Disaster Management of Earthquake : A Case Study

Subject: Geography

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UNIT: II- DISASTER CASE STUDIES

POINT: 1.

EARTHQUAKES

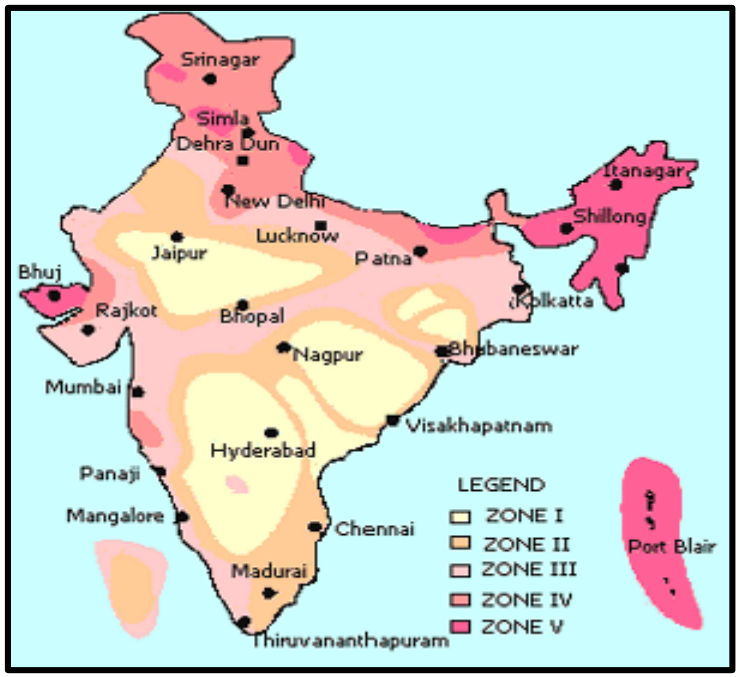
Earthquake is one of the most destructive natural hazard. They may occur at any time of the year, day or night, with sudden impact and little warning. They can destroy buildings and infrastructure in seconds, killing or injuring the inhabitants. Earthquakes not only destroy the entire habitation but may de-stabilize the government, economy and social structure of the country.

Earthquakes are the manifestations of sudden release of strain energy accumulated in the rocks over extensive periods of time in the upper part of the Earth.

Seismology (derived from Greek word *Seismos* meaning Earthquake and *Logos* meaning science) is the science of Earthquakes and related phenomena.

Seismograph/ Seismogram
Seismograph is an instrument that records the ground motions. Seismogram is a continuous written record of an earthquake recorded by a seismograph.

Seismic Zonation Map of India



Source: NRDMS, India.

Seismic Zonation map of a country is a guide to the seismic status of a region and its susceptibility to earthquakes. India has been divided into five zones with respect to severity of earthquakes. Of these, Zone V is seismically the most active where earthquakes of magnitude 8 or more could occur recent strong motion observations around the world have revolutionized thinking on the design of engineering structures, placing emphasis also on the characteristics of the structures themselves it should be realized that in the case of shield type earthquakes, historic data are insufficient to define zones because recurrence intervals are much longer than the recorded human history

this may often give a false sense of security. Occurrence of the damaging earthquake at Latur, falling in zone I is a typical example of this situation.

Cause of Earthquake :

The earth's crust is a rocky layer of varying thickness ranging from a depth of about 10kilometers under the sea to 65 kilometres under the continents. The crust is not one piece but consists of portions called 'plates' which vary in size from a few hundred to thousands of kilometres. The 'theory of plate tectonics' holds that the plates ride up on the more mobile mantle and are driven by some yet unconfirmed mechanisms, perhaps thermal convection currents. When these plates contact each other, stress arises in the crust. These stresses can be classified according to the type of movement along the plate's boundaries:

a) Pulling away from each other,
b) Pushing against one another and
c) Sliding sideways relative to each other.

All these movements are associated with earthquakes. The areas of stress at plate boundaries which release accumulated energy by slipping or rupturing are known as 'faults'. The theory of 'elasticity' says that the crust is continuously stressed by the movement of the tectonic plates; it eventually reaches a point of maximum supportable strain. A rupture then occurs along the fault and the rock rebounds under its own elastic stresses until the strain is relieved. The fault rupture generates vibration called seismic (from the Greek 'seismos' meaning shock or earthquake) waves, which radiates from the focus in all directions. The point of rupture is called the 'focus' and may be located near the surface or deep below it. The point on the surface directly above the focus is termed as the epicenter' of the earthquake

Magnitude:

It is a quantity to measure the size of an earthquake and is independent of the place of the observation.

Richter Scale:

The local magnitude is defined as the logarithm of the maximum amplitude measured in microns on a seismogram written by Wood-Anderson seismograph with free period of 0.8 second, magnification of 2,800, damping factor of 0.8 calculated to be at a distance of 100 kms. The relative size of events is calculated by comparison to a reference event of ML=0,using the formula, ML=log A-log Ao

where A is the maximum trace amplitude in micrometer recorded on a standard seismograph and Ao is a standard value which is a function of epicentral distance (Δ) in kilometers.

Classification of earthquakes	
Category	**Magnitude on Richter Scale**
Slight	Upto 4.9
Moderate	5.0 to 6.9
Great	7.0 to 7.9
Very Great	8.0 and more

Source: www.imd.gov.in

India has witnessed some of the most devastating earthquakes during the last century like the one in Kangra (1905), Bihar-Nepal (1934) and in Assam (1950). In the recent past, earthquakes have caused havoc in Uttarkashi (1991), Latur (1993), Jabalpur (1997), Chamoli (1999) and in Bhuj (2001).

On 26th January 2001, India experienced one of the worst earthquakes in recent times. Measuring 6.9 on the Richter scale, the earthquake caused incalculable damage not just to its epicenter, Bhuj but also to other towns of the district of Kutch and to about 500 villages out of the total of 900 villages. The reported damage to property in Gujarat was about Rs.21, 000crore and the number of human lives lost were about 14,000. Of these, more than 500 deaths were reported from Ahmedabad, situated at a distance of about 350 kms from Bhuj. In the same city,

close to 150 multi-storied buildings crumbled down. Cities far away from the epicenter, like Surat, too reported damage to property.

Some Damaging Earthquakes in India And Approximate Number of Lives Lost

Year of occurrence	Place of occurrence	Intensity		Others
1618	Bombay	-	-	2000 lives lost
1720	Delhi	6.5	-	Some lives lost
1737	Bengal	-	-	300,000 lives lost
1803	Mathura	6.5	-	The shock felt up to Calcutta.
1803	Kumaon	6.5	-	Killed 200-300 people.
1819	Kutchch	8.0	XI	Chief towns of Tera, Kathara and Mothala razed to the ground.
1828	Srinagar	6.0	-	1000 people killed.
1833	Bihar	7.7	X	Hundreds of people killed
1848	Mt.Abu, Rajasthan	6.0	-	Few people killed
1869	Assam	7.5	-	Affected an area of 2,50,000 Sq. miles.
1885	Srinagar	7.0	-	Kamiarary area destroyed.
1897	Shillong	8.7	XII	Wide spread destruction in Shillong.
1905	Himachal Pradesh	8.0	XI	Thousands of people killed.
1906	Himachal Pradesh	7.0	-	Heavy damage.
1916	Nepal	7.5	-	All houses collapsed at Dharchulla.
1918	Assam	7.6	-	Heavy damage.
1930	Dhubri, Meghalaya	7.1	IX	Heavy damage in Dhubri.
1934	Bihar, Nepal	8.3	XI	Large number of border area people killed.
1935	Quetta (in Pakistan)	7.5	IX	25,000 people killed
1941	Andaman	8.1	X	Very heavy damage.
1947	Dibrugarh	7.8	-	Heavy damage.

1950	Assam	8.6	XII	Heavy damage to life and property.
1952	NE India	7.5	-	Heavy damage.
1956	Bulandshahar, U.P.	6.7	VIII	Many people killed
1956	Anjar, Gujarat	7.0	VIII	Hundreds of people killed
1958	Kapkote, U.P.	6.3	VIII	Many people killed
1967	Koyna,	6.1	VIII	Koyna Nagar razed.
1969	Bhadrachalam	6.5	1	Heavy damage.
1986	Dharamshala (H.P)	5.7	VIII	Lots of damage.
1988	Assam	7.2	IX	Few people killed
1988	Bihar- Nepal	6.5	VIII	Large number of people killed.
1991	Uttarkashi	6.6	VIII	Lots of damage to life and property.
1993	Latur	6.4	VIII	Heavy damage to life and property about, 000 people killed.
1997	Jabalpur	6.0	VIII	Lots of damage to property, about 39 lives lost.
1999	Chamoli	6.8	VIII	Lots of damage to property about 100 people lost lives.
2001	Bhuj	6.9	X	Huge devastation, about ~ 14000 people lost lives

Earthquake Hazards in India

India has had a long history of earthquake occurrences. About 65% of the total area of the country is vulnerable to seismic damage of buildings in varying degrees. The most vulnerable areas, according to the present seismic zone map of India, are located in the Himalayan and sub-Himalayan regions, Kutch and the Andaman and Nicobar Islands. Depending on varying degrees of seism city, the entire country can be divided into the following seismic regions:

- **Kashmir and Western Himalayas - Covers the states of Jammu and Kashmir, Himachal Pradesh and sub-mountainous areas of Punjab**
- **Central Himalayas - Includes the mountain and sub-mountain regions of Uttar Pradesh and the sub-mountainous parts of Punjab**

- **North-east India - Comprises the whole of Indian territory to the east of north Bengal**
- **Indo-Gangetic basin and Rajasthan - This region comprises of Rajasthan, plains of Punjab, Haryana, Uttar Pradesh and West Bengal**
- **Cambay and Rann of Kutch**
- **Peninsular India, including the islands of Lakshwadeep**
- **The Andaman and Nicobar Islands**

Measures for Earthquake Risk Reduction

For better understanding of all the possibilities of earthquake risk reduction, it is important to classify them in terms of the role that each one of them could play. Therefore, in the pre-earthquake phase, preparedness, mitigation and prevention are concepts to work on. Post-disaster, immediate rescue and relief measures including temporary sheltering soon after an earthquake until about 3 months later and re-construction and re-habilitation measures for a period of about six months to three years need to follow. To encapsulate, the most effective measures of risk reduction are pre-disaster mitigation, preparedness and preventive measures to reduce vulnerability and expeditious, effective rescue and relief actions immediately after the occurrence of the earthquake. Depending upon the calamity and its consequences, strategies can also be divided into long term (five to fifteen years), medium term (one to five years) and short term (to be taken up immediately in high risk areas). Since it has been realized that earthquakes don't kill people but faulty constructed buildings do, the task of reducing vulnerability of structures and buildings will be the key to earthquake risk reduction. Also, pre-disaster preparedness through a post-earthquake response plan, including training of the concerned personnel in various roles, is considered essential for immediate and effective response after an earthquake occurrence. The major action points are highlighted in the following paragraphs.

Pre-Disaster Preventive Measures

Long-term measures

- **Re-framing buildings' codes, guidelines, manuals and byelaws and their strict implementation. Tougher legislation for highly seismic areas.**
- **Incorporating earthquake resistant features in all buildings at high-risk areas.**
- **Making all public utilities like water supply systems, communication networks, electricity lines etc. earthquake-proof. Creating alternative arrangements to reduce damages to infrastructure facilities.**
- **Constructing earthquake-resistant community buildings and buildings (used to gather large groups during or after an earthquake) like schools, dharamshalas, hospitals, prayer halls, etc., especially in seismic zones of moderate to higher intensities.**
- **Supporting R&D in various aspects of disaster mitigation, preparedness and prevention and post-disaster management.**
- **Evolving educational curricula in architecture and engineering institutions and technical training in polytechnics and schools to include disaster related topics.**

Medium term measures

- **Retrofitting of weak structures in highly seismic zones.**
- **Preparation of disaster related literature in local languages with dos and don'ts for construction.**
- **Getting communities involved in the process of disaster mitigation through education and awareness.**
- **Networking of local NGOs working in the area of disaster management.**

Earthquake Facts & Statistics

Frequency of Occurrence of Earthquakes

Descriptor	Magnitude	Average Annually
Great	8 and higher	1 [1]
Major	7 - 7.9	17 [2]
Strong	6 - 6.9	134 [2]
Moderate	5 - 5.9	1319 [2]
Light	4 - 4.9	13,000 (estimated)
Minor	3 - 3.9	130,000 (estimated)
Very Minor	2 - 2.9	1,300,000 (estimated)
[1]Based on observations since 1900. [2] Based on observations since 1990.		

Year-wise description of Earthquakes

Number of Earthquakes Worldwide for 2000 - 2005. Located by the US Geological Survey National Earthquake Information Center						
Magnitude	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
8.0 to 9.9	1	1	0	1	2	1
7.0 to 7.9	14	15	13	14	14	9
6.0 to 6.9	158	126	130	140	140	116
5.0 to 5.9	1345	1243	1218	1203	1509	1307
4.0 to 4.9	8045	8084	8584	8462	10894	10264
3.0 to 3.9	4784	6151	7005	7624	7937	5782
2.0 to 2.9	3758	4162	6419	7727	6317	3249
1.0 to 1.9	1026	944	1137	2506	1344	20
0.1 to 0.9	5	1	10	134	103	0
No Magnitude	3120	2938	2937	3608	2939	642

Total	22256	23534	27454	31419	* 31199	* 21390
Estimated Deaths	231	21357	1685	33819	284010	1957

List of Some Significant Earthquakes in India

Date	Epicentre		Location	Magnitude
1819 Jun 16	23.6	68.6	Kutch,Gujarat	8.0
1869 Jan 10	25	93	Near Cachar, Assam	7.5
1885 May 30	34.1	74.6	Sopor, J&K	7.0
1897 Jun 12	26	91	Shillongplateau	8.7
1905 Apr 04	32.3	76.3	Kangra, H.P	8.0
1918 Jul 08	24.5	91.0	Srimangal, Assam	7.6
1930 Jul 02	25.8	90.2	Dhubri, Assam	7.1
1934 Jan 15	26.6	86.8	Bihar-Nepalborder	8.3
1941 Jun 26	12.4	92.5	Andaman Islands	8.1
1943 Oct 23	26.8	94.0	Assam	7.2
1950 Aug 15	28.5	96.7	Arunachal Pradesh-China Border	8.5
1956 Jul 21	23.3	7.0	Anjar, Gujarat	7.0
1967 Dec 10	17.37	73.75	Koyna, Maharashtra	6.5
1975 Jan 19	32.38	78.49	Kinnaur, Hp	6.2
1988 Aug 06	25.13	95.15	Manipur-Myanmar Border	6.6
1988 Aug 21	26.72	86.63	Bihar-Nepal Border	6.4
1991 Oct 20	30.75	78.86	Uttarkashi, Up Hills	6.6
1993 Sep 30	18.07	76.62	Latur - Osmanabad, Maharashtra	6.3
1997 May 22	23.08	80.06	Jabalpur, MP	6.0
1999 Mar 29	30.41	79.42	Champoli, UP	6.8
2001 Jan 26	23.40	70.28	Bhuj, Gujarat	6.9

Source: www.cbse.nic.in/natural%20hazards%20&%20disaster%20management.pdf

References

www.imd.gov.in/section/seismo/static/welcome.htm (Seismological activities)