

Understanding Earthquakes

By Umesh Dhargalkar

Earthquakes are unpredictable natural disasters with a low probability of occurrence, but with unparalleled destruction. Recently a mighty earthquake with Richter magnitude of 9.0 struck Japan and caused great devastation to its life and property. It also triggered a tsunami which swept away houses, cars and ships. Japan has been known as an advanced country which has put in lot of investment and efforts into earthquake related research and has adopted stringent specifications to construct structures with the best standards of earthquake resistance. These measures have undoubtedly helped them in their hour of test; otherwise the devastation could have been much more. What do we, in India, learn from this? Are we doing enough for our safety? Should there be an earthquake in Mumbai, are we well equipped to face it? Will our structures stand in the event of even a modest earthquake? In this first of the two articles let us understand the phenomenon called earthquake.

Anatomy of earth:

In order to understand the cause of earthquakes, we need to understand the anatomy of mother earth. Broadly the inside of earth consists of four layers.

- Outermost "Crust" which is solid in nature exists up to a depth of 100 km from the surface of earth.
- "Mantle" which is liquid extends from 100 km to 2900 km.
- "Outer Core" is also liquid and lies from 2900 km to 5100 km.
- "Inner Core" which is solid extends from 5100 km to the center of earth which is 6378 km

Earthquake:

Earth's crust consists of several plates (disjointed pieces) of solid rock. There are 12 major plates in the world. These plates slowly but continuously slide over, under or past each other. Due to their movement and the resulting deformations, enormous amount of stresses go on getting accumulated within the rocks. When these stresses exceed the capacity of the rocks, they rupture, with a sudden violent motion of earth, releasing the accumulated energy. This is called an earthquake. Most earthquakes occur at the boundaries of the plates and are called inter-plate earthquakes. However sometimes an earthquake can occur within a plate also and such an earthquake is called an intra-plate earthquake. Usually an earthquake lasts for less than a minute. A strong earthquake may be preceded by occasional shaking which are called foreshocks. Similarly it may be followed by many recurring shocks which are called aftershocks. It is not possible to predict the location, time or magnitude of an earthquake.

Some Common Terms:

The plane along which the rocks rupture is called a fault plane. The place where an earthquake originates deep inside the earth is called its focus. Focus can be several kilometers below the earth's surface. The place right above the focus, on the surface of the earth, is called its epicenter. Earthquakes are recorded using instruments called seismographs. An earthquake mainly gives rise to two types of waves – body waves, which travel through the interior of the earth and the surface waves (analogous to water waves) which travel along the surface of the earth.

Earthquakes of varying magnitudes keep happening in different parts of the world. However it is only when an earthquake's magnitude or the destruction caused is high that it is globally noticed. Most of the strong earthquakes occur along a well known boundary called "Ring of Fire" which is located in the basin of Pacific Ocean.

The massive displacement caused by a strong undersea earthquake can give rise to giant waves called "Tsunamis". A tsunami travels at great speed and can rise in height as a tall

wall of water when it reaches a shore. Then it can travel deep into the land and can cause massive destruction.

The severity of an earthquake is described by its "magnitude" and "intensity".

Magnitude:

The magnitude of an earthquake is a measure of the energy released during the earthquake. It depends on the extent of shaking of earth. It is measured on the "Richter scale". It is a logarithmic scale, which means that an increase of unity in the Richter magnitude amounts to a tenfold increase in the energy released. For example, an earthquake with Richter magnitude 7 releases energy, which is ten times that released for magnitude 6; and 100 times that released for magnitude 5. The magnitude of the Bhuj earthquake was around 7.7 and that of the Latur earthquake was 6.3.

Intensity:

The destructive potential of an earthquake not only depends on its magnitude, but also on the depth of its focus, the nature of earthquake waves, geological and topological conditions of the area and such other factors. It is usually highest close to the epicenter and diminishes away from it. It is expressed as its intensity. The intensity is expressed on the MSK scale.

Seismic Zones:

India has a long history of earthquakes. In the last about 200 years India has suffered several earthquakes with magnitudes varying from 6.0 (Jabalpur in 1997) to 8.7 (Shillong in 1897). Especially due to the collision of the Indian Plate with the Eurasian Plate, the northeastern Indian border has been known to be earthquake prone. Due to the varying geology at different locations in our country the likelihood and probable severity of earthquakes at different locations is different. Depending on the perceived risk, India is divided into 4 seismic zones (zone II, III, IV & V). Nearly 65 % of Indian land falls under moderate (zone III) to severe (zone V) risk zones. Among the major cities Delhi is in zone IV. Closer home, Gujarat and parts of Maharashtra are very prone to earthquakes. Mumbai, Pune and Ahmedabad fall in zone III whereas Bhuj falls in zone V.

Natural disaster:

Earthquake can cause collapse of buildings, bridges, dams etc, fissures in ground, disruption of power, transport and communication and colossal loss of life and property. It can also lead to fires, floods, epidemics and a huge setback to the affected people. If the foundation of a building is laid on confined sand, during an earthquake the sand may become like soft jelly and cause the building to sink. The collapse of buildings can be sudden and people get very little time to react. For the city of Mumbai, which falls in seismic zone III (corresponding to an earthquake of Richter magnitude 6.5), dense population, old/ tall buildings and construction on reclaimed land can aggravate the situation. Moreover, most of the buildings in the city are not structurally designed to resist earthquakes. To face an earthquake, we must have our structures designed for the required earthquake resistance. We also must have good amount of awareness regarding earthquake safety among the common people. In the event of an earthquake, their quick action at the local community level can help the city immensely, rather than complete dependence on the government's disaster management plan.
