Seismic Activity in India - *The Problem Size*

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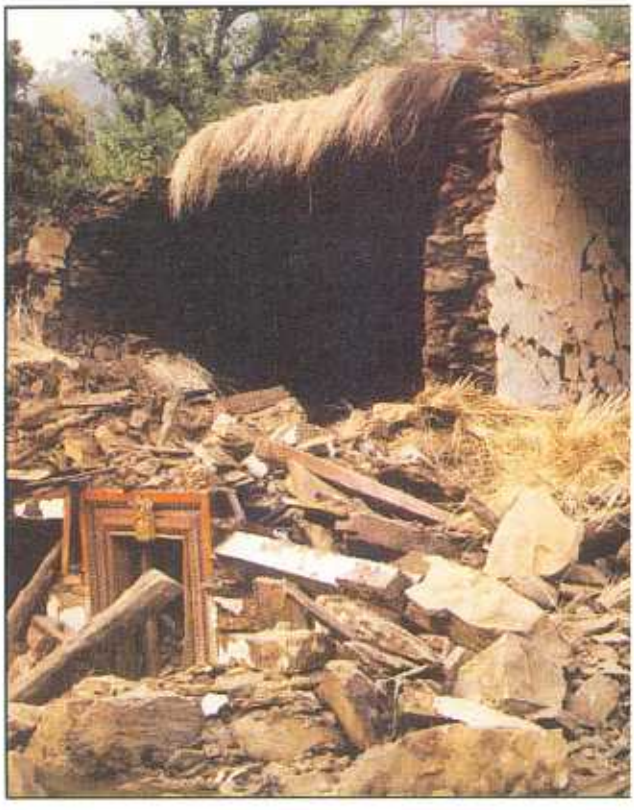
Introduction

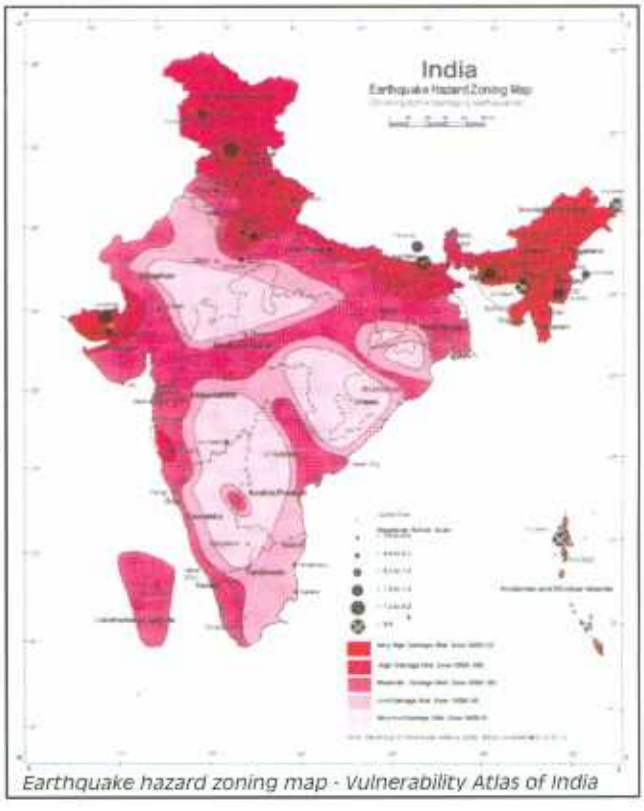
Earthquakes, the most feared of natural hazards as they occur without any recognizable warning, are unpredictable in space and time and inflict heavy losses in less than a minute duration. A UNESCO study indicates that on an average 10,000 people die each year from earthquakes and losses amounting to billions of rupees.

Over 300,000 earthquakes are recorded annually throughout the world, most of which are either insignificant or occur in inhabitant regions. The pattern of distribution of earthquakes identified two major belts – one is circum-pacific belt which amounts to 75 per cent of the world's seismicity, the other one is referred to as Alpide – Asiatic belt that includes the Himalayas, incorporating 22 per cent of the earthquakes Small fraction of the seismicity is also confined along mid – oceanic ridges, intra-continental rifts and other areas. In fact these narrow earthquakes belts or zones are confined to either convergent plate margins where subduction/ collision of crustal plates are taking place or along divergent plate margins, transform faults or intra-continental and continent margin rifts. Each major plate, in-turn is divided by several major fractures or lineaments, some of which are seismogenic in nature. It would be seen that all earthquake belts are narrow linear or arcuate zones, which are expressed as major linear features on global surface in satellite images or aerial photographs. Thus, direct relationship between Earthquakes and Lineament Tectonics is discernible though vice-versa may not always be true.

Earthquakes in Indian Sub-continent

Earthquake activity in India is directly related to the movement of Indian plate Indian Sub-continental plate after getting detached from its Gondwanic partners in early Cretaceous(~ 130Ma) moved very rapidly with consequent thinning and heating of its lithosphere. It started actively subducting underneath Asian and Burmese plates at differential rates with intense Ophiolitic activity(100 – 65 Ma) at its boundary followed by continental collision resulting in episodic uplift of Himalayas and Naga-Arakan-Yoma mountain ranges during Tertiary and Quaternary times. These mountain ranges attained their present geomorphic expression during quaternary times. Accumulation of compressive stresses with variable disposition of principal axes during mountain building activity resulting in rotational movement of Indian plate; generation of conjugate set of tensional stress regimes giving rise to many intra-plates rifts; and associated sedimentary basins on the Indian plate - both on shore and off- shore areas. Net outcome of all these processes was formation of several tectonically active mega-structural features dividing the Indian plate into number of fault bound blocks which have moved differentially relative to each other through geological times . These structural features occur as major lineaments on the tectonic map of India and on satellite images. Here, it is important to mention that all these Lineaments need not be seismogenic, only those lineaments showing evidences of Quaternary to Recent movements (Neo-Tectonism/Contemporary Tectonism) are seismogenic. These features are, in-fact, reflection of on-going geo-dynamic processes operating underneath in crustal – upper mantle regions. It has been established that differential thermal and crustal structures underneath the Indian Shield provides the first order motive force for the relative movements between the various blocks under the overall influence of the ambient stress field generated in the India plate . Such movements accumulate strain along block boundaries and on becoming critical get released causing earthquakes of varying magnitudes, focal depths and focal mechanism.





Earthquake hazard zoning map - Vulnerability Atlas of India