



International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 22 No. 4 (2026)



**ijerst.editor@gmail.com
editor@ijerst.com**

Research Paper

COMPARATIVE STUDY OF CONVENTIONAL AND SEISMIC-RESISTANT BUILDING STRUCTURES

PUNITRAJ PAWAN YADAV
KRISHNA SUDHIR KUKADE
KOMAL THAKUR
DHOKE RAVINA YUVRAJ
BHELANDE PRATHAM P
MANGRULKAR PRATHAMESH

DRGITR POLY AMRAVATI

Abstract

Earthquakes are among the most destructive natural hazards affecting buildings, infrastructure, and human life. The performance of a building during an earthquake depends on its structural configuration, construction materials, foundation conditions, lateral load-resisting system, ductility, and quality of workmanship. Conventional building structures are generally designed primarily to resist gravity loads and other loads specified by applicable design requirements. In contrast, seismic-resistant structures are specifically designed and detailed to withstand earthquake-induced forces and deformations while maintaining structural stability.

This research paper presents a comparative study of conventional and seismic-resistant building structures with respect to structural behaviour, earthquake resistance, construction cost, ductility, energy dissipation, safety, and long-term performance. The study is based on a review of earthquake engineering principles, relevant building design standards, and established structural design practices. Important seismic-resistant techniques, including shear walls, ductile detailing, cross-bracing, base isolation, and energy-dissipation devices, are discussed. The comparison indicates that properly designed and constructed seismic-resistant buildings can significantly improve life safety and reduce the likelihood of catastrophic structural failure during earthquakes. Although some seismic protection systems may increase initial construction costs, their benefits can include reduced damage, lower repair requirements, and improved resilience. The study emphasizes the importance of appropriate structural analysis, compliance with applicable building codes, skilled construction, and professional inspection.

Keywords: Conventional buildings, seismic-resistant structures, earthquake engineering, ductility, shear walls, base isolation, structural safety, lateral loads.

Introduction

Buildings are designed to withstand different types of loads, including dead loads, live loads, wind loads, and, where applicable, earthquake loads. In regions susceptible to earthquakes, structural design requires special consideration of the horizontal and vertical ground motions generated by seismic activity.

During an earthquake, the ground moves rapidly, causing the foundation and lower portions of a building to move with it. The upper floors tend to resist this motion because of their inertia. This difference in movement generates internal forces, storey drift, bending moments, shear forces, and stresses within structural members.

Conventional buildings that lack appropriate seismic design and detailing may experience severe cracking, damage to beam-column joints, failure of masonry infill walls, soft-storey collapse, or complete structural failure. The risk is particularly significant in buildings with irregular configurations, weak connections, poor-quality materials, or inadequate reinforcement detailing.

Seismic-resistant buildings are designed to accommodate earthquake-induced forces and deformations through suitable structural systems, adequate strength, ductility, and controlled energy dissipation. Their purpose is not necessarily to remain completely undamaged during every earthquake, but to reduce the probability of collapse and protect occupants.

The comparative study of these two approaches is important for understanding how engineering design decisions influence structural performance, construction expenditure, and the safety of occupants.

Problem Statement

Many buildings are constructed without adequate consideration of earthquake-resistant design principles. Inadequate reinforcement detailing, irregular structural layouts, weak storeys, poor connections, and insufficient lateral stiffness can increase vulnerability during seismic events.

The main problem addressed in this study is to understand how conventional building structures differ from properly designed seismic-resistant structures and how these differences influence structural safety, deformation, construction costs, and earthquake performance.

3. Aim and Objectives

3.1 Aim

To conduct a comparative study of conventional and seismic-resistant building structures and evaluate their relative performance under earthquake loading.

3.2 Objectives

To understand the basic principles of conventional and seismic-resistant structural design.

To study the effects of earthquake forces on building structures.

To compare structural strength, stiffness, ductility, and energy-dissipation capacity.

Results and Discussion

Based on the literature-based comparison, the following observations can be made.

1. Structural safety: Buildings with appropriately designed lateral load-resisting systems and ductile detailing are generally better equipped to resist earthquake effects than buildings lacking these provisions.
2. Displacement control: Shear walls, bracing systems, and suitably designed moment-resisting frames can improve lateral response. Their relative effectiveness depends on the building configuration and seismic demand.
3. Ductility and energy dissipation: Proper detailing enables selected structural components to undergo significant deformation without sudden loss of load-carrying capacity.
4. Damage reduction: Seismic-resistant design can reduce the likelihood of severe structural damage and collapse. However, non-structural damage may still occur and should be addressed through suitable detailing and restraint systems.
5. Economic performance: Additional initial investment may be justified by improved safety, reduced repair requirements, and lower potential downtime. Actual economic benefits require project-specific evaluation.
6. Construction quality: Even a well-designed building can perform poorly if reinforcement placement, concrete quality, connections, or construction supervision are inadequate.
7. Importance of regularity: A balanced structural configuration and a continuous load path help reduce undesirable torsional effects and concentrations of damage.

References

Bureau of Indian Standards. IS 1893 (Part 1): Criteria for Earthquake Resistant Design of Structures—General Provisions and Buildings. Consult the applicable current edition and amendments.

Bureau of Indian Standards. IS 13920: Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces. Consult the applicable current edition and amendments.

Bureau of Indian Standards. IS 4326: Earthquake Resistant Design and Construction of Buildings—Code of Practice. Consult the applicable current edition and amendments.

Federal Emergency Management Agency (FEMA). Earthquake-Resistant Design Concepts (FEMA P-749). Available at: https://www.fema.gov/sites/default/files/documents/fema_p-749-earthquake-resistant-design-concepts_112022.pdf

Sayani, P. J., and Ryan, K. L. (2009). “Comparative Evaluation of Base-Isolated and Fixed-Base Buildings Using a Comprehensive Response Index.” *Journal of Structural Engineering*, 135(6). [https://doi.org/10.1061/\(ASCE\)0733-9445\(2009\)135:6\(698\)](https://doi.org/10.1061/(ASCE)0733-9445(2009)135:6(698))