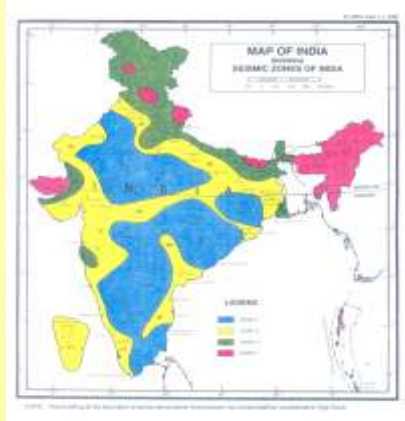


Seismic Zoning Map of India

Seismic zonation map of a country is a guide to the earthquake vulnerability of the region. India has been divided into four zones with respect to severity of earthquakes. Of these zone V is seismically the most active and zone II is the least active. **Delhi** comes under **Zone IV** of seismic hazard map.



Recent Significant Earthquakes in India

| Place & Year | Magnitude | Casualties |
|-------------------|-----------|------------|
| Bhuj (2001) | M=7.7 | 13,805 |
| Chamoli (1999) | M=6.8 | 103 |
| Jabalpur (1997) | M=6.0 | 39 |
| Latur (1993) | M=6.3 | 7,601 |
| Uttarkashi (1991) | M=6.6 | 769 |

Tsunami



A Photograph of recent 26th Dec 2004 Indian Ocean Tsunami

Tsunami is a Japanese word with the English translation "Harbour wave". When an earthquake of large magnitude occurs under the sea, due to large displacement of sea floor, the water column is disturbed and sea waves travel long distances and when they reach shallow waters, their amplitude increases. At any given place, the amplitude may range from a few meters to a few kms depending upon several factors including the magnitude of the event, the type of faulting, the depth of water column and bathymetry of the coast.

Earthquakes, landslides, volcanic eruptions, explosions and even the impact of cosmic bodies such as meteorites can generate tsunamis. Tsunamis can be predicted after the occurrence of an earthquake with the help of a dedicated Tsunami Warning System.

Tsunami is a Japanese word with the English translation "Harbour wave". When an earthquake of large magnitude occurs under the sea, due to large displacement of sea floor, the water column is disturbed and sea waves travel long distances and when they reach shallow waters, their amplitude increases. At any given place, the amplitude may range from a few meters to a few kms depending upon several factors including the magnitude of the event, the type of faulting, the depth of water column and bathymetry of the coast.

Earthquake Prediction

It is difficult to predict an earthquake but constructing earthquake resistant structures can minimize the damage due to an earthquake. Since Delhi is in seismically active zone there is a need for earthquake hazard assessment of the region.

Rules to remember during an Earthquake

Rule - 1: Protect yourself and your family

(Immediately get yourself under a table, desk etc. to protect your head from falling object when earth shakes)



Rule - 2: Turn off gas, electric heaters to protect against fire break out.

(It will prevent a serious disaster due to fire break out)

Rule - 3: Avoid rushing out of the house.

(Carefully check the situation and try to act accordingly)



Rule - 4: Open the exit window.

(During an earthquake the doors are destroyed and cannot be opened. To avoid such problems open the door quickly to secure a safe exit)

Rule - 5: When outside protect your head from dangerous objects.

(When you are outside, you should protect your head from falling objects like bricks, concretes, signboards etc.)



Rule - 6: Stop driving and park the vehicle in safe areas.

(Driving in the road may create traffic blockage causing problems for rescue operation)

Rule - 7: Avoid being misled by false alarms and try to obtain the correct information.

(False alarms are quite common during a disaster. One should be careful about the false alarms)



EARTHQUAKE AWARENESS CAMPAIGN

Supported By:

Seismology Division
Deptt. of Science and Technology
Government of India
New Delhi



RESOURCE DEVELOPMENT CENTRE

122, Katwaria Sarai, Saheed Jit Singh Marg, New Delhi - 16
Ph: 011 - 2652 5702, 2660 1460; Fax: 011 - 2696 2019

What is an Earthquake?

An earthquake is a sudden movement of the Earth caused by sudden release of strain that has accumulated over a long time.

Causes of Earthquakes

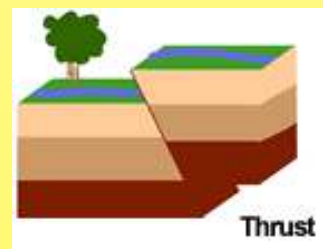
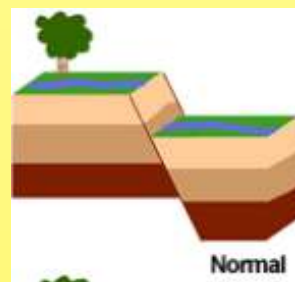
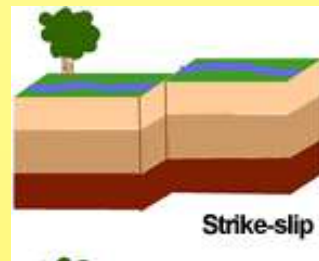
The Earth is divided into number of huge plates, which move apart each other by accumulating energy. Sometimes, the plates are locked together and unable to release the accumulating energy. When the accumulating energy grows strong enough, the plates break into faults and suddenly release a huge amount of energy by creating an earthquake. The earthquakes are mainly concentrated along the plate boundaries. The boundary of the Pacific Ocean is tectonically active. Frequent earthquakes and volcanic eruptions are quite common in this zone and coincide with the edges of one of the world's main tectonic plates called "**The Ring of Fire**".



Boundaries of major tectonic plates and distribution of earthquakes
(Source: Janson and Richardson, 1995)

What is a Fault

A fault is a fracture having relative movements parallel to the line of fracture. Generally there are 3 types of faults, which cause earthquakes.



Seismic Waves

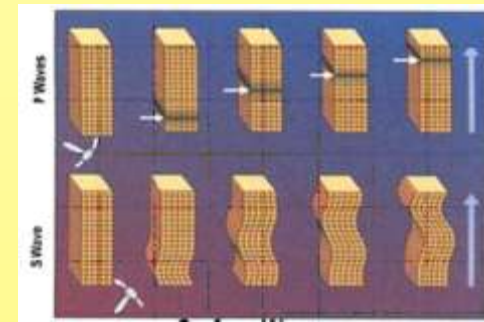
An earthquake or an explosion, which causes maximum damage to the lifeline structures, generates elastic waves. There are three types of waves that are created when stress is released during earthquakes. These waves are P, S and Surface waves.

The P Wave or primary wave is the fastest among 3 waves and first detected by Seismographs. P waves are compressional waves like sound waves and can travel both in liquid and solid rock.

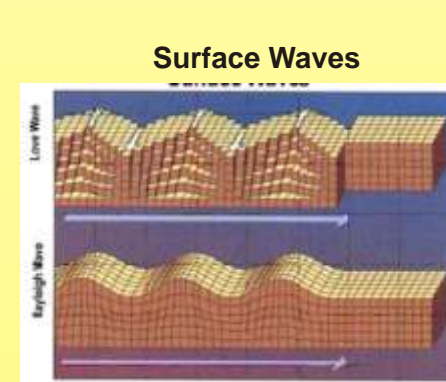
S Waves or Secondary waves are the waves, which follow the P waves. These waves are transverse waves in which the particle motion is perpendicular to the direction of wave motion. These waves do not travel through liquid.

Both P&S waves are called **body waves** because they move in the Earth's interior.

The third type of waves is the slowest one called **surface waves**. These waves travel close to the surface and that move both horizontally and vertically in a vertical plane. These waves cause more damages to the lifeline structures.



Body Waves



Surface Waves

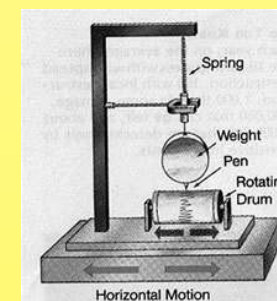
Earthquake Terminology

Main shock, foreshocks and aftershocks:

A large earthquake is generally preceded and followed by many smaller shocks. The largest earthquake is called the **mainshock**. The smaller ones that preceded the mainshock are called **foreshocks** and the subsequent shocks are called **aftershocks**.

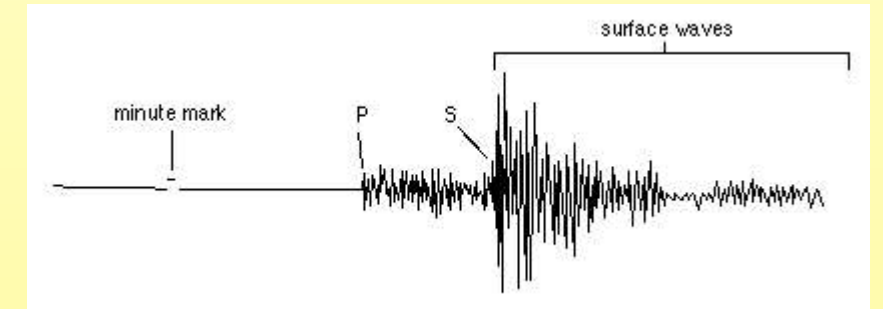
Seismograph:

Seismograph is the instrument for recording vibrations of earth's surface caused by seismic waves.



Seismogram:

The record of the earthquake is called a seismogram. Location and magnitude of an earthquake are calculated from seismogram.



Intensity:

Intensity is the measure, in terms of degrees, of damage to the surface and the effects on human. A descriptive scale is used to measure Intensity called as **Modified Mercalli Scale**.

Magnitude:

Magnitude is a measure of the size of the earthquakes. The magnitude is calculated from the amplitude of the seismic wave and is closely related to the energy released during the earthquake. Different scales are used for earthquake magnitude. One of such magnitude scale is called **Richter scale**.

Hypocenter & Epicenter :

The earthquake occurs as a result of the movement of a fault that is by rupture of rocks. The point at which the rupture originates called the **hypocenter** or the **focus** and the point directly above the ground is called the **epicenter**. Depth of the hypocenter from the surface is known as **focal depth**.

