1. Updated Seismic Zonation Map (2025) – Geography

India has released an updated seismic zonation map under the new Earthquake Design Code (2025). This revision aims to align India's seismic safety standards with modern scientific understanding, replacing the outdated 2016 map and historical-epicentre-based models

Need for Upgradation of India's Seismic Zonation Map

Earlier Maps Underestimated Himalayan Risk - The earlier BIS seismic maps (IS 1893 - 2002) treated the entire Himalayan arc as a combination of Zone IV and Zone V, without differentiating the extreme, uniform tectonic loading experienced along the collision boundary. Modern geophysical datasets (GPS, InSAR, fault slip rates) now show that the Himalaya accommodates the highest strain accumulation in the Indian subcontinent, making a single high-risk zone insufficient. Scientific understanding of locked fault segments, asperities, and potential multi-segment rupture events has evolved, demanding an updated representation.

Outdated Methodology - Past zonation maps relied mainly on historical macroseismic data—records of where earthquakes occurred and the damage observed. These maps did not incorporate probabilistic modelling, fault mechanics, or seismic wave propagation characteristics, leading to overly generalized hazard zones. The approach failed to capture unknown faults, blind thrusts, or future rupture scenarios, which PSHA can account for.

Underestimation of Rupture Propagation - The Himalayan Frontal Thrust (HFT) is capable of producing long, southward-propagating ruptures, affecting the densely populated foothill plains. Earlier models assumed shaking reduces sharply with distance, but new data show strong basin amplification and rupture directivity can expose areas like Dehradun–Mohand, Haridwar, Kathgodam, and other foothill towns to higher shaking intensity. This results in a systematic underestimation of seismic design loads for built structures in these regions.

Growing Exposure and Vulnerability - Nearly 75% of India's population now resides in zones classified as seismically active due to rapid urbanization in coastal belts, plains, and mountain systems. Expansion of infrastructure—metro systems, expressways, industrial parks, vertical residential complexes—magnifies the potential economic loss and fatality risk from major earthquakes. Urban sprawl into geomorphologically unstable zones (like old river channels or reclaimed land) further increases the vulnerability profile.

Gap with International Best Practices - Countries like Japan, US, New Zealand, and Chile apply Probabilistic Seismic Hazard Assessment (PSHA), regularly updating hazard curves, ground motion models, and zonation. India's previous reliance on deterministic "maximum considered earthquake" scenarios was outdated and inconsistent with global engineering standards. Aligning with PSHA improves building code reliability and enhances India's standing in international disaster risk management frameworks such as Sendai Framework metrics.

Seismic Zonation Map

Definition & Purpose - A seismic zonation map is a scientific classification of regions according to expected earthquake intensity, frequency, and ground-shaking potential, based on geophysical, geological, and probabilistic data. It guides planning authorities, builders, engineers, and disaster managers in designing and regulating infrastructure.

Issued by BIS and Integrated into IS 1893 - The BIS publishes the map as part of the Earthquake Resistant Design Code (IS 1893). Local governments, urban bodies, and infrastructure agencies use it as a mandatory reference for structural design and compliance.

Role in Risk Management - Acts as the foundation for urban planning, zoning regulations, critical infrastructure location, and retrofit prioritization. Enables disaster management authorities to estimate potential casualty profiles, asset exposure, and emergency response needs.

Key Features of the New Seismic Map (2025)

Introduction of Zone VI - A major reform - the entire Himalayan corridor from J&K–Ladakh to Arunachal Pradesh is placed under a new highest hazard Zone VI. Reflects the region's capability to generate Mw 8+ megathrust earthquakes similar to past events (1505, 1803, 1833, 1897, 1905, 1934, 1950). Acknowledges uniform tectonic loading due to Indian Plate convergence at ~18 mm/yr.

Scientific Methodology – PSHA Uses Probabilistic Seismic Hazard Assessment, which accounts for -

1. Variability in earthquake recurrence intervals.
2. Fault-slip rates and moment release.
3. Ground motion attenuation with distance.
4. Local geological and lithological amplification.

Produces hazard curves, uniform hazard spectra, and return-period based design accelerations, improving accuracy.

Enhanced Geographic Coverage - 61% of India's landmass now categorized as moderate to high-risk (earlier 59%). East-coast and interior Indian shield areas show minor refinements, maintaining stable profiles due to lower deformation rates. Updated microzonation studies of Delhi, Guwahati, Kolkata, Jaipur, Chennai, and Pune have refined local hazard estimates.

Boundary Rule Enhancement - To avoid ambiguity, towns along zone boundaries are automatically included in the higher-risk zone. Eliminates misuse by developers and strengthens regulatory clarity.

Non-Structural Elements Safety - For the first time, the code introduces mandatory safety standards for -

1. Parapet walls
2. False ceilings
3. Overhead tanks
4. Façade panels
5. Elevated equipment and fixtures
6. Electrical cabling and ducts

Recognizes that non-structural failures account for 70–80% of economic loss and can cause significant injuries

Near-Fault Provisions - Structures close to active faults must incorporate -

1. Pulse-type ground motions with extreme velocity demands.
2. Enhanced displacement and ductility considerations.
3. Higher detailing requirements for critical structural members.

Similar to near-fault design protocols used in California and Japan.

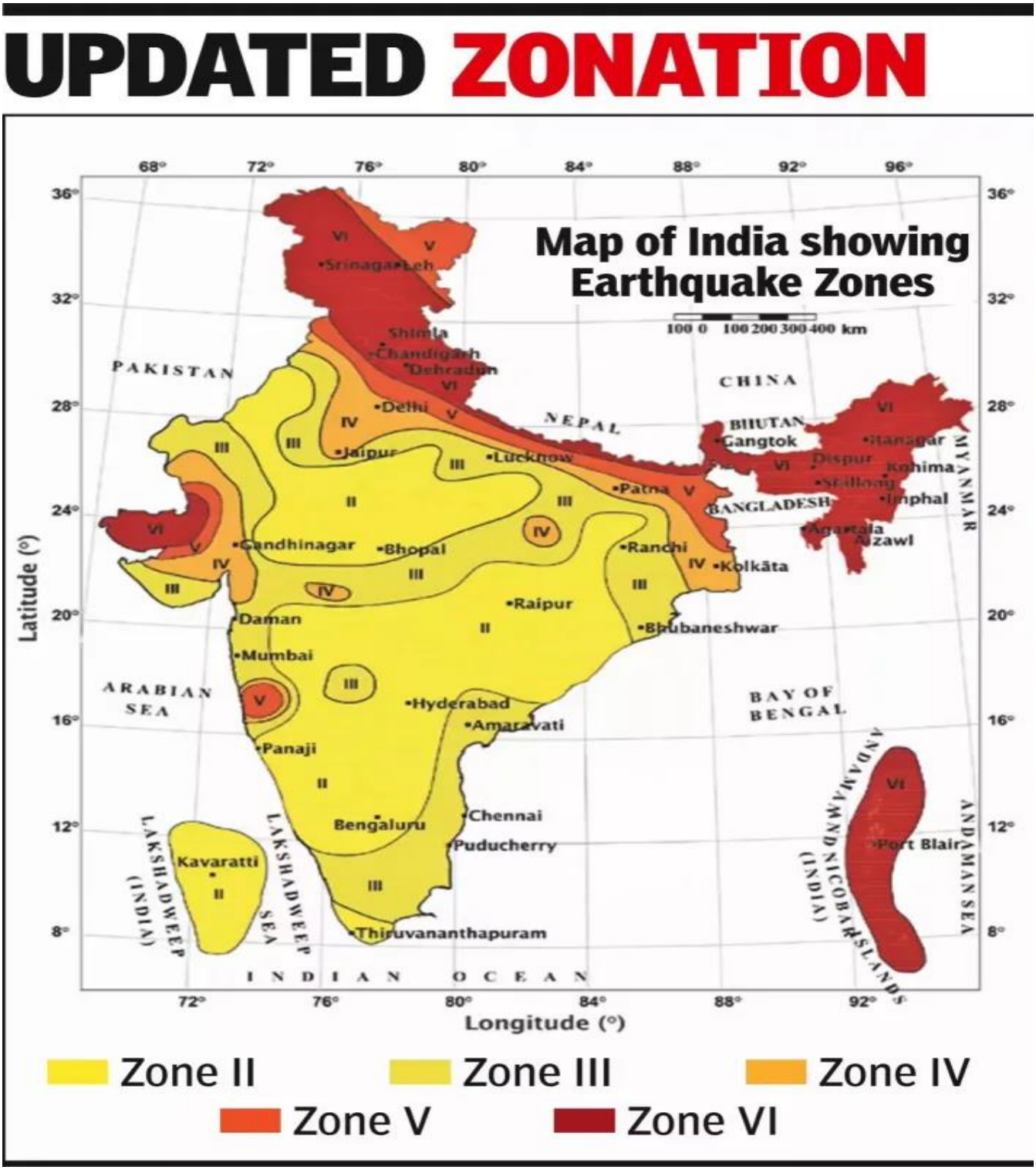
Site-Specific Requirements (SSI) - Addresses -

1. Soil liquefaction potential in river plains.
2. Soft soil amplification (e.g., alluvial basins).
3. Site-specific response spectra for major infrastructure.

Mandates geotechnical investigations for large buildings and public utilities.

Critical Infrastructure Standards - Lifeline facilities—hospitals, metro stations, power plants, schools, bridges, pipelines—must remain operational after a major earthquake. Includes performance-based design philosophies ensuring -

1. Immediate occupancy.
2. Reduced downtime.
3. Continuity of essential services.



Challenges in Implementation

Retrofitting Legacy Infrastructure - A large share of existing buildings predate modern seismic codes. Retrofitting requires - Structural assessment. Strengthening through jacketing, shear walls, base isolation

in special cases. Coordinating across municipal bodies, private owners, and state agencies is complex and expensive.

Higher Construction Costs - Compliance with stricter seismic detailing, ductile reinforcement, and quality controls raises upfront construction costs by 8–20%. Pushback likely from developers unless balanced by incentives, subsidies, or mandatory compliance mechanisms.

Geotechnical Investigation Requirements - Site-specific studies require - Drilling rigs, SPT/CPT tests, downhole/uphole surveys. Expertise in soil dynamics and geophysical profiling. Smaller towns and tier-II/III cities lack trained professionals and accredited laboratories.

Regulatory Enforcement Gaps - Building by-laws in many states remain outdated. Weak municipal enforcement leads to poor compliance with seismic design standards.

Capacity Building Needs - Engineers, architects, masons, and municipal officials require updated training in PSHA-based design. Institutes like NIDM, NITs, IITs, and professional bodies need expanded training programs.

Public Awareness and Acceptance - Homeowners often resist seismic safety investments due to delayed or invisible benefits. Requires strong public messaging and incentives for safer construction.

Source - https - //timesofindia.indiatimes.com/city/dehradun/india-unveils-new-seismic-map-entire-himalayan-arc-now-in-highest-danger-zone/articleshow/125620899.cms