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A Review on Novel and Comprehensive Analysis of Shear Bending and Torsion in Symmetrical and Unsymmetrical Multistory Building

Jagmohan Suryawanshi[1], Prof. Rakesh Kumar Grover[2]
Structure Civil Engineering, Jabalpur Engineering College, Gokalpur, Jabalpur, Madhya pradesh, Pin-482011

Abstract: ***A structure can be classified as irregular if it contains irregular distributions of mass, stiffness and strength or due to irregular geometrical configurations. The behavior of any building depends on the arrangement of structural elements present in it. The important aspects on which the structural configuration depends are geometry, shape and size of the building. In reality, many existing buildings contain irregularity due to functional and aesthetic requirements .However, past earthquake records show the poor seismic performance of these structures. This proposal will try to ignorance of the irregularity aspect in formulating the seismic design methodologies by the seismic codes.***
Keywords: Irregularity, Geometry, Shape and Size of the building etc.

I. INTRODUCTION

The seismic reaction relies on a seismic zone, importance factor, ground type, behaviour component and on the magnitude in addition to the distribution of stiffness and loads of constructing. In urban areas the usage of space in recent times has brought about many changes in the homes we need greater capability in less space which makes buildings uneven, this could cause homes with irregular distributions of their mass, stiffness and power alongside the height of building and purpose interruption of pressure waft and strain concentrations. While regular constructing preparations are almost symmetrical about the axis and make sure uniform distribution of the lateral force-resisting shape elements which deals a regular load route for each gravity and lateral masses. A few studies have targeted on assessing the response of "normal" systems [1-5].

A lack of symmetry produces torsional effects that are sometimes difficult to assess, and can be very adverse. The preferred method of minimizing torsional effects is to select floor plans that are regular and reasonably compact. Complex plan buildings should be divided by seismic separation joints introduced between rectangular blocks. The behaviour of buildings during earthquakes will be satisfactory only if all measures are taken to provide a favorable failure mechanism. A special account must be taken so that torsional effects do not endanger or preclude the global ductile behaviour of the structure. Buildings with an asymmetric distribution of stiffness and strength in plan undergo coupled lateral and torsional motions during earthquakes. Because of torsion, the seismic demands of asymmetric buildings increase above those required by just translational deformation. It is well-known that the larger the eccentricity between the center of stiffness and the center of mass, the larger the torsional effects. An important aspect of the inelastic behaviour of asymmetric structures is the considerations of the degree of control over inelastic twist. One of the design aims should be to restrain the system against unrestricted inelastic twist. In the structures, which remain elastic during an earthquake, torsional vibrations may cause significant additional displacements and forces in the lateral load resisting elements. However, the design of the majority of buildings relies on inelastic response. In that case torsional motion leads to additional displacement and ductility demands. Hence, the relevance of current code recommendations, based on elastic torsional response, is open to questions [6-10].

II. RESEARCH MOTIVATION

Conventional Civil Engineering structures are designed on the basis of strength and stiffness criteria. In case of earthquake forces the demand is for ductility. Larger is the capacity of the structure to deform plastically without collapse, more is the resulting ductility and the energy dissipation. This causes reduction in effective earthquake forces [11].The behaviour of a building during earthquakes depends mainly on its overall shape, size and geometry, in addition to how the earthquake forces are carried to the ground. The earthquake forces developed at different floor levels in a building need to be brought down along the height to the ground by the shortest path; any deviation or discontinuity in this load transfer path results in poor performance of the building.

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Buildings that have fewer columns or walls in a particular storey or with unusually tall storey tend to damage or collapse which is initiated in that storey [12]. Floating Column: A column is supposed to be a vertical member starting from foundation level and transferring the load to the ground. The term floating column is also a vertical element which ends (due to architectural design/ site situation) at its lower level (termination Level) rests on a beam which is a horizontal member as shown in figure 1.The beams in turn transfer the load to other columns below it. Such columns where the load was considered as point load. This is being provided more space in ground floor for a) Accommodation of parking or ground lobbies b) For architectural beauty c) To increase floor space index [13].

III. LITERATURE REVIEW

Shrivallabh S. Chavan, Amit C. Thoke, Yogesh R. Vanshe (2018) "Analysis And Design Of L-Shaped Building In Different Seismic Zones" In this Study, It is very essential to consider the effects of lateral loads induced from earthquakes in the design of reinforced concrete structures, especially for high-rise and unsymmetrical buildings. The IS Code of Practice for Calculating Loads and Forces in Structural and Building Works, IS 456-2000 and IS 1893:2002 gives simplified methods for calculating such loads in different seismic zones. This depends on some seismic parameters defined by codes. In this research the effects will be studied and compared according to the IS 1893: 2002. The codes are reviewed for earthquake analysis and discussed to show some factors affecting the design like mode shape and displacement of structure. Peak Shear in X and Z direction increases as we move from Zone II to Zone V. Displacement in X and Z direction increases as we move from Zone II to Zone V. Percentage of Steel is increasing from zone II to Zone II is 2.51 tons, zone III to Zone IV is 1.72 tons & zone IV to Zone V is 4.96 tons. And the percentile increment is 0.25% to 0.71%. Dead Load plays a very significant role to counter balance the uplifting earthquake forces.

Ashvin G. Soni, Prof. D. G. Agrawal, Dr. A. M. Pande "Effect of Irregularities in Buildings and their Consequences" In his Study, Many buildings in the present scenario has irregular configurations both in plan and elevation. This in future may subject to devastating earthquakes. In case, itis necessary to identify the performance of the structures to withstand against disaster for both new and existing one. This is due to the irregularities in plan or elevation or in both. The paper discusses the performance evaluation of RC Buildings with irregularity. Structural irregularities are important factors which decrease the seismic performance of the structures. This proves that irregularities in buildings are harmful for the structures and it is important to have simpler and regular shapes of frames as well as uniform load distribution of load around the building.

Rucha S. Banginwar, M. R. Vyawahare, P. O. Modani (2012) "Effect of Plans Configurations on the Seismic Behavior of the Structure By Response Spectrum Method" In this Study, The behaviour of building during earthquake depends critically on its overall shape, size and geometry. Building with simple geometry in plan have performed well during strong past earthquake but building with u, v, H & + shaped in plan have sustained significant damage. In this proposed work the study is carried on the effect of difference geometrical configurations on the behaviour of structure of the already constructed building located in the same area during earthquake by RSM in this paper, more emphasis is made on the plan configurations and is analysed by RSM since the RSM analysis provides a key information for real world application. The plan configuration of structure has significant impact on the seismic response in terms of displacement, story drift, and story shear.

Dj. Z. Ladjinovic and R. J. Folic (2008) "Seismic Analysis of Asymmetric in Plan Buildings" Buildings with an asymmetric distribution of stiffness and strength in plan undergo coupled lateral and torsional motions during earthquakes. In many buildings the center of resistance does not coincide with the center of mass. By reducing the distance between the center of mass and the center of stiffness, torsional effects should be minimized. The stiffness characteristics control the dynamic response of the building structure. The choice of the stiffness characteristics of structures is an important step in the conceptual design phase. The good behaviour of the structure can be provided with a well distributed lateral load resisting system. The inelastic seismic behaviour of asymmetric-plan buildings is considered by using the histories of base shear and torque (BST). The procedure to construct the BST surface of the system with an arbitrary number of resisting elements in the direction of asymmetry and of ground motion is proposed. The BST surface describes the inelastic properties of a system, however, the inelastic deformation cannot be computed unless a non-linear static or dynamic analysis is performed. The factors that determine the seismic response are the strength eccentricity, lateral and torsional capacity of the system, plan wise distribution of stiffness and excitation.

Ratnesh Pathak, Behaviour of Asymmetric Building during Earthquake (May 2019), The paper examines the seismic analysis of the asymmetrical constructing, in which constructing have 3 distinctive form which includes T, L and plus form. Researcher supplied each re-entrant corner supplied curved beam with slab. the primary purpose of imparting curve beam in each model to lessen the specially torsion at nook due to the fact storey overturning moment is most at the base and if the torsion is also maximum at the base, then maximum possibilities to produce the crack at the re-entrant corner of the constructing.

There are six models in this paper and taking zone 5 for seismic evaluation. All the analysis of the fashions is completed with the assist of the ETABS software by way of the usage of one of a kind IS Code consisting of IS CODE 1893 part1: 2016 for the earthquake resistant layout of the structure and IS CODE 456:2000 for design and evaluation of the reinforced concrete shape. observe consists of the version of torsion of body at corner, storey overturning second, base shear, and so on due to offer the curved beam and without curved beam.

Purushotham Dewangan, Seismic Analysis of Regular and Irregular structures and its comparison (Sep 2018). The main goal of earthquake engineering is to layout & build a structure in such a manner that the damage to the structure and its structural issue during an earthquake is minimized. Creation can suffer various damages whilst they're subjected to Seismic excitations. For the identical structural configuration, location & earthquake, damages inside the systems are neither same nor homogeneous. Seismic analysis of constructing has now end up an essential component in gift era of modern-day Structural designs; it's far due to the fact earthquake causes plenty of damages and lack of existence. Multi-storey structures built by using reinforced Cement Concrete are subjected to severe movements of Seismic waves all through earthquake. The primary cause for the failure of RC building is Irregularity. The Irregularities can be in its plan measurement, lateral pressure distribution. After proper change the bending second potential of re-entrant corner column is increased. Base Shear for normal shape is extra than that of abnormal structure. Base Shear for changed structure is greater than that of original shape. Ductility ratio and reaction discount issue is more for everyday shape. Abnormal structures can behave as every day structures if proper precautions and changes are made.

Vaishnavi Vishnu Battul, Study of Seismic Effect on Re-entrant Corner Column (April 2018). The take a look at mainly focuses on the irregularities in buildings. Irregularities are usually predicted because of many reasons like aesthetics, mild, air flow, and so on. The irregularity is because of the purpose the stiffness middle and mass middle of the constructing isn't always at the same place. Consequently, it's far had to examine behavior of such structures during earthquake. The objective of this takes a look at is to understand plan irregularity and to investigate the seismic performance of the abnormal frame using nonlinear static evaluation in SAP2000. The study includes identification and measure of the irregularity degree due to the irregular plan and improvement of the structural gadget considering seismic conduct. Irregularity in plan is unavoidable. It’s far due to many reasons like requirement of purchaser, purposeful necessities, and so forth. Due care is needed while designing such structures. It is found from above take a look at that fore-entrant nook columns want more interest than the opposite columns. Those columns must be designed properly. After right modifications the bending second potential of re-entrant corner column is expanded by means of 1.5 and twice in case of IS456 and IS13920 respectively. Base Shear for normal systems is extra than that of abnormal structures. Base shear for modified systems is more than the unique structures.

Reena Sahu, Ravi Dwivedi, Seismic Analysis of RC Frame with Diaphragm Discontinuity, Seismic analysis is a subset of structural analysis which involves the calculation of the response of a structure subjected to earthquake excitation. This is required for carrying out the structural design, structural assessment and retrofitting of the structures in the regions where earthquakes are prevalent. The influence of diaphragm openings on the seismic response of multi-storeyed buildings played a major role in reducing the base shear, hence attracting lesser seismic forces. An attempt is made to try to know the difference between a building with diaphragm discontinuity and a building without diaphragm discontinuity. This present paper makes a humble effort to portrait the behavior of multi storied buildings with diaphragm openings under earthquake static analysis and response spectrum analysis using STAAD.Pro. To achieve this objective various models with varying percentages of diaphragm openings were analyzed and compared for seismic parameters like base shear, maximum storey drifts, shear force, Bending Moment and Axial Force.

Sabahat J. Ansari, Dr. S. D. Bhole, Comparative Study of Symmetric & Asymmetric L- Shaped & T-Shaped Multi-Storey Frame Building Subjected to Gravity & Seismic Loads with Varying Stiffness (April 2016). This paper presents an overview of overall performance of the torsion best friend balanced and unbalanced homes additionally referred to as symmetric and uneven buildings subjecting to seismic analysis. In gift situation, maximum of the buildings are frequently built with irregularities which include smooth storey, torsion al irregularity, unsymmetrical format of in-fill partitions, vertical and plan irregularity, and many others. Past earthquake research shows that the maximum of the RC homes having such irregularities had been significantly broken underneath the seismic ground motion. 3 building fashions for L-shaped and T-fashioned constructing are taken into consideration for observe, that are built on medium soil in seismic region III of India (as in line with IS: 1893-2002[9]), one symmetric and three asymmetric in stiffness distribution. In this paper it's far concluded that the overall performance of the fashions wherein the stiffness of plan length taken into consideration is determined better whilst as compared with the fashions wherein the stiffness of plan length omitted.

B K Raghu prasad, Vinay S, Amarnath.K, Seismic Analysis of Buildings Symmetric & Asymmetric in Plan (May 2016). In this paper the inelastic seismic behaviour of symmetric and asymmetric single & multi-storied buildings is studied. The effects of torsion on buildings are investigated. There is an increase in shear in columns and the rotation of columns need some special attention. The natural frequencies of an asymmetric spring model are greater than those of symmetric spring model while the rotations about the vertical axis through the mass center of an asymmetric model are lesser than those of symmetric model. Similarly, maximum displacement of an asymmetric spring model due to an earthquake is greater than that of symmetric spring model.

Chaithra S, Behavioural Analysis on Asymmetrical Buildings with Solid, Coupled and Shear Wall with Staggered Openings (Aug 2016). The venture considers the Behaviour of an uneven multistoried buildings without shear walls and with stable, coupled and shear wall with staggered openings beneath static and dynamic loads. Shear partitions are vertical contributors supplied in the homes to resist the lateral hundreds specifically in the activities of earthquake and wind. they'll be strong or with openings. Functionality is maintained by the provision of openings. Coupled shear walls are one among such gadget normally utilized in medium and high-rise systems to withstand lateral forces. these structures must not disintegrate or be inclined all through intense harm in the course of earthquake actions. Because of this, coupled shear partitions need to have high electricity, excessive ductility, excessive electricity absorption capability and excessive shear stiffness to limit lateral deformations. If the depth of the coupling beam varies there may be an impact at the perspective of inclination furnished inside the diagonal reinforcement and as a result coupled partitions are studied at one-of-a-kind depths of coupling beam. A comparative approach is developed to understand the effect of staggered commencing in a shear wall. Staggered association of openings in shear partitions satisfies both the architectural and the seismic necessities. A comparative observe is executed on multistoried buildings without shear wall and with stable, coupled, and staggered commencing shear wall.

A.P. Mundada et al., dealt with the study of architectural drawing and the framing drawing of the building having floating columns. In this study an existingG+7 residential building is selected for the equivalent static analysis of load distribution on floating columns and various effects due to it are presented using staad pro v8i. Thus the main objective of this paper is to find the various analytical properties of the structure and also understand a very systematic and economical design of the structure.

Pratyush Malaviya., et al., made a comparative study of effect of floating columns on the cost analysis of a structure designed on staad pro v8i. The conclusion is made that in the framed structure with no floating columns, the nodal displacements is minimum with uniform distribution of stresses at all beams and columns and these are the most economical one and at a particular case (all the outer columns(Y direction) in ground floor) there is maximum requirement of concrete and steel. This type of building is frequently used so as to avoid any external facility for parking of vehicles; so the analysis shows that it is not advisable to propose such structures.

Srikanth.M.K et al., studied the importance of explicitly recognizing the presence of the floating column in the analysis of building and also along with floating column some complexities were considered for ten storey building at different alternative location and for lower and higher zones. It is concluded that, the displacement of the building increases from lower zones to higher zones, similarly for drift, because it is correlated with the displacement. Storey shear will be more for lower floors, then the higher floors due to the reduction in weight.

Prerna Nautiyal et al., investigated the effect of the floating column under earthquake excitation for different soil conditions and a linear dynamic analysis is done for the 2D frame of the multi-storey building with and without floating column to achieve the response of the frame for safer and economical design of the structure under such excitations.

T.Raja Sekhar, Mr.P V Prasad, (2014), “Study Of Behaviour Of Seismic Analysis Of Multi Storied Building With And Without Floating Column”, In the present investigation, the main incident of building with floating column is pre figurative in the construction of modern multi- storey in India, this is not suitable in the seismic areas. This study is about recognizing the presence of the floating column in the analysis of building. FEM codes are developed for 2D multi storey frames with and without floating column to study the responses of the structure at different earthquake conditions having different frequency by keeping the PGA and time duration factor constant. The behavior of building frame with and without floating column is studied under static load, free vibration and forced vibration condition. The results are plotted for both the frames with and without floating column by comparing each other time history of floor displacement, base shear. The equivalent static analysis is carried out on the entire project mathematical 3D model using the software STAAD Pro V8i and the comparison of these models are been presented. This will help us to find the various analytical properties of the structure and we may also have a very systematic and economical design for the structure.

Srikanth.M.K, Yogeendri.R.Holebagilu, (2014), "Seismic Response of Complex Buildings with Floating Column for Zone II and Zone V", Open first story and Floating column are typical features in the modern multi-storey constructions in urban India. Such features are highly undesirable in buildings built in seismically active areas; this has been verified in numerous experiences of strong shaking during the past earthquakes like Bhuj 2001. In this study an attempt is made to reveal the effects of floating column & soft story in different earthquake zones by seismic analysis. For this purpose Push over analysis is adopted because this analysis will yield performance level of building for design capacity (displacement) carried out up to failure, it helps determination of collapse load and ductility capacity of the structure. To achieve this objective, three RC bare frame structures with G+4, G+9, G+15 stories respectively will be analyzed and compared the base force and displacement of RC bare frame structure with G+4, G+9,G+15 stories in different earthquake zones like Rajkot, Jamnagar and Bhuj using SAP 2000 14 analysis package.

Many urban multistory buildings in India today have open first storey as an unavoidable feature. This is primarily being adopted to accommodate parking or reception lobbies in the first stories. The upper stories have brick unfilled wall panels. The draft Indian seismic code classifies a soft stories one whose lateral stiffness is less than 50% of the store above or below [Draft IS: 1893, 1997]. For the upper storey's, however, the forces in the columns are effectively reduced due to the presence of the Buildings with abrupt changes in storey stiff nesses have uneven lateral force distribution along the height, which is likely to locally induce stress concentration. This has adverse effect on the performance of buildings during ground shaking. Such buildings are required to be analyzed by the dynamic analysis and designed carefully. Reinforced concrete (RC) frame buildings with masonry infill walls have been widely constructed for commercial, industrial and multi-family residential uses in seismic-prone regions worldwide. Masonry infill typically consists of brick, clay tile or concrete block walls, constructed between columns and beams of a RC frame. These panels are generally not considered in the design process and treated as architectural (non-structural) components On the other hand, negative effects can be caused by irregular positioning of the infill's in plan.

IV. CONCLUSION

From the above review I have concluded that lot of research have carried on the Earthquake effect on the building with symmetrical configuration. In my analysis I purpose to study basic parameter such as shape factor, modal analysis, deflection, storey drift, twisting moment. Results will be interpreted on the bases of this parameter. Lack of research have observed on the building with unsymmetrical configuration thus in the further work I will compared the building with unsymmetrical configuration.

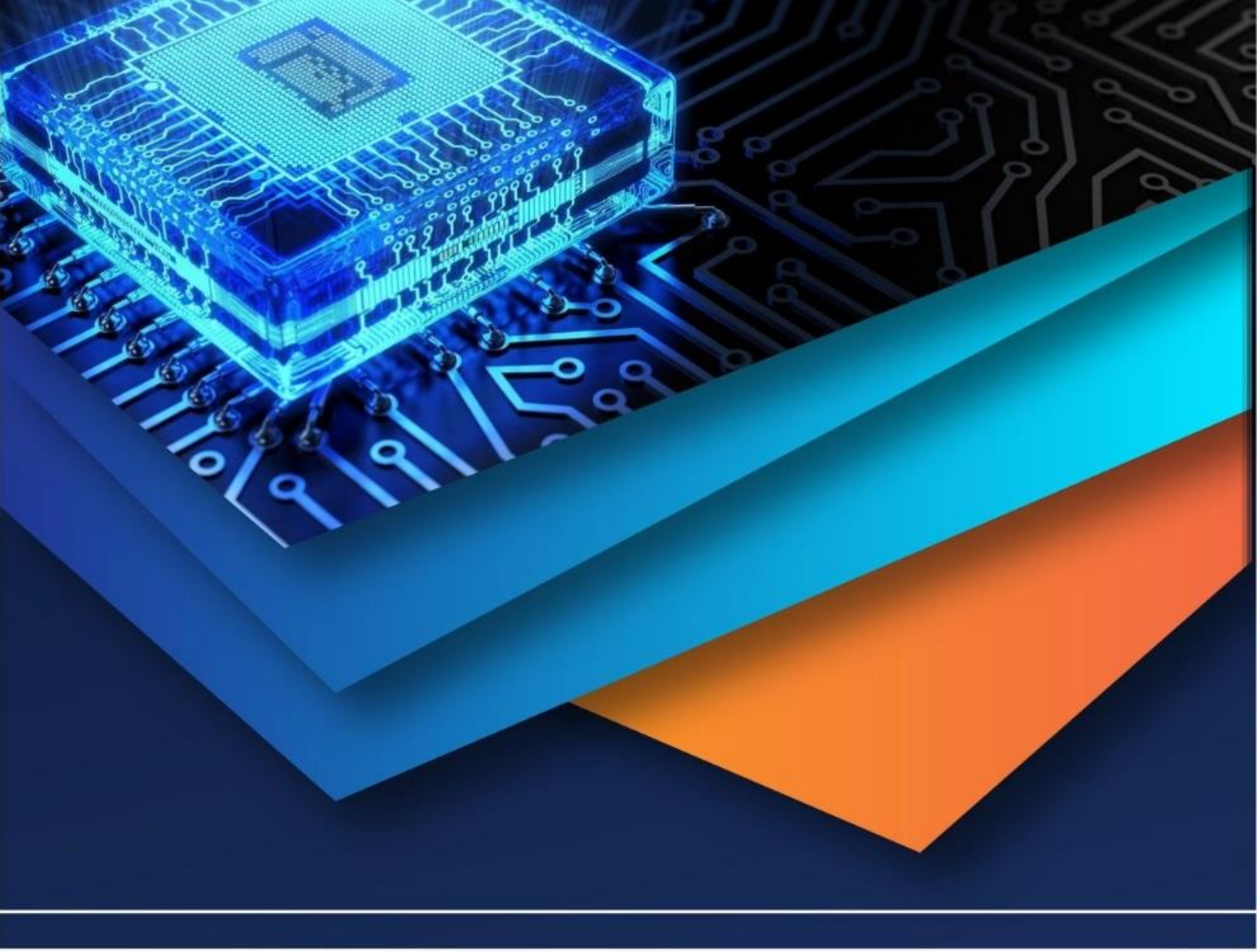
1) Select a regular building and compare it with irregular building.
2) Perform Response spectrum analysis for regular building models taken in this study.
3) Pushover analysis is done for irregular building.
4) Presentation of the results with the help of graphs and tables considering all the included parameters such storey overturning moment, base shear, storey stiffness, bending moment, displacement in structure etc.

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