5
EARTHQUAKE DISASTER AND MANAGEMENT

5.1 MEASUREMENT OF EARTHQUAKE MAGNITUDE

An earthquake is a major demostration of the power of the tectonic forces caused by endogenetic thermal conditions of the interior of the earth. 'An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking building apart and causing gaping fissures to open in the ground. The earthquake is a form of energy of wave motion transmitted through the surface layer of the earth in widening circles from a point of sudden energy release, the 'focus' (A.N. Strahler and A.H. Strahler, 1976).

The magnitude or intensity of energy released by an earthquake is measured by the **Richter scale** devised by Charles F. Richter in 1935. The number indicating magnitude or intensity (M) on Richter scale ranges between 0 and 9 but in fact the scale has no upper limit of number because it is a logarithmic scale. 'It is estimated that the total annual energy released by all earthquakes is about 10^{25} ergs, and most of this is from a small number of earthquakes of magnitude over 7' (A.N. Strahler and A. H. Strahler, 1976).

The 1934 Bihar earthquake (India) measuring 8.4 magnitude on Richter scale and Good Friday Earthquake of March 27, 1964, in Alaska, U.S.A. measuring 8.4 to 8.6 on Richter scale are among the greatest earthquakes of the world ever recorded. The following description of Richter scale may help in assessing the devastation caused by the energy release during earthquakes of varying magnitudes. 'The world's largest and most intensive recorded earthquake was of the magnitude of 8.9 (and 9.3) and the number of recorded earthquakes increases 10 times as magnitude decreases by one.'

Table 5.1 : Richter scale of earthquake magnitude

Magnitude	Description
o	Smallest earth tremor detected by seismograph only. Energy released by such insignificant earthquake amounts to 3×10^{12} ergs.
2.5 to 3.0	Such earthquakes may be felt and detected if they occur near the settlements. The annual frequency of such earthquakes is around 100,000. No damage is done.
4.5	Local damage is done.
5.0	The quakes of this magnitude equal in energy to ordinary atomic bomb. The atomic bomb hurled on Hiroshima (Japan) during Second World War equalled the magnitude of 5.7 on Richter scale. The energy released from such earthquakes equals 8×10^{20} ergs.
6.0	Such earthquakes become destructive within a limited area provided that the geological structure is weak and the area is heavily populated.
>6.0	Devastation increases with increasing magnitude.

Another scale of the measurement of the degree of destructiveness or intensity of earthquakes is **Mercalli scale**. The degree of destructiveness or intensity of an earthquake depends on a variety of factors e.g. magnitude, distance from epicentre, acceleration, duration, amplitude of waves, type of ground, water table, nature of geomaterials of the region concerned and the nature and type of constructions (such as buildings made of wood or bricks or stones or concretes, dams whether concrete or earthen, buildings made of muds, tin shades, huts etc.) affected by an earthquake. Table 5.2 represents the comparative picture of Mercalli Intensity Scale and Richter Magnitude Scale.

Table 5.2 : Comparative picture of Mercalli and Richter Scales

Mercalli Intensity	Description of Characteristic Effects	Richter Magnitude corresponding to highest intensity reached
I Instrumental	The tremors of this category of earthquakes are detected only by seismographs	
II Feeble	Such earthquakes are noticed by only sensitive people	3.5
III Slight	Like the vibrations caused by passing truck or lorry; felt by	4.2

	people at rest especially in upper floors of the buildings	
IV Moderate	Felt by people while walking; rocking of loose objects including standing vehicles	4.3
V Rather Strong	Felt generally, most sleeping people are awakened and bells ring	4.8
VI Strong	Trees sway and all suspended objects swing; damage is caused by over-turning of vehicles and falling of loose objects	4.9-5.4
VII Very Strong	General alarm; walls crack; plaster falls	5.5-6.1
VII Destructive	Vehicle drivers seriously disturbed; masonry constructions are fissured, chimnyes fall; poorly constructed buildings damaged	6.2
IX Ruinous	Some houses collapse where ground begins to crack and pipes break open	6.9
X Disastrous	Ground cracks badly; many buildings destroyed and railway lines bent; landslides on steep slopes	7-7.3
XI Very disastrous	Few buildings remain standing; bridges destroyed, all serivces (railways, pipes and cables) out of action; great land-slides and floods	7.4-8.1
XII Catastrophic	Total destruction; objects thrown into air; ground rises and falls in waves.	above 8.1

5.2 GENERAL CHARACTERISTICS OF EARTH-QUAKES

The place of the origin of an earthquake is called **focus** which is always hidden inside the earth but the depth of which varies from place to place. The deepest earthquake may have its focus at a depth of even 700 km below the ground surface but some of the major Himalayan earthquakes, such as the Bihar-Nepal earthquake of August 21, 1988, have their focus around 20-30 km deep. The place on the ground surface, which is perpendicular to the buried **'focus'** or **'hypocentre',** recording the seismic waves for the first time is called **epicenter.**

The **seismic waves** move away from the source of the earthquake (focus or hypocentre) in the form of (i) primary or pressure waves (P waves), (ii) secondary, shear or transverse waves (S waves) and (iii) long waves or surface waves (Lwaves). These seismic waves are recorded with the help of an instrument called **seismograph** or **seismometer** at the epicentre. The patterns of recorded seismic waves are studied and various definite information about the centre of the origin of the earthquake (focus or