Topic Name:- Comparative Study of Old Earthquake IS Codes (IS 1893:2002, IS 1893:2016) & Draft Code (IS 1893:2023) Using Multi-Storey RCC Building Analysis: A Case Study

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Abstract

This research paper presents a comparative seismic analysis of a G+14 reinforced concrete (RCC) building using three versions of the Indian seismic code: IS 1893:2002, IS 1893:2016, and the Draft IS 1893:2023. ETABS software is used to evaluate structural response parameters such as base shear, storey displacement, and storey drift. The results indicate progressive increases in seismic demand with each code revision, reflecting enhanced safety measures and alignment with performance-based design practices.

Keywords: *Seismic analysis, reinforced concrete (RCC) building, ETABS, IS 1893:2002, IS 1893:2016, Draft IS 1893:2023, base shear, storey displacement, storey drift, earthquake resistance, comparative study, performance-based design.*

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1. Introduction

Earthquakes are sudden natural events that can cause severe damage to buildings and loss of life. To mitigate this risk, engineers perform seismic analysis to study building behavior under earthquake forces. While buildings are typically designed for vertical loads (self-weight, occupancy, furniture), earthquakes introduce horizontal forces that can cause cracks, tilting, or collapse if not properly considered.

The 2001 Bhuj earthquake in Gujarat highlighted deficiencies in construction and design, prompting a major revision of the Indian seismic design code: **IS 1893:2002**. Later, **IS 1893:2016** was introduced with stricter rules, including compulsory dynamic analysis for most buildings and guidance for irregular structures. The recently proposed **Draft IS 1893:2023** includes updated seismic zoning maps, improved soil classification, and performance-based design methods, bringing Indian standards closer to international practice.

Seismic analysis can be conducted using:

1. **Equivalent Static Method** – suitable for low-rise, regular buildings.
2. **Dynamic Methods** – Response Spectrum or Time History Method for taller or irregular structures.

This study analyzes a **G+14 RCC residential building (45 m high)** using ETABS software under all three codes. Key response parameters—**base shear**, **storey displacement**, and **storey drift**—are compared to assess improvements in safety and building performance.

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2. Comparative Overview of IS 1893:2002, IS 1893:2016, and Draft IS 1893:2023

Parameter	**IS 1893:2002**	**IS 1893:2016**	**Draft IS 1893:2023**
Soil Types & Site Factors	3 types: Hard (I), Medium (II), Soft (III)	Same classification, updated site factor (S) values in spectrum	Adds rock category; refined amplification factors; allows site-specific response spectrum
Importance Factor (I)	1.0 general, 1.5 important	1.0–1.5 based on occupancy	1.0–2.0, higher for critical facilities
Response Reduction Factor (R)	Fixed for systems (OMRF: 3, SMRF: 5)	Revised for some systems	Based on ductility and detailing; R > 6 allowed for advanced damping/isolation systems
Drift Limits	0.004h for buildings without brittle finishes	Same	Stricter for tall buildings (>50 m); additional serviceability drift checks

3. Aim and Objectives

Aim:

To compare the effect of different earthquake codes (IS 1893:2002, IS 1893:2016, Draft IS 1893:2023) on the seismic response of a G+14 RCC building using ETABS.

Objectives:

1. Compare key seismic design parameters: Zone Factor (Z), Importance Factor (I), Response Reduction Factor (R).
2. Analyze the building's seismic response under different code provisions using ETABS.
3. Compare results such as base shear, storey displacement, and storey drift.
4. Highlight improvements in seismic safety and design approaches with newer codes.

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4. Methodology

A **G+14 RCC building with a soft storey** is modeled in ETABS. Structural components (beams, columns, slabs, walls) are defined as frame and shell elements with material and geometric properties as per IS codes.

Load Definition:

- Dead Load: IS 875 Part 1
- Live Load: IS 875 Part 2 (2 kN/m² typical)
- Seismic Load: Response Spectrum Method as per IS 1893:2002, 2016, 2023 Draft
- Load Combinations: IS 456 & IS 1893

Earthquake Loads:

Code	Zone	Z	I	R	Soil	Damping
IS 1893:2002	V	0.36	1.0	5	Medium	5%
IS 1893:2016	V	0.36	1.5	5	Medium	5%
Draft IS 1893:2023	VI	0.75	1.0	6	Medium	5%

Output Parameters:

- **Base Shear –** total seismic force at the foundation
- **Storey Displacement** – lateral movement of floors
- **Storey Drift** – relative movement between consecutive floors

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5. Results and Discussion

5.1 Base Shear (X-Direction)

Code	Base Shear Vb (kN)	Seismic Weight W (kN)	Horizontal Coefficient Ah (%)
IS 1893:2002	1824.73	61042	2.989
IS 1893:2016	2737.10	61042	4.484
Draft 2023	3167.63	61042	5.189

Relative Increase:

- 2016 vs 2002: +50%
- 2023 vs 2002: +73.59%
- 2023 vs 2016: +15.73%

Observation: Newer codes result in higher base shear, reflecting conservative seismic design.

5.2 Storey Displacement

Code	Maximum Roof Displacement (mm)
IS 1893:2002	38.06
IS 1893:2016	57.09

Code	Maximum Roof Displacement (mm)
Draft 2023	66.07

Observation: Higher base shear increases displacement; all values are within codal drift limits.

5.3 Storey Drift

- IS 1893:2002 & 2016: 0.004 × storey height permissible
- Draft 2023: Zone-dependent drift limits (0.0025–0.004)

ETABS Analysis: Maximum drift ratios: 0.001–0.0015 → within permissible limits.

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6. Conclusion

- Base shear, displacement, and drift increase progressively with newer codes.
- IS 1893:2016 and Draft 2023 provide enhanced safety and serviceability.
- Adopting newer codes ensures stronger, more earthquake-resilient buildings.
- Performance-based design approaches should be adopted for critical structures.

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7. Future Scope

1. Validate Draft 2023 once officially released.
2. Incorporate Soil–Structure Interaction (SSI).
3. Study structural irregularities (setbacks, torsion, soft storeys).
4. Apply nonlinear time-history analysis for performance-based evaluation.
5. Assess non-structural components.
6. Explore retrofitting strategies like shear walls, bracings, and dampers.

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8. References

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