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A Comparative Analysis of Seismic Behavior of Regular and Irregular Shaped Buildings with OMRF and SMRF Structural Systems: A Review

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Abstract: These days, modern residential buildings are getting higher and higher. The way these structures perform is significantly impacted by the impact of lateral loads from wind and earthquakes. It is impossible to completely prevent irregularities when building. It is mandatory to investigate how these irregularly shaped structures behave during earthquakes. The behaviour of regular and irregular buildings is represented in this study. As a result of the irregular plan and elevation configurations of various buildings in the current situation, which could be subject to hazadous earthquakes in the future, it is necessary to assess how well the structures are performing in terms of their ability to withstand disasters, primarily earthquakes. This project aims to compare the seismic behaviour of regular-shaped buildings with OMRF and SMRF structural systems versus. The study will make use of STAAD-Pro software, and the buildings' performance will be evaluated according to several criteria. The results of the research will broaden our understanding of earthquake engineering and provide insight into the performance of OMRF and SMRF structural systems in both regularly shaped and irregularly shaped buildings.
Keywords: regular building , irregular building, framed structure, building models, safety and serviceability

I. INTRODUCTION

When constructing buildings like the Acropolis in Greece or the pyramids in Egypt, structural engineering principles were applied th ousands of years ago.

Contemporary structural engineering offers an extensive and intricate corpus of knowledge that can precisely forecast how various f orms and materials will behave in structures to withstand loads and stresses.A building's structural design process consists of three st ages: load computation, structural analysis, and design.

Standards and building codes can be used to estimate the weight of the building and the loads that snow, wind and earthquakes will place on the structures, depending on the use of the building.

Following the identification of the loads operating on the structure, an analysis of the structure is conducted to ascertain the combine d impact of these loads on each of the constituent elements.

Structural engineers can analyse several types of structures using engineering software.

It is usually a good idea to use first principle knowledge and fundamental structural analysis formulas to verify the correctness of the programme results.The primary structural components, such as the floor system, vertical supports, foundations, and other sections o f the structure, can be designed using the forces and stresses obtained from the structural analysis programme.

A multidisciplinary field of engineering known as "earthquake engineering" plans and evaluates structures—like buildings and bridges—keeping earthquakes in mind. Making such constructions more earthquake-resistant is its main objective. The goal of an earthquake engineer is to build structures that will not collapse or sustain significant damage during a big earthquake. It's not always necessary for a well-engineered construction to be very sturdy or costly. It needs to be built correctly to endure the effects of earthquakes with a reasonable amount of damage.

A. Seismic Loading

Applying an excitation to a structure or geo-structure caused by an earthquake is known as seismic loading. It occurs at the points where a structure comes into contact with the earth, nearby structures, tsunami gravity waves, or other structures. Engineering seismology estimates the expected loading at a specific place on Earth's surface. It has to do with the area's potential for earthquakes.

B. *Seismic Performance*

The ability of a structure to maintain its primary tasks, like safety and serviceability, during and after a specific earthquake exposure is known as earthquake or seismic performance. If a structure doesn't partially or totally collapse and risk the lives and wellbeing of people inside or around it, it's usually regarded as safe. If a structure can do the operating tasks for which it was intended, it may be deemed serviceable.

Regular and irregular buildings behave very differently during earthquakes. Because of their uniform mass and stiffness distribution, regular buildings behave in a fairly predictable way during earthquakes. However, because of their uneven mass and stiffness distribution, irregular buildings can exhibit complicated behaviour during seismic events. Three types of irregular buildings can be distinguished: mass irregularity, stiffness irregularity, and geometric irregularity. Buildings with asymmetrical floor plans or vertical irregularities are referred to as geometrically irregular. Buildings classified as mass irregularity have a notable variation in the mass distribution among their floors. Buildings with a noticeable variation in stiffness between the floors are referred to as stiffness irregularities.

A building's seismic behaviour is also influenced by its structural system. Shear walls, dual systems, and moment-resisting frames are the three most often utilised structural systems in buildings. High-rise buildings frequently use moment-resisting frames because of their strong resistance to lateral loads. Shear walls offer excellent resistance to lateral loads and are typically found in low- to medium-rise structures. Dual systems, which are frequently employed in medium- to high-rise buildings, combine the advantages of moment-resisting frames and shear walls.

II. REVIEWED LITERATURE

Calvi, et.al. The study explored the behavior and performance of irregular buildings during earthquakes, emphasizing their vulnerability to damage. It discusses irregularities like geometric, mass, and stiffness, and discusses design philosophies and techniques to mitigate their effects and improve seismic performance. The study underscores the importance of seismic-resistant measures.

Gantes, et.al. The study compared seismic performance of regular and irregular reinforced concrete frames using EC 2 and Eurocode 8 using Performance-based seismic design criteria. Results show Eurocode 8 frames perform better, and increased ground motion intensity improves seismic performance, suggesting PBSD may be beneficial for seismic hazards.

Roik, et.al. In order to determine the factors that affected the structural performance of steel moment resisting frame (SMRF) buildings during the 2011 Tohoku, Japan earthquake, the authors gathered and analysed post-earthquake damage data from various SMRF buildings. They discovered that ground motion characteristics, building configuration, and connection detailing all had an impact on the performance of SMRF buildings. The study recommends that SMRF buildings be designed to withstand the seismic forces.

Kalkan, et.al. centred on how regular and irregular building structures behaved during earthquakes. This research delves into the effects of plan asymmetry and vertical irregularities, among other irregularities, on building seismic performance. The study examines the behaviour of six building models—including regular and irregular buildings—under various seismic scenarios. According to the study, irregularities can have a substantial effect on a building's seismic behaviour by reducing its lateral strength and stiffness and creating an uneven force distribution within the structure. The study emphasises how crucial it is to take irregularities in building design and their possible effects on seismic performance into account.

Ghobarah, et.al. examined the seismic performance of irregularly shaped buildings by performing a parametric analysis on variously shaped buildings. The purpose of the study is to ascertain how irregularities, such as soft stories, mass irregularities, and vertical irregularities, affect a building's ability to withstand earthquakes. The authors assessed the seismic behaviour of the structures using nonlinear dynamic analysis while taking various ground motions into account. The study came to the conclusion that irregularly designed buildings are more receptive of seismic hazards than regularly designed buildings, and that the kind of irregularity greatly influences how the structures behave during earthquakes. The study's conclusions emphasise how crucial it is to take irregularities into account when designing and analysing buildings in order to guarantee their seismic safety.

Filiatrault , et.al. The study examined the seismic performance of irregular concrete buildings designed for gravity loads. The authors found that these buildings had significant torsional response and lateral force distribution irregularities, leading to damage concentration in specific areas. They also found larger peak inter-story drifts and higher maximum floor accelerations. The irregularities in the building configuration significantly impacted seismic performance and should be considered in design to improve earthquake resistance.

Sabelli, et.al. examined how steel moment frame buildings, both regular and irregular, performed seismically during near-fault ground motions. The primary goal of the research was to compare how steel moment frames with varying heights, spans, and lateral loads responded to ground motion characteristics at various distances from the fault. The study's findings showed that the seismic behaviour of steel moment frames is significantly impacted by near-fault ground motions, particularly for those with greater spans and shorter heights. The study also came to the conclusion that moment frame designs based on the current code provisions might not be adequate to address seismic hazards close to faults. As a result, the authors recommended that more study be done in order to create new steel moment design criteria for moment frames of steel exposed to ground motions close to a fault.

III. CONCLUSION

After reviewing numbers of literature here we concluded as there are various of studies equations and soft wares to analyse seismic effects on structures of various types, in our study authors used different codes and software and explained about story drift moments shear for different frame types torsion responses on columns. A wide range of seismic design and behaviour-related subjects are covered in the review, such as the seismic performance of reinforced concrete structures, masonry-filled structures, and steel moment-resisting frames. Additionally investigated were the effects of design codes and irregularities as well as a comparison of seismic performance under various ground motion hazard levels. The review also covered the various structural system types used in seismic design, with an emphasis on OMRF and SMRF in particular. All things considered, this review of the literature offers insightful information about how buildings behave during earthquakes, information that can be utilised to enhance and refine the seismic design and construction methods for buildings located in seismically active areas.

IV. PROBLEM IDENTIFICATION

Inadequate strength and confinement in key areas were frequently the cause of reinforced concrete structure collapse. The standard procedures for handling gravity loading were not followed in the cases of collapsed buildings, as evidenced by the lack of reinforcement on the opposing faces of beams that were designed to sag at midspan and hog at column connections. Tension can develop on the beams' opposing faces as a result of a load reversal brought on by seismic activity. Lack of continuity between structural elements, inadequate shear reinforcement, improper placement and spacing of reinforcing bar laps, inadequate anchorage into concrete and inadequate reinforcement for seismic loading—which is not usually taken into account in design—were common examples of poor detailing that led to failures. A column's short length may cause it to fail if it is comparatively stiff in relation to other columns at the same floor level. This is because each member's stiffness determines how much of the transverse forces produced at that floor level are distributed. Therefore, in comparison to a more slender member, a short column will bear a greater percentage of the load and be less able to withstand the deflections that occur along its height.

It is advised that reinforced concrete framed buildings be designed with ductility in mind to avoid collapses in the future. This can be accomplished by using lap lengths and proper anchorage, along with continuous reinforcement in all faces of beams and columns. High-quality concrete with sufficient strength is also necessary, and this can be accomplished by employing the right materials and keeping a close eye on the job site. Lastly, it is imperative that one follows the current Indian seismic design standard, IS 1893. All things considered, the earthquake that struck Gujarat in 2001 serves as a reminder of the significance of sound structural design, safe construction methods, and quality control procedures. By adhering to these recommendations, future tragedies can be prevented and structures can be made to withstand seismic activity, protecting people and reducing harm.

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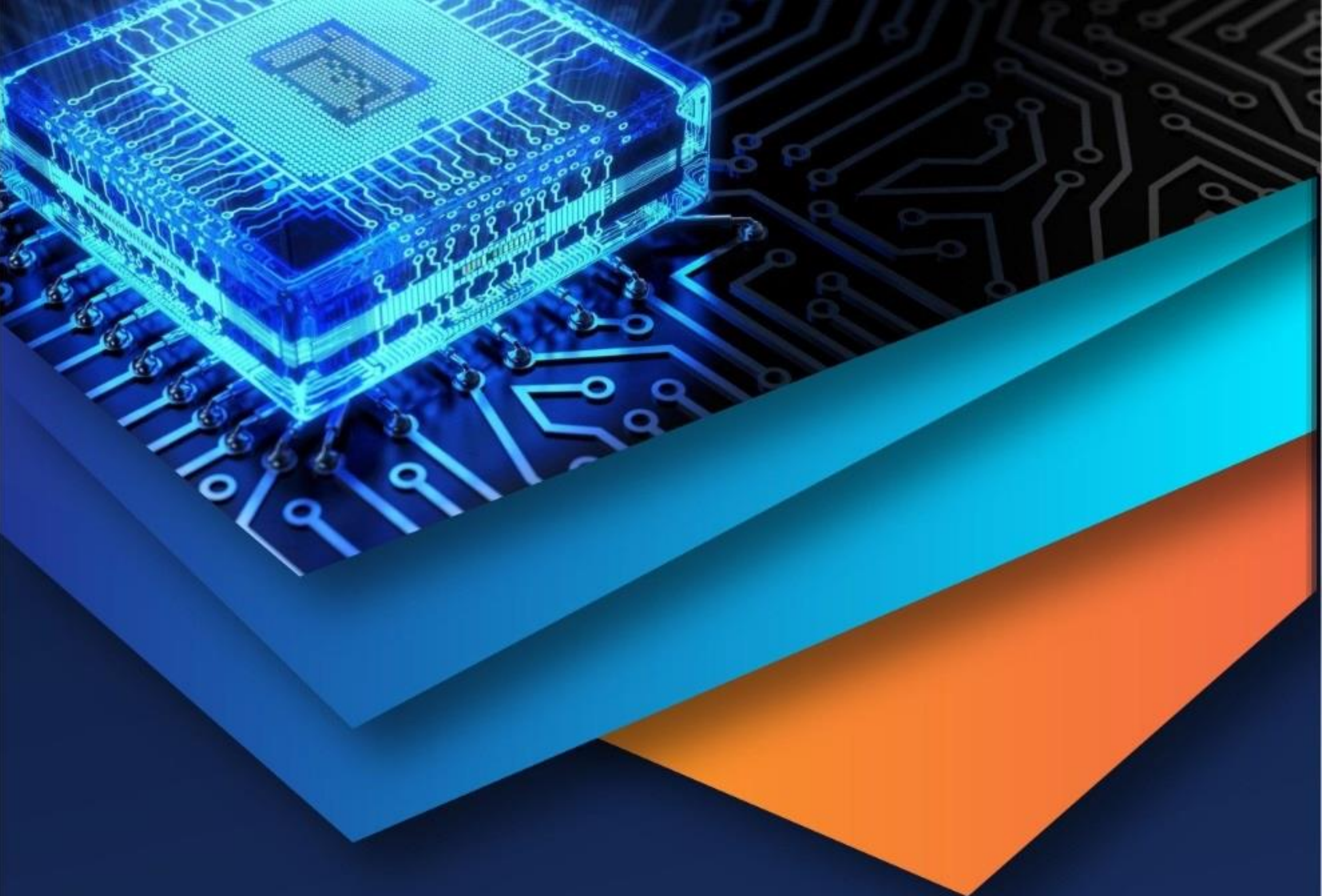

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