

# Earthquakes in India

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Indian subcontinent has experienced some of the devastating earthquakes. Though codes and regulations are in place to mitigate the losses, very little is done to implement the same. One has to read the topic from mains point of view to understand preparedness as well as precautions to be taken to lessen the after effects of earthquakes.

**In news** Delhi-NCR has experienced 11 mild earthquakes since May.

**Placing it in syllabus** Disaster Management/Geography – Earthquakes

## **Static dimensions**

1. Seismic vulnerability of India (map of zones)
2. Types of earthquakes
3. Major Earthquakes in India

## **Current dimensions**

1. NDMA guidelines on earthquake
2. Critical areas of concern
3. Causes for recent tremors in Delhi NCR

## **Content**

### **Seismic vulnerability of India:**

- Seismic zones divide the earthquake-prone areas in the country on the **basis of seismicity**, earthquakes occurred in the past and tectonic setup of the region.
- The latest 2002 version of the **seismic zone map by the Bureau of Indian Standards (BIS)** divided India into **four zones**, viz. Zone II, III, IV and V.



**Zone II:** This is seismically the least active region. It covers parts of India that are not included in Zone III, IV and V.

**Zone III:** Comprises Kerala, Goa, Lakshadweep islands, remaining parts of Uttar Pradesh, Gujarat and West Bengal, Parts of Punjab, Rajasthan, Madhya Pradesh, Bihar, Jharkhand, Chhattisgarh, Maharashtra, Orissa, Andhra Pradesh, Tamil Nadu and Karnataka.

**Zone IV:** It covers parts of Jammu and Kashmir and Himachal Pradesh, National Capital Territory (NCT) of Delhi, Sikkim, Northern parts of Uttar Pradesh, Bihar and West Bengal, parts of Gujarat and small portions of Maharashtra near the west coast and Rajasthan.

**Zone V:** This is **seismically the most active region**. Parts of the Himalayan boundary in North and Northeast India, the Kutch area in the West falls here. Remaining parts of Jammu and Kashmir, Himachal Pradesh, Uttarakhand, part of North Bihar and Andaman and the Nicobar Islands are included.

## Types of earthquakes

**Tectonic Earthquake:** The energy stored in the crustal rocks causes the tectonic plates

to move towards or away or push against each other. With time, the enormous pressure built up within the region between two plates becomes the cause of the fault line e.g San Andreas Fault line, and plates move over or apart from each other.

From the **focus** of the earthquake, waves of energy travel towards the surface and the point on the surface directly above the focus is called the **epicenter**. From the epicenter of an earthquake, the energy waves traveled in a different direction on the earth's surface causes vigorous movement on the surface of the earth which is known as an earthquake.

**Volcanic earthquake:** Earthquake-related to volcanic activity is called a volcanic earthquake. The magnitude of these quakes is usually weak.

### **Two types of volcanic earthquakes**

**Volcano-tectonic earthquake:** The tremors happen due to injection or withdrawal of magma between the stressed rocks is called a volcano-tectonic earthquake. The movements of the molten magma cause mostly volcanic earthquakes directly underneath a volcano.

**Long-period earthquake:** A long period earthquake occurs while the injection of magma into the surrounding rocks. These all happen due to the pressure changes among the layers of the earth.

**Explosive earthquake:** Explosive earthquakes mostly happen during the testing of nuclear weapons and sometimes the blasts during detonation become the cause of the earthquakes.

### **Collapse earthquake:**

These earthquakes are of weak magnitude earthquakes that happen in the caverns and mines. Sometimes, underground blasts (Rock breaking) in the mines become the cause of the collapsing of mines and collapsing of mines produces seismic waves.

## Major Earthquakes in India:

1. **Indian Ocean Earthquake, 2004**
  - Magnitude – 9.1–9.3
  - Epicenter – West coast of Sumatra, Indonesia
2. **Bihar Earthquake, 1934**
  - Magnitude – 8.7
  - Epicenter – South of Mount Everest
3. **Gujarat Earthquake, 2001**
  - Magnitude – 7.7
  - Epicenter – Kutch, Gujarat
4. **Kashmir Earthquake, 2005**
  - Magnitude – 7.6
  - Epicenter – Muzaffarabad, Pakistan-administered Kashmir (PoK)
5. **Uttarkashi Earthquake, 1991**
  - Magnitude – 6.8
  - Epicenter – Garhwal, Uttarakhand
6. **Latur Earthquake, 1993**
  - Magnitude – 6.4
  - Epicenter – Killari, Latur (Maharashtra)

**NDMA guidelines on earthquake** NDMA released its earthquake guidelines in 2007, the basic premise of which includes six pillars of Earthquake management. **Earthquake-Resistant Design and Construction of New Structures:** Data on past earthquakes show that over 95% of the lives lost were due to the collapse of buildings that were not earthquake-resistant. Though there are buildings codes and other regulations which make it mandatory that all structures in earthquake-prone areas in the country must be built in accordance with earthquake-resistant construction techniques, new constructions often overlook strict compliance to such regulations and building codes.

**Seismic Strengthening and retrofitting of Lifeline and Priority Structures:** Most of the buildings in seismic Zones III, IV and V are not earthquake-resistant and are potentially vulnerable to collapse in the event of a high intensity

earthquake. Due to problems of feasibility, these guidelines recommend the structural safety audit and retrofitting of select critical lifelines structures and high priority buildings.

**Regulation and Enforcement:** A periodic revision of the codes and standards relating to earthquake-resistant construction will be undertaken by drafting groups in keeping with international practices. Codes developed by other organisations such as the Ministry of Shipping, Road Transport and Highway (MoSRTTH), the Atomic Energy Regulatory Board (AERB) etc... will also be updated and made consistent with the current state-of-the-art techniques on earthquake-resistant design and construction.

**Awareness and Preparedness:** A comprehensive awareness campaign will be developed and implemented on the safe practices to be followed before, during and after an earthquake. A handbook on earthquake safety will be prepared for the general public highlighting the safety of persons (i.e., indoors, outdoors, and driving), buildings and structures and non-structural contents of buildings and is available on NDMA site.

**Capacity Development (Including Education, Training, R&D and Documentation):** The developments of high-quality education materials, textbooks, field training and the improvement of the quality of teaching at all levels will be given due emphasis. Education and training programmes will be designed, with greater attention on developing the capacity and skills of trainers and trained teachers.

**Response:** The management and control of the adverse consequences of future earthquakes will require coordinated, prompt and effective response systems at the district and the community levels. Many of the components of response initiatives are the same for different types of disasters and systems need to be developed considering the multi-hazard scenario of various regions in order to optimally utilise

available resources.

## **Critical Areas of Concern for the management of earthquakes in India**

- lack of awareness among various stakeholders about the seismic risk;
- inadequate attention to structural mitigation measures in the engineering education syllabus;
- inadequate monitoring and enforcement of earthquake-resistant building codes and town planning bye-laws;
- absence of systems of licensing of engineers and masons;
- absence of earthquake-resistant features in non-engineered construction in suburban and rural areas;
- lack of formal training among professionals in earthquake-resistant construction practices;
- lack of adequate preparedness and response capacity among various stakeholder groups.

## **Causes for recent tremors in Delhi NCR**

- Since May 15, the National Center for Seismology has recorded several small earthquakes, ranging from 1.8 to 4.5 on the Richter scale, with epicentres at Faridabad, Rohtak and New Delhi.
- Delhi lies in a **zone of moderate to high seismicity**.
- A host of crustal discontinuities in the peninsular mass and the detachment surface in the Himalayan mobile belt govern the seismic hazard of the region.
- Recent earthquakes in this region were due to **“release of stress” accumulated from the movement of the Indian tectonic plate and its collision with the Eurasian tectonic plate**.
- Though the fears of a devastating earthquake have been dismissed, the real fear for Delhi is from the **Himalayas, the ‘most active fault line on earth’**.
- The **large sediment thickness in the Ganga Alluvial Plains** to the north of Delhi tends to amplify the impact

of earthquakes.

- It is opined that the NCR would not be able to withstand a high intensity earthquake, due to the unplanned manner in which building constructions are carried out.

**Mould your thought** What are Critical Areas of Concern for the management of earthquakes in India? Brief about the NDMA guidelines on earthquakes.