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Analysis and Design of Earthquake Resistance Building- A Review

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ABSTRACT: Earthquakes represent a major threat to structures, especially those lacking proper seismic design considerations. The primary goal of earthquake-resistant design is to ensure life safety by providing a ductile failure mechanism and preventing catastrophic collapse. This review discusses major seismic analysis procedures such as the Equivalent Static Force Method, Modal Response Spectrum Method, and Dynamic Time-History Analysis. Modern codes increasingly favour dynamic analysis for multi- storey or irregular buildings, while static methods remain applicable for low-rise structures in low-seismic zones. Findings from various studies show that seismic loads generate significantly higher bending moments, shear forces, and inter-storey drifts than static loads, often exceeding allowable limits. This paper highlights modelling considerations, the importance of shear walls, capacity design concepts, and recent trends in performance-based seismic design.

I. INTRODUCTION

Earthquakes generate ground shaking that can cause severe damage to structures, landslides, and soil liquefaction. Reinforced concrete (RC) moment-resisting frames often perform poorly during moderate to strong earthquakes due to inadequate detailing, especially at beam-column joints. These joints play a critical role in transferring loads between structural components. Traditional seismic design philosophy requires that structures remain functional under minor earthquakes, sustain repairable damage under moderate earthquakes, and avoid collapse under severe earthquakes. Modern building codes permit the use of simplified equivalent static load analysis for regular low-rise buildings, while emphasizing the need for dynamic analysis—particularly for irregular or tall buildings. Dynamic behaviour of buildings depends on mass, stiffness, damping, and the characteristics of ground motion. Although dynamic analysis provides more accurate results, it is complex and sensitive to assumptions regarding modelling, material behaviour, and ground motion input. As a result, capacity design concepts and advanced analysis methods like the Response Spectrum Method are widely adopted. Shear walls are essential structural components that provide significant lateral stiffness and strength. They help resist wind and earthquake loads, reduce torsional effects, and maintain structural integrity. In high-rise buildings, shear walls are crucial for controlling deflections and preventing structural failure.

II. LITERATURE REVIEW

Ravi Kumar et al. (2017)
Shear walls effectively resist both earthquake and wind loads. Their placement significantly influences the behaviour of multi-storey buildings. A ten-storey RC building analysed in ETABS showed improved performance when shear walls were optimally located.

Vaesha R. Harne et al. (2014)
Shear wall systems provide high in-plane stiffness and strength. This study focused on determining the best shear wall locations for a six-storey building in seismic Zone II using STAAD.Pro. Three configurations were analysed, highlighting the importance of shear wall placement.

Hassaballa et al. (2013)
A multi-storey RC frame was analysed using the Response Spectrum Method. Results showed excessive inter-storey drifts and large increases in axial stresses in exterior columns due to earthquake effects. Seismic loads produced bending moments and shear forces several times higher than static loads.

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A. Ilki & Z. Celep (2012)
Review of earthquake performance in Turkey revealed that structural deficiencies—not outdated codes—were primary causes of failure. Evolution of seismic codes highlighted the increasing adoption of realistic seismic demand and capacity concepts.

Zhang Minzheng et al. (2008)
Based on damage surveys of 1,005 buildings in the Wenchuan Earthquake, RC frame buildings performed best, while masonry buildings performed worst. Taller buildings showed lower seismic resistance, whereas public buildings suffered more damage than residential ones.

Murat Saatcioglu et al. (2003)
Discussed dynamic analysis as preferred in modern codes, outlining linear and nonlinear methods. Nonlinear response analysis requires expert judgement and detailed modelling.

Shunsuke Otani (2003)
Reviewed the development of earthquake-resistant design, showing improvements from the 1930s to the present. Modern performance-based design ensures greater safety and requires upgrading older buildings.

Reza Latifi et al. (2021)
Compared three popular seismic analysis methods (ELF, MRS, LRH) using ASCE 7-16 and ETABS. Demonstrated variations in base shear and storey shear distributions, providing insights for choosing effective analysis methods.

Jason McCormick et al. (2008)
Reviewed permissible residual drift limits. Found that construction tolerances are low and that higher residual drifts cause significant loss of functionality even before structural failure.

Carlos Molina Hutt et al. (2022)
Presented a probabilistic post-earthquake recovery model. Introduced recovery states such as stability, shelter-in-place, reoccupancy, and functional recovery, aiding decision-making for urban resilience.

J.C. de la Llera et al. (2015)
Investigated 43 RC shear wall buildings after the 2010 Chile earthquake. Brittle damage was concentrated on lower storeys and occurred mostly near vertical irregularities.

III. CONCLUSION

Earthquake-resistant design requires a transition from simplified static methods to advanced dynamic procedures for accurate prediction of structural behaviour during earthquakes. The Response Spectrum Method and Time-History Analysis provide more realistic assessments of seismic demand, especially for irregular and tall buildings. Shear walls significantly improve seismic performance by increasing lateral stiffness and reducing torsional effects. Proper modelling, material characterization, and adherence to capacity design principles (strong column–weak beam) are essential for preventing catastrophic failure. Modern seismic design must also incorporate performance-based approaches that address downtime, functionality, and post-earthquake recovery. Overall, dynamic analysis—combined with ductile detailing and optimized structural systems—ensures greater resilience and safety for multi-storey RC buildings.

REFERENCES

1. Hassaballa, A. E., et al. Seismic Analysis of a Reinforced Concrete Building by Response Spectrum Method, IOSR-JEN, Vol. 3, Issue 9, 2013.
2. Amit Kumar, A., et al. Analysis and Capacity Based Earthquake Resistant Design of Multi- Storeyed Building, IOSR-JEN, Vol. 4, Issue 8, 2014.
3. Rajeswari, P. & Neelakantam, A. Seismic Analysis and Design of Multistorey Building in Different Seismic Zones by Using ETABS, IRJET, Vol. 6, Issue 9, 2019.
4. Patel, A. K., et al. Earthquake Resistance and Design of Buildings, IJRT, Vol. 12, Issue 3, 2024.
5. Bhandarkar, R. R., et al. Seismic Analysis & Design of Multistory Building Using ETABS, IJEDR, Vol. 5, Issue 2, 2017.

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6. Duggal, S.K. Earthquake Resistant Design of Structures, PHI Learning.
7. Uma, S.R., & Jain, S.K. Seismic Design of Beam-Column Joints in RC Moment Resisting Frames, SEM, 2006.
8. Magenes, G., & Pampanin, S. Seismic Response of Gravity-Load Design Frames with Masonry Infills, 13th WCEE, 2004.
9. Abrams, D.P. Influence of Axial Force Variations on Flexural Behaviour of RC Columns, ACI Journal, 1987.
10. ACI Committee 318 (2002). Building Code Requirements for Reinforced Concrete.
11. Adam, J., & Atkinson, G. Development of Seismic Hazard Maps, Canadian Journal of Civil Engineering, 2003.
12. Construction Ministry of PRC (2001). Code for Seismic Design of Buildings (GB 5001— 2001).
13. AIJ/JSCE/BU (1993). Damage Report on 1992 Erzincan Earthquake, Turkey.

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