International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Impact Factor 2024: 7.101

Evolution of Seismic Zoning in India Over Various Revisions of IS 1893

Dr. N K Saxena

Professor, Civil Engineering Department, KNIPSS, Faridipur, Sultanpur, U.P, India

Abstract: ***Zoning of India from Earthquake point of view is a very important aspect of Earthquake Resistant Design of Structures. At first instance the seismic zone in which the structure is located gives an idea of severity of an earthquake. The seismic zoning of India has been changing from the IS Code IS 1893 from one version to the other. This has been mainly due to more and more data of earthquakes became available as time passed. Moreover, more and more research in the area of Earthquake Engineering has made the change of zoning imperative. In this paper an effort has been made to critically review the changes in zoning in various versions of the code.***

Keywords: seismic zoning of India, earthquake resistant design, IS 1893 revisions, seismic hazard assessment, evolution of earthquake codes

1. Introduction

Earthquake resistant design of structures in India has evolved for over more than sixty years, primarily guided by the IS Code- "Criteria for Earthquake Resistant Design of Structures" i.e., IS 1893. One of the most important features of this code is the seismic zoning map, which classifies different regions of the country according to their expected seismic hazard. Seismic zoning in India has never been static, with each major revision of IS 1893, zones were redefined, merged, modified, or newly introduced, reflecting:

- Growth of seismic data
- Advances in seismology
- Improved understanding of tectonics
- Lessons learned from damaging earthquakes
- Shift in engineering safety philosophy

IS 1893-1962

In the pre-independence era, India relied mainly on British empirical rules and post-earthquake reconstruction experience. The Quetta earthquake (1935) and Bihar–Nepal earthquake (1934) exposed the urgent need for a national seismic code. The IS Code 1893 was first published in the year 1962. As per this version of the code India was divided into five seismic zones which are

Zone	Seismic Severity
Zone I	Very Low
Zone II	Low
Zone III	Moderate
Zone IV	Severe
Zone V	Very Severe

This was the first official seismic zoning map of India under BIS.

The zoning was based mainly on:
1) Historical earthquake intensity
2) Modified Mercalli Intensity (MMI)
3) Damage reports
4) Collapse patterns
5) Structural cracking
6) Geological intuition
7) Known mountain belts
8) Rift zones
9) Sparse instrumental data
10) Very few strong-motion stations existed
11) Engineering Philosophy
12) Earthquake forces were treated as static equivalent lateral forces
13) Design philosophy was strength-based
14) Dynamic behaviour was largely ignored

Limitations
- No probabilistic assessment
- No fault-based modelling
- Zone I implied "almost no earthquake risk", which was later found incorrect
- Peninsular India was underestimated

IS 1893:1966- FIRST REVISION

Soon after the first edition, several events occurred which highlighted deficiencies of the Code. The following major events occurred:

1) Koyna earthquake (1963) – magnitude ~6.3

Koyna earthquake (1963) having a magnitude of 6.3 occurred in a region considered stable. It was caused by reservoir-induced seismicity

Zoning Changes
- Zones I to V retained
- Minor boundary corrections were carried out.
- Increased attention to: Western India and Deccan plateau

Scientific Significance

This revision challenged the concept of absolute seismic safety, especially in supposedly stable regions.

IS 1893:1970- Second Revision

By the late 1960s: Seismograph network had expanded more earthquake catalogs were available and Engineering seismology began developing as a discipline

Zoning
- Continued with five zones (I–V)
- Boundaries refined particularly in: Northeast India, Himalayan foothills and Andaman–Nicobar region

Technical Improvements

- Better correlation between Earthquake magnitude and Observed damage
- Preliminary consideration of Regional seismicity trends

Key **Learning**

Seismic hazard is regional, not point-specific. Large zones required conservative assumptions.

IS 1893:1975- Third Revision

Major Technical Shift

This revision marked the beginning of modern seismic design thinking in India. The following were introduced in this revision:

- Seismic coefficient method
- Lateral force proportional to:
- Building mass
- Seismic zone
- Importance

Zoning Impact

* Still Zones I to V
* Some central Indian areas upgraded slightly
* Zone boundaries made smoother for practical use

Reason for Changes

Growing realization that structural response governs damage and seismic design must be systematic

IS 1893:1984- Fourth Revision (Very Important)

Why 1984 Revision Was Critical

By early 1980s:

1) Major earthquakes studied globally
2) Plate tectonics theory was well established
3) Engineering demand for rational force estimation increased

Zonal System

- Zones I–V retained
- But philosophy changed significantly

Major Improvements

- Introduction of design horizontal seismic coefficient
- Recognition of: Soil effects, structural configuration and very importantly due importance to Ductility.

Zoning Rationale

Zoning now reflected: Expected ground shaking, Not just historical damage.

Remaining Weakness

Zone I still existed, continuing a false sense of safety.

IS 1893:2002- Fifth Revision (Landmark Change)

Triggering Event

Bhuj Earthquake, 2001 (Mw ~7.7)

Bhuj earthquake occurred in Zone V, but surrounding regions also suffered severe damage. The main reason for the damage was poor detailing, underestimation of hazard, soil amplification effects.

Most Important Zonal Change

- Zone I Removed Completely
- New Zonal Pattern:

Zone II
Zone III
Zone IV
Zone V

Why Zone I Was Removed

- No region in India is earthquake-free
- Stable continental regions still experience:
- Reservoir-induced seismicity
- Intraplate earthquakes
- Zone I encouraged unsafe construction

Introduction of Zone Factor (Z)

Zone	Z
II	0.10
III	0.16
IV	0.24
V	0.36

These values represent effective peak ground acceleration.

Scientific Advancement

- Shift to probabilistic seismic hazard assessment (PSHA)
- Adoption of return period concepts
- Hazard-based zoning rather than intensity-based

IS 1893:2016- Sixth Revision

Why No Zonal Change?

By 2016:

- Four-zone system was considered adequate
- Focus shifted to structural performance, not zoning

Improvements Without Zonal Change

- Improved response spectra
- Better soil classification
- Consideration of:
- Vertical irregularities
- Torsional effects
- Near-fault shaking

Zoning Philosophy

Zoning treated as a macro-level hazard indicator, while site-specific design gained importance.

IS 1893:2025- Seventh Revision (Paradigm Shift)

Why 2025 Revision Is Revolutionary

- Advances enabling change:
- Dense strong-motion network
- GPS-based crustal deformation studies
- Active fault mapping
- Himalayan seismic gap theory

New Zonal Structure

- Five zones again, but NOT same as 1962:

Zone II
Zone III
Zone IV
Zone V
Zone VI (NEW – Ultra High Risk)

What is Zone VI?
- Entire Himalayan arc
- Regions with potential mega-earthquakes (Mw > 8.0)
- Areas with:
- High strain accumulation
- Locked thrust faults

Why Zone VI Was Necessary
- Himalayan earthquakes are qualitatively different
- Higher expected: PGA

Duration of shaking
- Existing Zone V was insufficient

Engineering Implications
- Higher design forces
- Stricter ductile detailing
- Performance-based design becomes essential

Core Reasons for Zonal Changes (Summary)
- Growth of Seismic Data
- From subjective reports → instrumental recordings

Shift in Scientific Understanding
From intensity → PGA → PSHA

Earthquake Lessons
- Each damaging earthquake forced reassessment
- Change in Engineering Philosophy
- From "no collapse" → "controlled damage & life safety"

2. Conclusions

The evolution of seismic zoning in IS 1893 reflects India's journey from empirical design to science-based earthquake engineering. The introduction of Zone VI in 2025 represents the maturity of Indian seismic codes and aligns them with global best practices. **Seismic zoning will continue to evolve as the** Data improves, Urban density increases, Performance expectations rise.

References

[1] IS 1893:1962, Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi, 1962.
[2] IS 1893:1966, Criteria for Earthquake Resistant Design of Structures (First Revision), BIS, New Delhi, 1966.
[3] IS 1893:1970, Criteria for Earthquake Resistant Design of Structures (Second Revision), BIS, New Delhi, 1970.
[4] IS 1893:1975, Criteria for Earthquake Resistant Design of Structures (Third Revision), BIS, New Delhi, 1975.
[5] IS 1893:1984, Criteria for Earthquake Resistant Design of Structures (Fourth Revision), BIS, New Delhi, 1984.
[6] IS 1893 (Part 1):2002, Criteria for Earthquake Resistant Design of Structures – Part 1: General Provisions and Buildings, BIS, New Delhi, 2002.
[7] IS 1893 (Part 1):2016, Criteria for Earthquake Resistant Design of Structures – Part 1: General Provisions and Buildings (Sixth Revision), BIS, New Delhi, 2016.
[8] IS 1893 (Part 1):2025, Criteria for Earthquake Resistant Design of Structures – Part 1: General Provisions and Buildings (Seventh Revision), BIS, New Delhi, 2025.