) multi storey residential building using STAAD pro, AIJREAS vol 2, (ISSN-2455-6300).
[12]. Aman, Manjunath Nalwadgi 2016, Analysis and design of multistorey building by using STAAD Pro, (IRJET) Volume: 03
[13]. Y. Tamura, H. Tanaka, K. Ohtake, M. Nakai, Y. Kim (2010), Aerodynamic Characteristics of Tall Building Models with Various Unconventional Configurations, 2010 Structure Congress, ASCE.
[14]. K. S. Moon (2010), Stiffness-based design methodology for steel braced tube structures: A sustainable approach, Engineering Structures, vol. 32, pp. 3163-3170.
[15]. K. S. Moon (2012), 3 rd Year Research Report, Cutting-edge Urban Development Program, Korea.
[16]. American Society of Civil Engineers, ASCE/SEI 7-05 Minimum Design Loads for Building and Other Structures, ed. Reston, VA: ASCE, 2006.
[17]. [1] C. Leone, W. Florio, “Analise param ´ etrica de iluminac¸ ´ ao natural e de protec¸ ˜ ao solar de edif ˜ ´ıcios torcidos”, Ambiente Constru´ıdo, vol. 21, n. 4, 2021.
[18]. K. S. Moon, “Studies on various structural system design options for twisted tall buildings and their performances.”, The Structural Design of Tall and Special Buildings, 23(5), 319–333, 2014.
[19]. A. Sev, B. Basarir, “A recent trend in tall building design: Twisted forms”. e-Journal of New World Sciences Academy, 6(4), 1603–1619. 2011.
[20]. CBTUH, “Tall buildings in numbers: Twisted tall buildings”, CBTUH, 3, 46-47.
[21]. V. Yadav, A. Bajpai, “Seismic Study of Diagrid Structure with Brace Frame and Damper Frame System of Different Arrangement”, Journal of Civil Engineering and Environmental Technology, Volume 7, Issue 2; 2020, pp. 174-178
[22]. J. Shaikh, A. Shaikh, G. Patel, S. Sayed and R. Tinwala, “Analysis and Design of Twisted Skyscraper Building Using ETABS”, International Journal of Engineering Development and Research, Volume 8, Issue 3, 2020
[23]. G. N. Taskin, “A Comparative Study on Alternative Structural System Layouts of Twisted Tall Buildings”, MSc thesis, Middle East Technical University, 2019.