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A Review Paper on Nonlinear Dynamic Analysis of Irregular RCC Multistory Building for Different Seismic Intensities

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Abstract: The architectural designs of today's structures often feature numerous flaws that cannot be avoided. The structure is more susceptible to natural disasters like earthquakes because of these flaws. The behavior of irregular buildings during seismic events is examined in the current study. Nonlinear static analysis is used to evaluate the effectiveness and susceptibility of the irregular building models taken into consideration. Building reaction to earthquakes is a challenging, dynamic, nonlinear, three-dimensional challenge. It is generally acknowledged that the most accurate method for modelling the reaction of structures exposed to high levels of seismic excitation is nonlinear time-history analysis. This analytical approach may replicate the inherent inelastic dynamic behavior of structures and is founded on strong fundamental ideas. As a result, the combination of analysis accuracy and simple modelling allows for the reduction of the sense of complexity associated with nonlinear dynamic analysis. Modelling presumptions are explored together with their effects on the nonlinear time-history analyses' numerical outcomes, which were found to be in strong accord with the findings of the experiments. According to the study, it is advised that Time History method analysis of multi-story RCC buildings become important to assure safety against earthquake force. In the case of irregular buildings, the angle of seismic force incidence is significant. Even though the building structure is safe when assessed and developed in accordance with design code requirements, the incidence of seismic action makes it more vulnerable. For this reason, it is crucial to examine the behavior of the considered models while taking the incidence angle of earthquake forces into consideration using parametric test. By taking into account various earthquakes, nonlinear dynamic analysis has been done in various directions to establish the critical angle of incidence, which is comparable to the response spectrum of the Indian standard code. In the current research, nonlinear dynamic analysis of high-rise RCC buildings is explored, taking into account various seismic intensities, as well as the seismic reactions of such buildings. ETABS software is used to model the building under examination while taking into account various seismic intensities. With the help of time history analysis, dynamic structural response to loads can be evaluated linearly or nonlinearly and may vary depending on the chosen time function

Index Terms **-** Time History Analysis, Irregularity, Non-Linear Dynamic Analysis, Multistorey Building, Seismic Zones, Shear wall, ETABS Software

I. INTRODUCTION

The structural design affects how multi-story buildings respond to intense earthquake motions. One of the main causes of failure during earthquakes is recognized to be irregular configuration, either in plan or in elevation. Unfavorable behavior is shown by irregular structures during earthquakes. **(Siva Naveen et al 2018**). Under seismic action, the abnormalities in the building cause damage to be amplified. Buildings having an irregular configuration or an unbalanced distribution of structural features have in fact sustained more damage during previous earthquakes. (**Stefanu et. Al., 2014**). According on the stiffness and mass distribution of the building's layout and elevation, the majority of seismic codes, including IS-1893 (part 1): 2016, divide buildings into regular and irregular types. Plan irregularities lead to torsional effects in buildings, whereas elevation irregularities enhance seismic demand in a particular story. Both types of abnormalities result in a localized increase in seismic demand for a particular element that isn't given enough strength and ductility. To account for the torsional impact, the Indian standard code has specified a parameter called design eccentricity. These suggestions, however, are based on models of single-story, linearly functioning framed structures that are extremely idealized. Therefore, the torsional effect in practice is different from what was predicted for traditional design. Therefore, it is crucial to select an analysis technique that can reveal the true behavior of structures when exposed to seismic stimulation. Reducing the uncertainties and part of the conservatism associated with the code base will lower the design earthquake loads and result in a more cost-effective design for nonlinear dynamic analysis. Time history analysis can be a helpful substitute for the seismic design of a structure for this reason. Because Time History is a realistic method, it is utilized for seismic analysis and offers a better check to the safety of structures that have been analyzed and developed using the method prescribed by the IS code. **(A S Patil et. Al; 2013**) It is important to do a seismic analysis of the structure utilizing deferment available methods in order to determine seismic responses (1). Static Analysis, Nonlinear Static Analysis, Linear Time History Analysis, and Nonlinear Time History Analysis are the four types of static analysis. For regular structures with a limited height, linear static analysis or an equivalent static approach can be utilized. The level of the forces and their distribution, coupled with the height of the structure, are the key distinctions between linear static and linear dynamic analysis. In that it permits inelastic behavior of structures, nonlinear static analysis is superior than linear static or dynamic analysis. The sole technique for describing the real behavior of a structure during an earthquake is a nonlinear Time History analysis. (**Lovepreet Singh et. Al 2022)** According to research by George Georgios's et al. (2015), the rotational response of building structures under powerful ground motions is the primary reason for partial or complete collapse. The structural design affects how multi-storey buildings respond to intense earthquake motions. One of the main causes of failure during earthquakes is recognized to be irregular configuration, either in plan or in elevation. Unfavorable behavior is shown by irregular buildings during earthquakes (Siva Naveen et al., 2018). In their study of the seismic response of multi-story buildings with vertical structural defects, Valmundsson and Nauhave (1997) found that a 30% reduction in stiffness increased the story drift by 20–40%.

II. LITERATURE REVIEW

- ***A S Patil D Kumbhar (2013*****):** A more efficient design will result from using the Time History Analysis method to reduce the uncertainties and part of the assumptions associated with the code base, which additionally decreases the design seismic loads. Time history analysis can be a helpful substitute for the seismic design of a structure for this reason. Because Time History is a realistic method, it is utilized for seismic analysis and offers a better check to the safety of structures that have been analyzed and developed using the method prescribed by the IS code.

- ***Pedram Omidiam, Hamid Saffari (2015)****:* This study examines the seismic response of RC buildings with SMAs in three different building height cases: regular, torsional irregularity, and high torsional irregularity. The impacts of SMA as longitudinal reinforcement in structures with various story counts that represented the Low, Mid, and High were studied for this purpose. According to research, the use of SMA in irregularly shaped buildings reduces the destructive impacts of irregularity, including base shear and drift in buildings. It is noted that the Steel example has a bigger drift than the other cases, while the SMA case has the lowest rise in slope. When taking into account residual drift, it is discovered that the rate of rise in the residual drift for the Steel instance is larger in comparison to other examples and is about 12%, whereas the rate of increase for the SMA case is about 3.5%.

- ***George Georgoussisa, Achilleas Tsompanosa and Triantafyllos Makariosb (2015):*** This paper examined A rough method is offered for the study of multi-story asymmetric setback buildings. Approximate seismic analysis of multi-story buildings with mass and stiffness abnormalities. Periods, base shears, and, to a lesser extent, base torques, can all be predicted with considerable accuracy. Two structures are considered in this study. Both systems are separated into two substructures and are 8-story mono-symmetric buildings. Tower structure floors are 15 x 10 m and the base structure floor is 22 x 15m. In the x direction, two linked walls (30x300cm) and two structural walls (30x500cm) are taken into consideration. Imperial Valley ground motion from 1940 is taken into consideration at PGA=0.5g. Using the software SAP2000-V11, all nonlinear response history analyses were carried out. About CM per floor, the mass and the gyrating radius are as follows: mb=264kNs2 /m, rb= 7.687m, and mt=120kNs2 /m, rt= 5.204m. The elastic modulus is E=20x106 kN/m2 and the story height is 3.5m.

- ***Sagar R Padol1 , Rajashekhar S. Talikoti(2015*****):** This study's analysis of the seismic reactions of multistory RC buildings with uneven mass came to a conclusion. The analysed structural response is typically nonlinear, making time history analysis one of the key methods for structural seismic analysis. This study uses ETABS software to analyse and highlight the impact of mass irregularity on various floors in RCC buildings over time. It is evident from numerous earlier studies that shear walls, base isolation, and other measures can be taken to reduce the impact of earthquakes on structures.

- ***Prajwal T P, Imtiaz A Parvezb, Kiran Kamatha stidied(2016):*** Nonlinear Analysis of Unusual Structures The angle of incidence of seismic force is significant in the case of irregular buildings, according to the in Direction of Seismic Waves. Even though it is safe when analyzed and designed, the incidence of seismic action makes the building structure more vulnerable, so it is crucial to study how the models under consideration behave. Accounting the incidence angle of earthquake forces using parametric test, nonlinear dynamic analysis has been carried out along different directions to determine the critical angle of incidence by considering the different earthquakes, which is comparable to response spectra of the Indian earthquake.

- ***Zaid Mohammada, Abdul Baqib, Mohammed Arifb (2016):*** study on the seismic response of buildings made of RC frames and perched on hill slopes for step-back setback buildings, a base shear value drops of about 45% is seen. When compared to step-back designs, two distinct configurations of hill structures have been modelled and examined in the current study utilising the ETABS v 9.0 finite element code. Step-back structures also exhibit higher levels of story drift and story shear, which increases their susceptibility to earthquake stresses. Therefore, when subjected to seismic stresses, step-back setback buildings perform better than step-back configuration. The shear forces created in the columns at foundation level have been described in terms of the dynamic parameters acquired from analyses.

- ***Balaji. U., Mr. Selvarasan M.E. (2016):*** A residential G+13 multi-story building is examined for earthquake loads in this study using ETABS. Static and dynamic analyses are carried out under the assumption that material properties are linear. These non-linear analyses take into account seismically active areas, and the behavior is evaluated using kinds II soil conditions. Plots of several responses, including displacements and base shear, are shown. The greatest center-of-mass displacement is thought to show the differences between all approaches. The greatest displacement is shown to increase from the first to the last story. However, time history analyses for both earthquakes revealed the largest center of mass movement.

- ***Alessia Di Cuia, Luca Lombardi, Flavia De Luca(2017)*** Linear Time-History Analysis for EC8 Design of CBF (concentric brace frame) Structures is studied in this work. For the design of EC8-compliant CBF structures, a new optimised design approach is put forth and put into practise using linear time-history analysis as the methodology. The new design method allows for a significant reduction in brace sections at the expense of an increasing overstrength factor, which, in some cases, results in an increase in column sections. When using the traditional linear static approach for typical, mid-rise structures, the design process is quite smooth.

- ***Atul, N. Kolekar, Y.P.Pa war, Dr. C.P. Pise, D.D.Mohite, S.S. Kadam, C.M.Deshmukh(2017):*** *This* essay compares the performance of RCC multi-story buildings during the earthquakes in Koyna and Bhuj. In the current work, reaction spectrum analysis and time history analysis are used to carry out dynamic analysis of G+12 RC multi-story framed buildings that are taken into consideration for the Koyna and Bhuj earthquakes. SAP2000 software is also used to compare the responses of such buildings. By applying time history analysis, it is discovered that the seismic response, such as base shear, for the Bhuj earthquake is greater by 45.44% than the Koyna earthquake. Because performance point base shear for the Koyna and Bhuj earthquakes is greater than design base shear, it is determined that the building used for pushover analysis is seismically safe.

- ***Prof. Ravi M. Desai, Omkar J. Parkar, Tanvi K. Sa jane, Snehal N. Nirmalkar, Prathamesh U. Shinde (2017):*** The RC-Framed structure's seismic response is examined in this research using both human calculations and SAP 2000. Since the modal mass participation factor for the modal in the Y direction is higher than in the X direction, this direction is thought to be the weakest during an earthquake. Base shear for low-rise structures is seen to be higher than for tall structures, demonstrating that low-rise structures are more rigid during earthquakes.

- ***David Bru, Antonio González, F. Javier Baeza, Salvador Ivorra (2018):*** Examine the impact of corrosion on the structure. A substantial shift in the building's seismic behaviour was caused by the irregular corrosion effect along the structure. In particular, before corrosion, the analysed building was safe from the assumed seismic loads. The study's findings, which include a decrease in the mechanical strength of the steel rebars and an increase in their plastic deformation, are discussed in more detail below. Due to the significant loss of the rotational capacity in the concrete components at the coastal front, that is sufficient to prevent the seismic collapse of the building.

- ***Deressa Ajema (2018):*** This study compares the seismic behaviour of braced and multistorey shear wall frames. The results showed that the X-braced frame showed the maximum reduction in story displacement and fundamental time period of the frame than the inverted V-braced frame and the V-braced frame when two bays in a row are shear walled and braced at the corner of the building in both the X and y directions. The design of an earthquake resistant structure does not always benefit from increased shear wall thickness.

- ***Siva Naveen Ea, Nimmy Mariam Abrahamb, Anitha Kumari S D (2018):*** This study paper aims to analyse irregular structures subjected to earthquake loads. The current study examines the seismic response of structures made of reinforced concrete that have different combinations of imperfections. It has been noted that irregularity has a significant impact on the seismic reaction. Stiffness irregularity is discovered to have the greatest impact on the reaction out of all the single irregularities of different types that have been examined. The design with mass, stiffness, and vertical geometric irregularities has shown the best reaction among cases with combinations of irregularities. The findings of this study would help in the thoughtful design of irregular structures without sacrificing their performance. Maximum displacement response was demonstrated by the combination of stiffness and vertical geometric imperfections, whilst minimal displacement was demonstrated by the combination of re-entrant corner and vertical geometric irregularities.

- ***Luca Lombardi, Flavia De Luca, John Macdonald(2019):*** This study discusses an innovative framework for Eurocode 8-compliant design utilizing linear time-history analysis (LTHA), and a 12-storey regular The design of buildings through linear time-history analysis is studied, optimizing the ground motion selection, and a new index for LTHA ground motion selection is proposed to control response variability in relation to the dynamic properties of the structure. Reinforced-concrete Moment-Resisting Frame Building is used as a case study. Here, it has been specifically examined if it is possible to use the spectrum-compatibility process offered by Eurocode 8 for Nonlinear Time-History Analysis (NTHA). This can be quite important since it enables direct comparison of linear and nonlinear outcomes using the same set of ground movements if the ground motion selection technique is completely compatible with NTHA.

- ***UmamaheswaraRao Tallapalem1, Nurulla Shaik2, Gopi Pagidimarry (2019):*** The purpose of this study is to analyse multi-story buildings in various seismic regions in India. The building's base shear is greater in seismic zone V than in zones II, III, and IV, according to the analysis of the structure in various seismic zones across India. Base shear in seismic zone V is also larger than that in zones II, III, and IV, respectively. Based on the zone factor, base shear, displacements, support reactions, and steel quantity are more prevalent in zone-v. Seismic zone V has more steel than seismic zones II, III, and IV combined.

- ***Dr. S. G. Makarande, Akash P. Gupta, Prof. G. D. Dhawale (2019):*** In this study, reinforced concrete buildings are seismically analysed for dynamic ground motion characteristics. It's crucial to comprehend the characteristics of ground motion in order to take safeguards against damage to life and damage to structures caused by ground motion. The proposed review will examine how low, middle, and high-rise reinforced concrete structures respond to ground vibrations with low, intermediate, and high-frequency content. According to the study, it is advised that in order to ensure safety against earthquake force, an analysis of multistorey RCC buildings using the Time History approach will be required.

- ***Allauddin Shaik (2019):*** This study paper's goal is to describe the concept of the response spectrum to analyse multi-story buildings in various seismic zones and to point out the importance of considering this impact when deciding on earthquake resistance standards. Also outlined are the codal requirements for response spectrum analysis of multi-story buildings under IS:1893 (Part 1)-2002 code. Legitimately, base shear is dependent on seismic acceleration. Accordingly, a structure's design base shear would be modest if it wasn't necessary for it to be subjected to strong seismic forces. The entire estimated movement of the story due to lateral forces is referred to as story displacement.

- ***Rajiv Banerjee, J.B. Srivastava(2019):*** Finding the ideal shear wall position for zones III and IV in an irregular building is the study's main goal. This study examines a G+15 story building. The building is T-shaped and has an uneven shape. To determine where the shear wall should be placed in the structure, a comparison study is conducted. The shear wall's overall length in the construction is kept constant for optimisation purposes. The base shear, narrative displacement, and tale drift are used as the basis for the comparative investigation. The comparative investigation led to the conclusion that the shear wall's position is crucial in boosting resistance to lateral stresses.

- ***Kaushal Vijay Rathod, Sumit Gupta*** *(2020):* This study examined the variation of story drift in X and Y direction with respect to time history and used ETABS to perform a nonlinear time history analysis on a ten-story RCC building frame. The results demonstrate that the maximum drift was achieved as well as the variation of base shear in X and Y direction. We can infer this from the time history plot and get to the conclusion that the base reaction gets stronger over time. The load-bearing capacity, ductility, stiffness, damping, and mass of a structure are its key seismic analysis inputs. Calculations are made for the various response parameters, such as base shear, narrative drift, and tale displacements.

- ***K.S. Patil, Desai Shubham S, Dahifale Rahul S(2021):*** investigated the effects of seismic forces on building behavior and life cycles using time history analysis. In this project, we learned how to use Staad Pro, an integral building design software, and we also used time history analysis to examine the effects of seismic force responses on the life cycle and behavior of buildings. The modal calculation for buildings is carried out, and natural frequencies for various mode shapes of the buildings are obtained.

- ***Kalpak.A. Zagade, Aniket. Patil, Abhijeet.Galatage(2021):*** The purpose of this paper is to describe time history analysis utilizing ETABS and the study relies on a multistorey structure's linear and nonlinear analysis to determine base shear, story displacement, and time period. In time history analysis, the reaction is obtained directly from the time history of the applied force or rate of acceleration. The time evolution of the response cannot be estimated in response spectrum analysis. Only the highest possible response is predicted. Additionally, there is no information on the period of time when the response is at its peak. The structural response can be predicted more correctly using time history analysis than response spectrum analysis, hence it should be used

- ***Haitham Abdel Malek, Tarek K. Hassan, Ayman Mustafa (2021):*** This study intends to shed light on the performance-based design (PBD) procedure's absence from the (ECP-201) seismic design regulations as well as the benefits of adopting PBD to improve the design of tall structures. Three reinforced concrete case studies with a maximum height of 40 storeys were designed for this study in accordance with the (ECP-201) regulation and optimised for improved performance and lower costs. Additionally, two seismic hazard levels—design-based earthquake (DBE) and maximum significant earthquake (MCE)—were used to assess the optimised models, demonstrating conformity with the ASCE 41-13 restrictions. The results demonstrate that the optimised models conform with and perform better than the ECP-201 in terms of an improvement in ductility that ranges from 110% to 150%. As a result, the findings illustrated the advantages of using performance-based design practises to the conception and assessment of mid-to high-rise buildings in the Egyptian code of practise. Before collapsing, the 10, 20, and 40-story code models' maximum roof drifts were 2.5% and 3.7%, 4.2% in the X-dirt and 6.3% in the Y-dirt, respectively.

- ***M. A. Amzar Kamarudin, S. W. Ahmad, W. A. R. Wan Ariffin (2021):*** This study tries to determine how high-rise structures respond to various earthquakes when shear walls are present. ETABS software was used to create and analyse two models, one with a shear wall and the other without one. When undergoing seismic analysis, the obtained results showed that the building with the shear wall is more resilient and sturdier than buildings without shear wall. According to base shear studies, buildings with shear walls are more valuable than those without them. A building with a shear wall has a higher story stiffness than a building without one. When undergoing seismic analysis, the obtained results showed that the building with the shear wall is more resilient and sturdier than buildings without shear wall.

- ***Rajiv Banerjee, Jyoti Bhushan Srivastava & Nakul Gupta (2022):*** This work examines the seismic response of a multi-story building in Y shape with optimal shear wall placement. The goal of this study is to identify the shear wall's optimal location in the zone IV of a Y-shaped irregular G+14 structure. In this study, 14 test models with different shear wall locations are taken into account, and variables including Time Period, Story Displacement, Static Eccentricity, Story Drift, Joint Displacement, Base Shear, and Base Force are compared to the bare model. Therefore, based on models with the lowest static eccentricity, minimum displacement, minimum drift, minimum time period, minimum joint displacement, and maximum base shear, the ideal position for the shear wall is indicated. When shear walls are added, the seismic weight increases, increasing base shear in comparison to the bare model. In comparison to a building model without a shear wall, the story displacement has decreased as a result of the introduction of shear walls into various models. When compared to models with T-T-R behavior in the first three modes, Model 6 performs well in terms of displacement.

- ***Fousiya Zaker, Sharon Teressa Biju, Jesmi Thaha, Dony Stanly (2022):*** Seismic Analysis of a Multistorey RCC Building with Structural Irregularities: Study Because of growing safety and structural performance concerns, designing buildings with seismic resistance is becoming increasingly important. In this study, a multistory RCC-framed building with a plan and vertical irregularity is evaluated using the reaction spectrum. The Response Spectrum technique of study was used to compare various responses, such as story displacements, story drift, etc., in order to evaluate the seismic performances. Conclusion: For irregular buildings in seismic zones, response spectrum analysis must be significant.

- ***Mohammed Misaquddin Hussain, Mohammed Ehsaan Ullah Shareef, Mohammed Abdul Razzaq, Touseeq Anwar Wasif (2022):*** The maximum displacements of structures at various storeys in both the X and Y directions for all analytical methodologies are compared and shown in the study's multi-story building design and analysis under static and dynamic loading circumstances. Furthermore, it is seen that the largest centre of mass displacement, which is supposed to distinguish between all methods, increases from the first to the last floor. The main point of mass movement was nonetheless found by time history analysis of both earthquakes.

- ***Lovepreet Singh, Harpal Singh, Inderpreet Kaur (2022):*** Analysed the nonlinear time history of an irregular RC construction on a slope. This work is an effort to comprehend how structures behave on hill slopes. For the purposes of the analytical inquiry, a (G+9) story building designed for three distinct slopes and one standard ground-level structure with nine stories were both taken into consideration. Four models are taken into consideration. The beams produce the most hinges, followed by the columns. The findings show that L-shaped shear walls should be placed at the corners to prevent the failure of structural components. The highest story drift is seen on the sixth story at model (m2, m3, m4), and it was found that the Step-back Set-back building configuration is great for building on hill slopes. Although torsion and stiffness irregularities cannot be completely eliminated, they can be reduced by giving the building a shear wall and bracing system.

- ***Domenico Magisanoa, Antonella Corrado, Antonio Madeoa, Giovanni Garcea (2023):*** This research studies the formulation of a reduced modal space for the nonlinear dynamic seismic analysis of elasto-plastic 3D frame buildings. It performs nonlinear time history seismic analysis of inelastic 3D frame buildings in a reduced modal space. The approach is tested on a somewhat asymmetrical frame in this study. It has a five-story reinforced concrete frame with three spans in the X direction that are 4, 6 and 5 metres wide, and four spans in the Y direction that are, respectively, 5, 6, 4, and 4 metres wide. It has a 15.9 m overall height H. 90% of the supporting beams bear the vertical stress on the one-way ribbed slabs in the X direction, and 10% of the parallel ones. The reduced modal space for time history seismic studies of framed buildings was described in this work. It is a multi-scale approach where the dynamic equilibrium is imposed in a smaller space while the internal forces are assessed on the entire model. The single-story mechanism produced with static analysis for each direction of the seismic activity, the associated plastic collapse mechanisms, and the first elastic modes in terms of mass participation factor are all included in the modal basis. Results highlight the necessity of integrating plastic modes when seismic stress results in meaningful excursions in the plastic range as well as the accuracy and robustness of the reduced model.

(III) CONCLUSION

This review article includes information on a number of variables that aid in understanding how multistorey irregular constructions behave when subjected to dynamic loading situations. From the study with an increase in Zone, Lateral Displacement increases in vertical irregularities buildings, we can infer that nonlinear methods of analysis work well for tall structures since they offer lower values for all the parameters and allow for a reduction in the amount of steel utilized in construction as the structure's height and lateral displacement rise. By working on this project, we gained experience utilising integrated building design software. We also used time history analysis to investigate the effects of seismic force responses on building life cycles and behaviour. We have come to the conclusion that the Time History approach, employed for seismic analysis, is realistic and that it improves the safety of structures that have been assessed and developed using the manner outlined by the IS code. Last but not least, as demonstrated here, LTHA can be used to design buildings in seismic regions that are susceptible to near-field circumstances (such as pulse-like), but further research is required in this area.

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REFRENCESs

1. A S Patil1 and P D Kumbhar "Time History Analysis method reducing the uncertainties and some of the conservatism associated with code base", International journal of structural and civil engineering, ISSN 2319 – 6009 Vol. 2, No. 3, August 2013.
2. Lavepreet Singh, Harpal Singh, Inderpreet Kaur "Nonlinear time history analysis on irregular RC building on sloping ground", Innovative Infrastructure Solutions, P-ISSN 23644176. 30 January 2023.
3. K.S. Patil, Desai Shubham S, Dahifale Rahul, Parade Shashikant, Rajput Ashish M. "Time History Analysis and Design of Multi-storeyed Building", International Journal of Research in Engineering and Science, ISSN (Online): 2320-9364, ISSN (Print): 2320-9356 Vol.9, July 2021.
4. Kaushal Vijay Rathod, Sumit Gupta "A nonlinear time history analysis of ten story multi-storey building", International Research Journal of Engineering and Technology, e-ISSN: 2395-0056 Volume: 07 Issue: 06 | June 2020 p-ISSN: 2395-0072.
5. Alessia Di Cuica, Luca Lombardi, Flavia De Luca, Raffaele De Risia, Silvia Caprilib , Walter Salvatore. "Linear Time-History Analysis for EC8 design of CBF structures", Procedia Engineering, ISS18777058N, Published by Elsevier Ltd, 2017.
6. Luca Lombardi, Flavia De Luca, John Macdonald "Design of buildings through Linear Time-History Analysis optimising ground motion selection: A case study for RC-MRFs", Elsevier, 23 April 2019.
7. Prajwal T P, Imtiaz A Parvez, Kiran Kamath "Nonlinear Analysis of Irregular Buildings Considering the Direction of Seismic Waves", Elsevier, 2017.
8. Zaid Mohammad, Abdul Baqi, Mohammed Arif "Seismic Response of RC Framed Buildings Resting on Hill Slopes", Elsevier, 2017.
9. Pedram Omidian, Hamid Saffari "Comparative analysis of seismic behavior of RC buildings with Shape Memory Alloy rebar in regular, torsional irregularity and extreme torsional irregularity cases", Journal of Building Engineering, 2018.
10. David Bru, Antonio González, F. Javier Baeza, Salvador Ivorra "Seismic behavior of 1960's RC buildings exposed to marine environment", Elsevier, 2018.
11. Kalpak.A.Zagade, et al. "A REVIEW PAPER ON TIME HISTORY ANALYSIS / NON-LINEAR DYNAMIC ANALYSIS OF HIGH-RISE BUILDING USING ETABS", IJCRT2107579, ISSN: 2320-2882, Volume 9, Issue 7 July 2021.

12. UmamaheswaraRao Tallapalem, et al, "Analysis of Multi-Storey Building in Different Seismic Zones of India", International Journal of Research in Advent Technology, Vol.7, No.5, May 2019 E-ISSN: 2321-9637.
13. Sagar R Padol, Rajashekhar S. Talikoti, "REVIEW PAPER ON SEISMIC RESPONSES OF MULTISTORED RCC BUILDING WITH MASS IRREGULARITY", International Journal of Research in Engineering and Technology, eISSN: 2319-1163, Volume: 04 Issue: 03, Mar-2015.
14. Deressa Ajema," SEISMIC BEHAVIOUR OF MULTI STORY SHEAR WALL FRAME VERSUS BRACED FRAME", JETIR (ISSN-2349-5162), January 2018, Volume 5, Issue 1.
15. Atul N.Kolekar et al, "Comparative study of Performance of RCC Multi-Storey Building for Koyna and Bhuj Earthquakes", Journal of Engineering Research and Application, ISSN : 2248-9622, Vol. 7, Issue 5, (Part -2) May 2017.
16. Dr. S. G. Makarande et al, "Seismic Analysis of Reinforced Concrete Building for Dynamic Characteristics of Ground Motion", International Journal for Research in Applied Science & Engineering Technology", ISSN: 2321-9653; Volume 7 Issue V, May 2019.
17. M. A. Amzar Kamarudin," The Behaviour of High-Rise Building with or without Shear Wall under Different Earthquakes", journal.ump.edu.my/construction, VOL. 1, ISSUE 2, 93 – 101, 30th Nov 2021.
18. Prof. Ravi M. Desai," Non-Linear Dynamic Analysis of RC-Framed Structure", International Journal for Research in Applied Science & Engineering Technology, Volume 5 Issue III, March 2017, ISSN: 2321-9653.
19. Razaq, Touseeq Anwar Wasif," Design & Analysis of Multi-storied Building under Static and Dynamic Loading Conditions", International Research Journal of Engineering and Technology, e-ISSN: 2395-0056, Volume: 09 Issue: 05 | May 2022.
20. Balaji.U. A, "DESIGN AND ANALYSIS OF MULTISTOREYED BUILDING UNDER STATIC AND DYNAMIC LOADING CONDITIONS USING ETABS", International Journal of Technical Research and Applications e-ISSN: 2320-8163, www.ijtra.com Volume 4, Issue 4 (July-Aug, 2016).
21. Allauddin Shaik," Analysis of Multi-Storey Building by Response Spectrum Method using E-Tabs Software", International Journal of Engineering Research & Technology, ISSN: 2278-0181, Vol. 8 Issue 10, October-2019.
22. Fousiya Zaker, "Study on Seismic Analysis of Multistorey RCC Building with Structural Irregularities", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Published by, www.ijert.org ICART - 2022 Conference Proceedings.
23. Kalpak.A.Zagade, "A REVIEW PAPER ON TIME HISTORY ANALYSIS / NON LINEAR DYNAMIC ANALYSIS OF HIGH RISE BUILDING USING ETABS", 2021 IJCRT | Volume 9, Issue 7 July 2021 | ISSN: 2320-2882.
24. Prakriti Chandrakar, Dr. P. S. Bokare, "A Review - Comparison between Response Spectrum Method and Time History Method for Dynamic Analysis of Multistoried Building", International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064, Volume 6 Issue 5, May 2017.
25. Haitham AbdelMalek et al, "Nonlinear time history analysis evaluation of optimized design for medium to high rise buildings using performance-based design", Elsevier,2022.
26. George Georgoussis et al, "Approximate seismic analysis of multi-story buildings with mass and stiffness irregularities", Elsevier, 2015.
27. Siva Naveen et al, "Analysis of irregular structure under earthquake load", Elsevier, 2nd International Conference on Structural Integrity and Exhibition 2018.
28. Domenico Magisano et al, "Nonlinear time history seismic analysis of inelastic 3D frame buildings in a reduced modal space", Elsevier, 2023.
29. J.Selwyn Babu, "Comparative study on non-linear time history analysis of a building with and without base isolation using etabs", IOP Conference Series: Materials Science and Engineering,2021.
30. Sayed Mahmoud, "Time-History Analysis of Reinforced Concrete Frame Buildings with Soft Storeys", Springer: 3 December 2016