

EARTHQUAKE PROBLEM: Do's and Don'ts for Protection



Sponsored by [Rajiv Gandhi Foundation](#), New Delhi and

Prepared by Department of Earthquake Engineering,

[University of Roorkee](#), Roorkee

PREFACE

A large number of earthquakes are felt all over the globe every year. The small ones are unnoticed while the large ones are felt over thousands of kilometers. The big quakes are not necessarily the most destructive. Earthquakes have damaged and destroyed man's work since time immemorial. Here, we have tried to explain the nature, distribution, causes and effects of this terrifying natural event. We look at the possibilities of minimizing its disastrous consequences.

In this context, the present booklet has been prepared under a project sponsored by Rajiv Gandhi Foundation, New Delhi to Department of Earthquake Engineering, University of Roorkee. The objective is to educate children in the region affected by Oct. 20, 1991 earthquake in Uttarkashi so as to create awareness in their minds about the earthquake problem.

This booklet has been prepared by Dr. Brijesh Chandra and Dr. (Mrs) Amita Sinvhal, members of the faculty of Department of Earthquake Engineering, University of Roorkee. Drawings included in the booklet are prepared by Mrs. Ila Gupta.

We hope that this effort made by Department of Earthquake Engineering, University of Rootkee through inspiration and funding by Rajiv Gandhi Foundation, will prove useful and helpful for children in their future life.

October 1994

Prof. & Head
Department of Earthquake Engg.
University of Roorkee, Roorkee

EARTHQUAKE PROBLEM

In India epicentres of earthquakes are concentrated along the Himalayan mountains, from Kashmir to Arunachal Pradesh. This region extends southwards into the Nicobar islands. Gujarat and parts of Maharashtra are also very prone to earth-quakes. All other regions in India have smaller and fewer earthquakes. From seismicity viewpoint India has been divided into five seismic zones.

THE GREAT INDIAN EARTHQUAKES

Within the last two hundred years, India has experienced five great earthquakes, each with Richter magnitude exceeding 8. The regions where these occurred are as follows:

1819 Kutch, Gujarat

1897 Assam

1905 Kangra, Himachal Pradesh

1934 Bihar-Nepal

1950 Assam-Tibet

Some special effects of these earthquakes are described here.

The Assam Earthquake of 1897

This earthquake had its epicentre near Shillong. It is supposed to be one of the largest earthquakes in the world, and has been assigned magnitude 8.7. The earth heaved in the most frightful manner, causing massive landslides and widespread floods. At some places land was displaced on the surface upto 12 meters. Along the Chedrang river several water falls and lakes developed. More than 1500 people lost their lives in this thinly populated area.

The Kangra Earthquake of 1905

This earthquake had twin epicenters - in the Kangra-Kulu and the Mussoorie-Dehradun valleys. It caused several large landslides, rock falls and large scale changes in the flow of water in springs, streams and canals. More than 19,000 people perished.

The Bihar-Nepal Earthquake of 1934

This earthquake was accompanied by spectacular effects of slumping, subsidence of ground, fissures in alluvium and sand, and water fountains. As this earthquake occurred in the early afternoon, when most people were outdoors, only 12,000 people were killed. If this earthquake had occurred at night, more people would have been trapped in house collapses.

The Assam-Tibet Earthquake of 1950

The epicentre of this earthquake was near Rima, on the Assam Tibet border. The earthquake caused huge fissures, subsidence and elevation of ground and gigantic landslides. Rivers Dihang, Subansiri and other tributaries of Brahmaputra were dammed by landslides. Later, when these dams burst, the area downstream was flooded which caused further damage to life and property.

Apart from these, there have been other devastating earthquakes in the Indian sub-continent, which have created public awareness about this problem. A major earthquake occurred in Kutch in 1819. In Quetta, 30,000 people were killed in a devastating shock in 1935. In Koyna an earthquake occurred in 1967 which surprised everybody since no such shock had struck the Deccan plateau until then and this area was considered as stable from earthquake point of view. In 1991, a damaging earthquake occurred in Uttarkashi also.

EARTHQUAKE DAMAGE

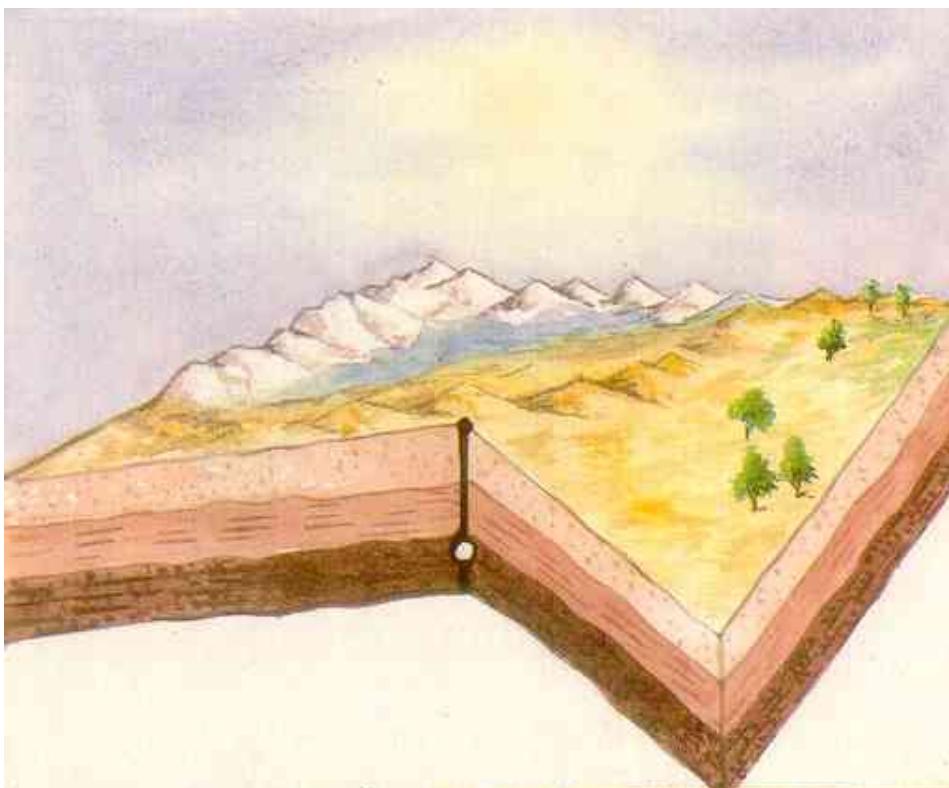
Most human lives in earthquakes are lost due to collapse of houses. Styles of making houses depend on local climate, construction material available and on local traditions.



WHAT IS AN EARTHQUAKE

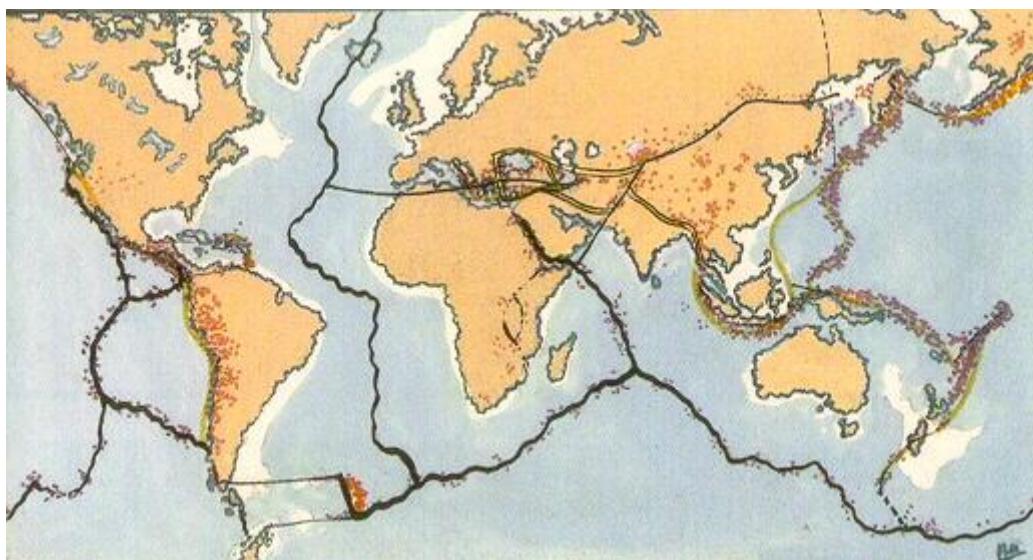
An earthquake is a sudden violent motion of the earth, which lasts for a short time, within a very limited region. Most earthquakes last for less than a minute, but sometimes shock may last, for as long as 3 to 4 minutes.

The place where an earthquake originates inside the earth is called the focus of the earthquake. The point vertically above this, on the surface of the earth, is called its epicentre.



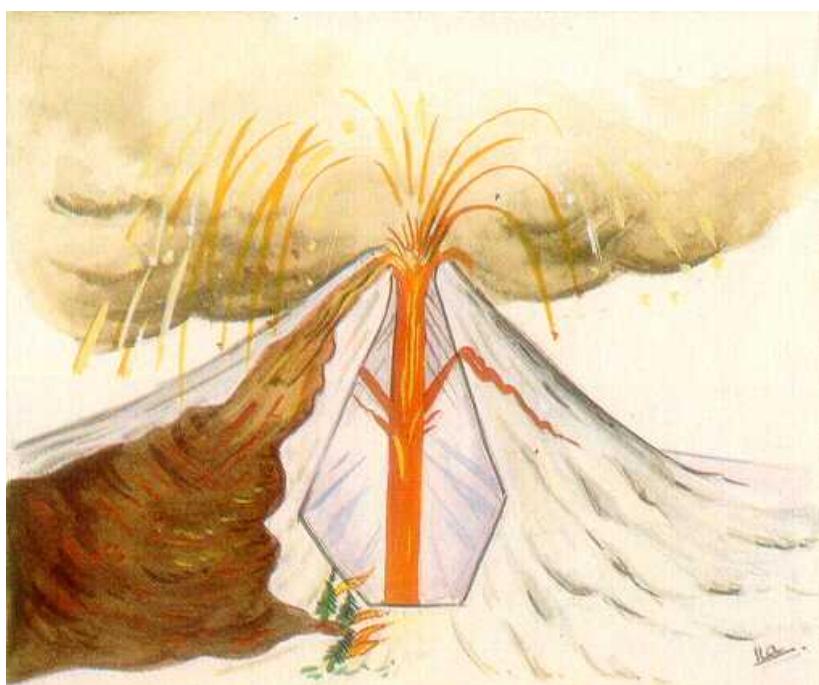
WHY DO EARTHQUAKES HAPPEN

The entire surface of the earth is made up of several wide, thin and rigid plate like blocks. These are in constant motion with respect to each other. This causes most earthquakes at edges of plates and a few earthquakes within the plate. The movement is very slow but in some places it is as much as about 5 cm per year.



Earthquakes occur almost everywhere in the world. Some regions have more earthquakes than other parts of the globe. Earthquakes can be caused by other reasons too. Volcanic activity can shake the ground. Blasting, quarrying and mining can cause small earthquakes. Underground nuclear explosions are also man made earthquakes.

Tremendous amount of energy is released during an earthquake. This can cause widespread damage. Human dwellings have to be protected from earthquakes. Collapse of buildings in an earthquake, specially in congested areas, can cause havoc.





EMERGENCY SERVICES

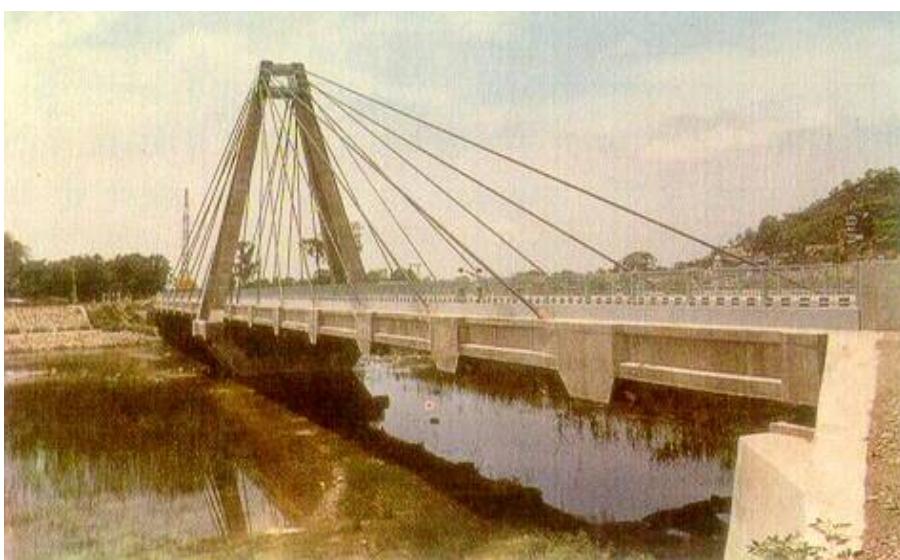
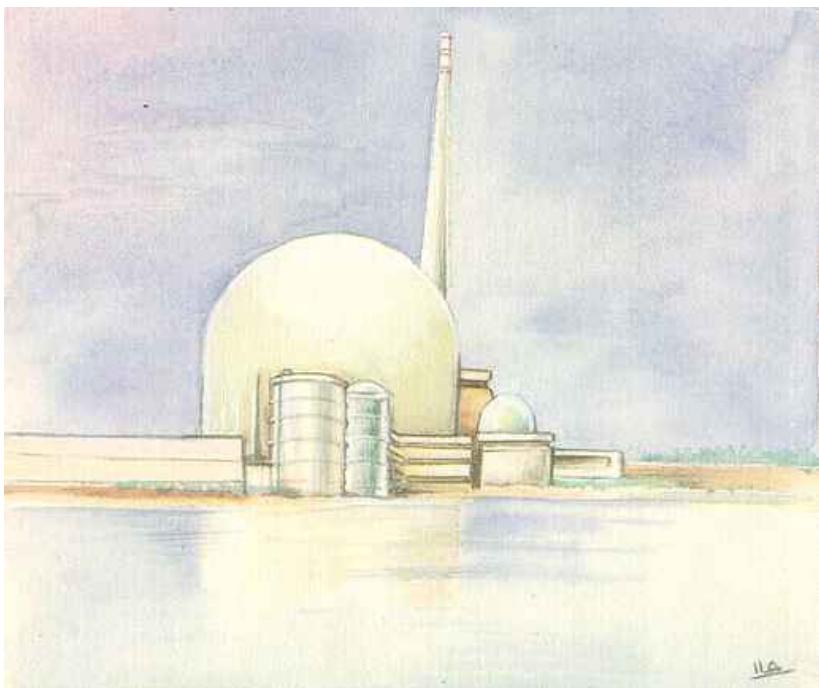
Damage to emergency services, such as to hospitals, fire stations and disruption of electricity and water supply causes spread of fire and diseases. This adds to the chaotic situation created by an earthquake.

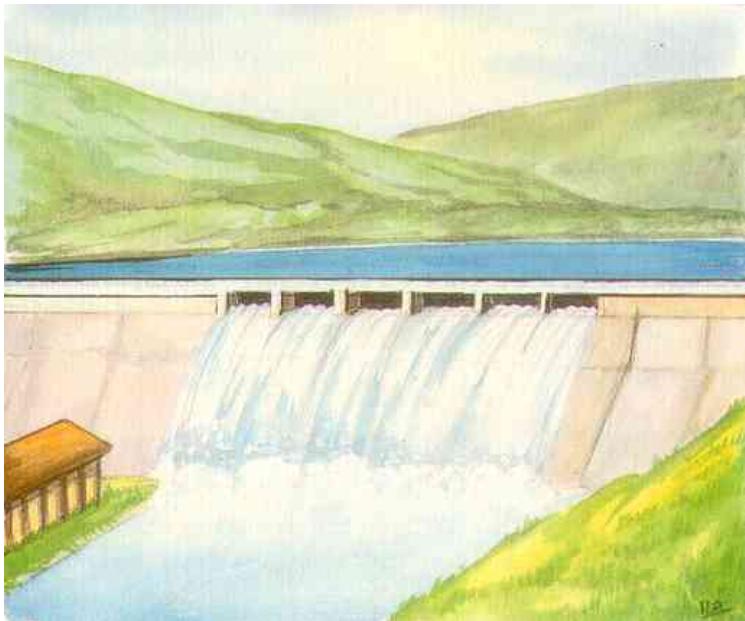


SPECIAL STRUCTURES

It is very important that special structures are protected from the effects of earthquakes. Nuclear power plants, dams, bridges and industrial complexes, which deal with hazardous chemicals, can also be designed to withstand damage from future earthquakes.

These special structures are designed and constructed after study of all aspects of earthquake problem at the site.

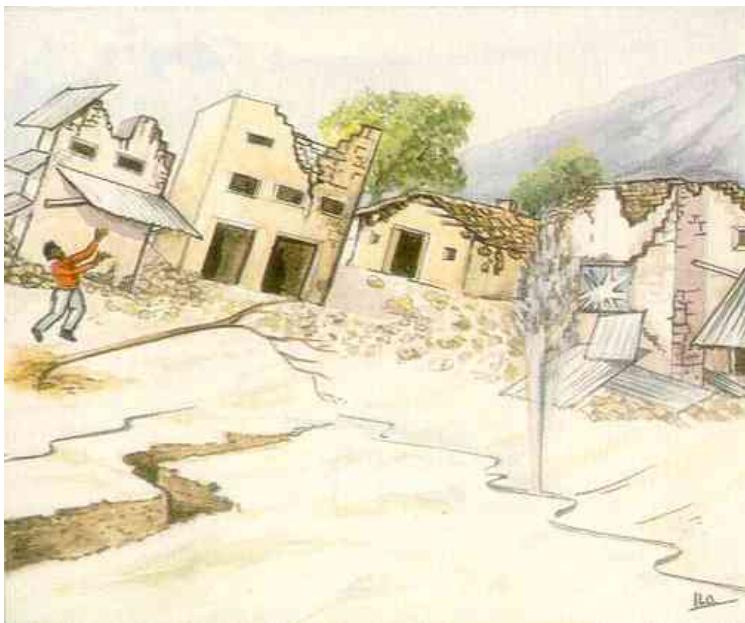




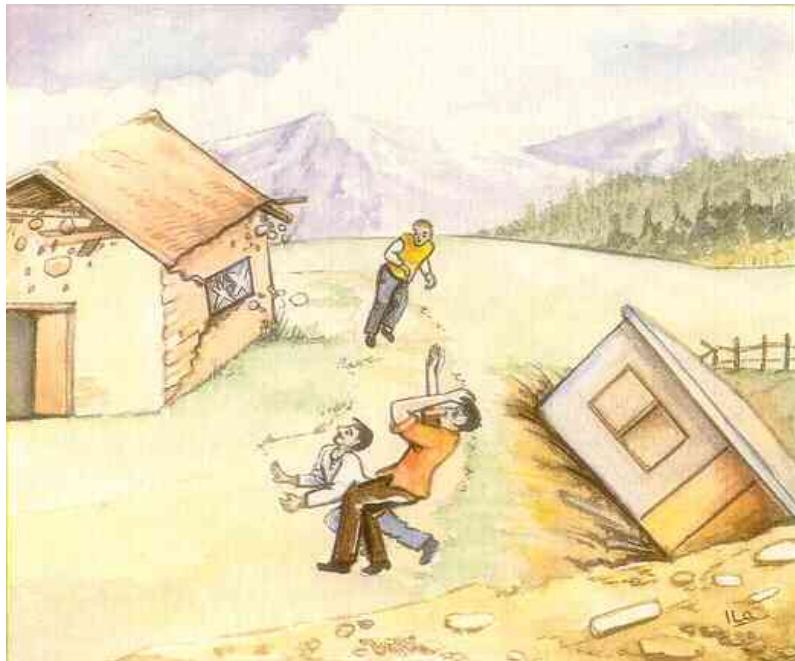
EARTHQUAKE EFFECTS ON GROUND

Violent shaking during an earthquake can cause large fissures and can also rupture the ground. Shaking is amplified in soft sediments, which may cause liquefaction of soil. Sometimes fountains of sand and water are also witnessed.

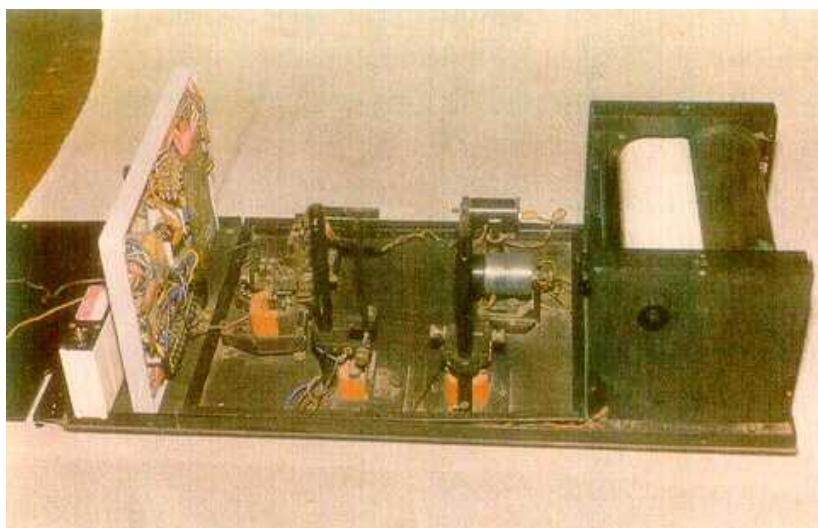
Landslides may sometimes artificially dam rivers to form lakes. When such dams fail, flash floods cause further havoc downstream.

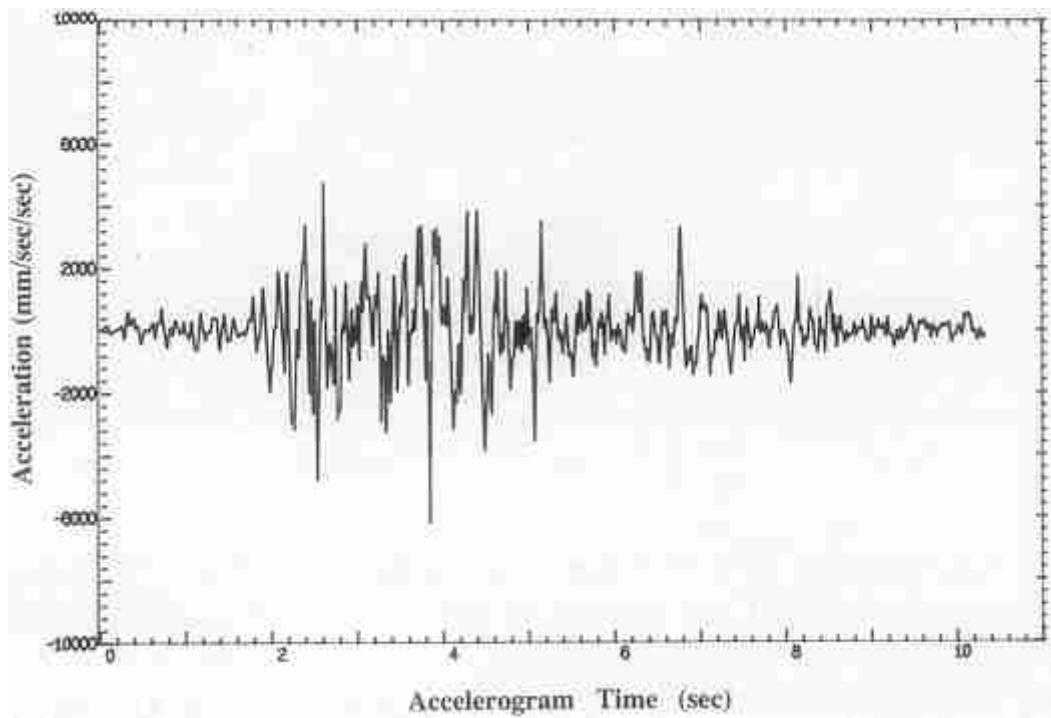


An earthquake shakes houses as well as other structures. If these structures are well designed and well constructed then even violent earthquakes will not be able to destroy them. Technology has been developed for constructing houses, which will resist the onslaught of earthquakes.



Earthquakes are recorded on sensitive instruments called seismographs and the record is called a seismogram. Strong ground motions are also recorded by another instrument called accelerograph and the record obtained on it is known as accelerogram.





MEASURES OF EARTHQUAKE

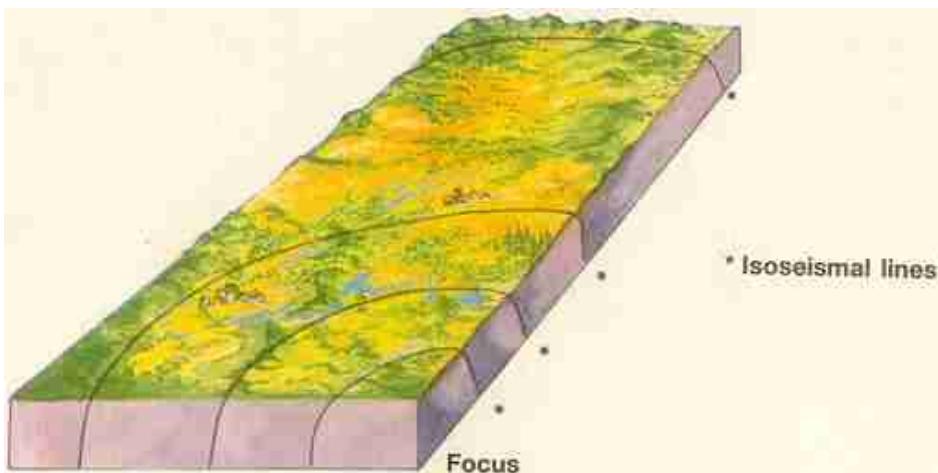
There are two scales for measuring earthquake severity - magnitude and intensity.

Magnitude

Magnitude gives an estimate of the total energy release in an earthquake. It is related to the maximum amplitude recorded on a seismograph. It is expressed by a specific number for an earthquake and is called Richter Magnitude. The Uttarkashi earthquake of October 20, 1991, had Richter magnitude 6.6.

Intensity

Intensity classifies the degree of shaking on a descriptive scale. It is gauged from inspection of damage and other effect of an earthquake at a particular place. It is usually maximum close to the epicentre and diminishes away from it.



The Modified Mercalli Intensity (MMI) describes earthquake effects at a place on a twelve-point scale in Roman numerals, from I-XII. Lines which join places of equal intensity are called isoseismals.

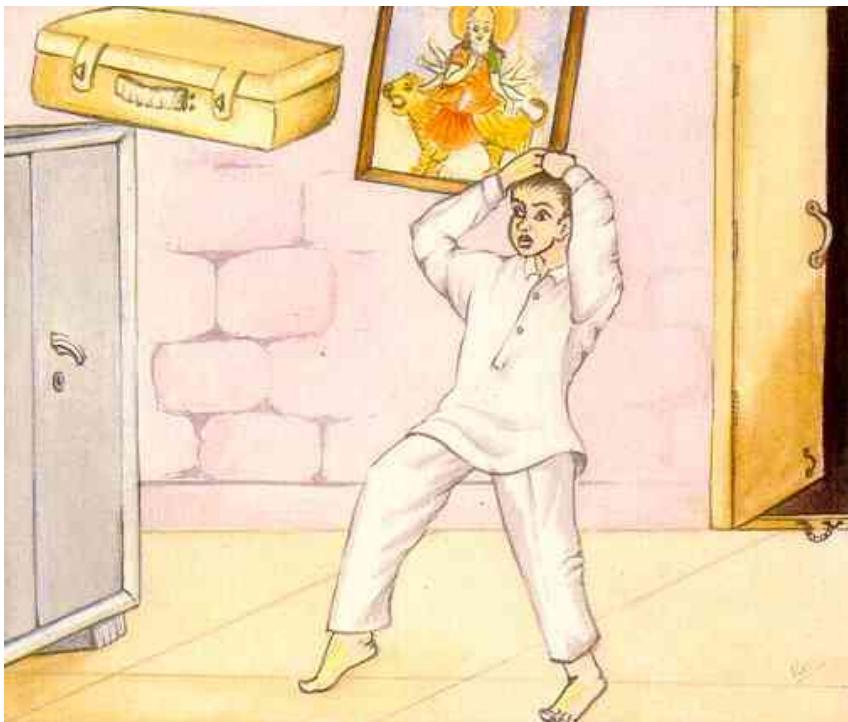
THE SHAKE TABLE

The shaking effects of an earthquake can be simulated in the laboratory. The shaking is generated and controlled either mechanically or through a computer. Small models of structures or sophisticated equipment can be tested on shaking tables. Such tests give useful information about capability of structures or equipment to resist earthquakes.



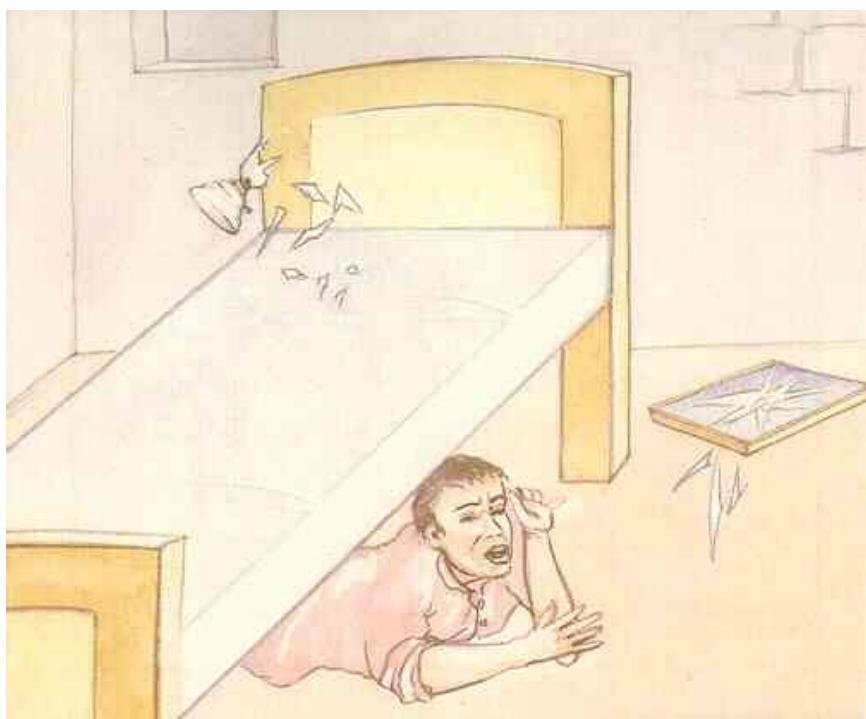
COPING WITH AN EARTHQUAKE

An earthquake does not cause death or injury by itself. People are hurt by falling plaster and collapsing walls or falling of heavy objects. Collapsing buildings and vibrations can cause short circuits and electric fires. Lighted gas or stoves may also cause fires. All this leads to panic and confusion. With some precautions it is possible to avoid such confusion.



If you are caught indoors at the time of an earthquake,

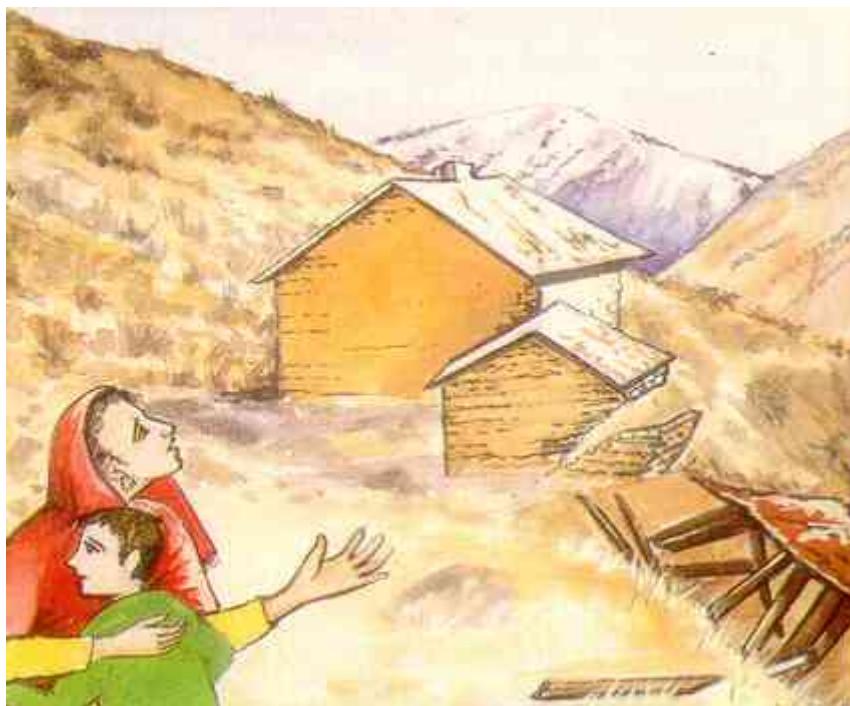
- Keep calm.
- Stay away from glass windows, doors, almirahs, mirrors etc.
- Stay away from falling plaster, bricks or stones.
- Get under a table or a sturdy cot so that you are not hurt by falling objects.
- Do not rush towards the doors or staircase. They may be broken or jammed.



If you are outdoors at the time of earthquake,

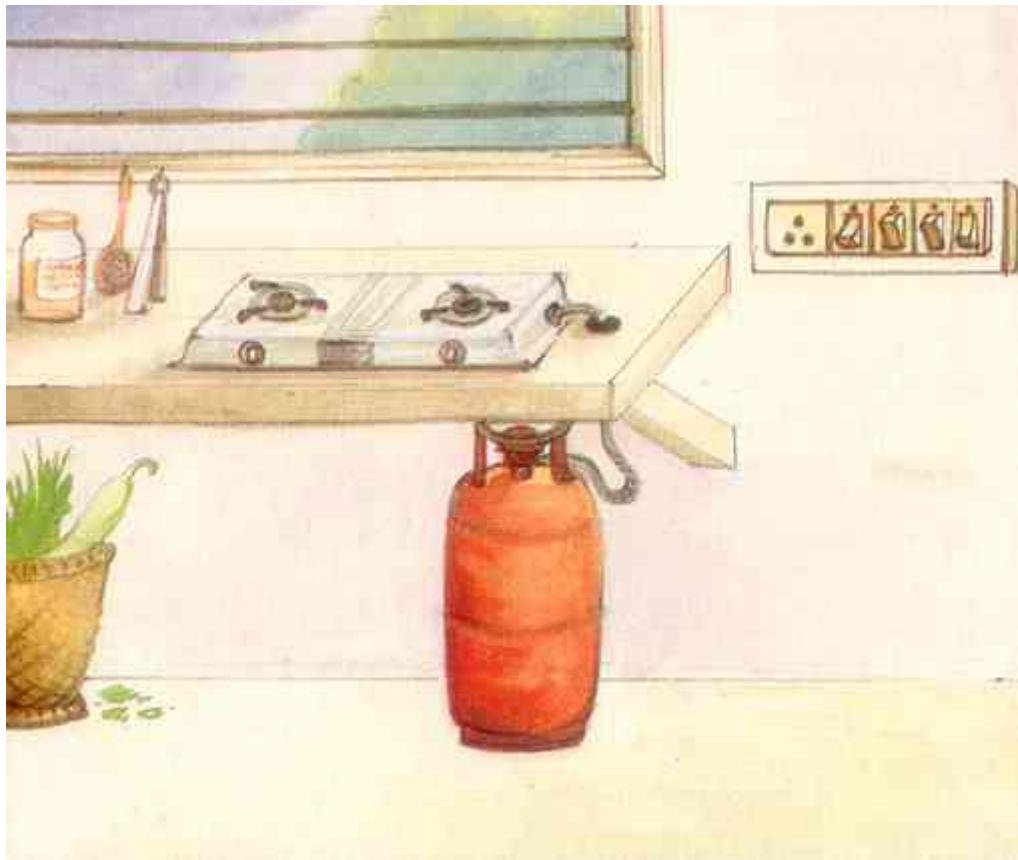
- If open space is available nearby, go there.
- Keep away from tall chimneys, buildings, balconies and other projections.

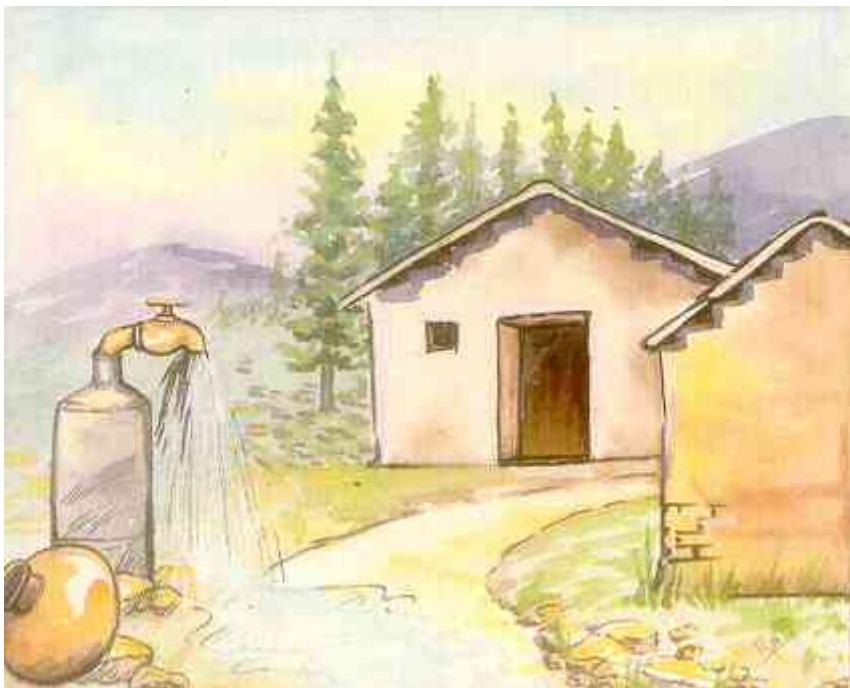
- Do not run through streets; hoardings or lamps may fall on you.



After an earthquake

- Check if you or anyone else is hurt. Use first aid atleast on the cuts and bruises.
- Keep the streets clear for emergency services.
- Switch off all appliances like the refrigerator, TV or radio. Turn off the gas.
- Wear shoes to protect your feet from debris.
- A battery operated radio will help you to get important messages.
- Be prepared for more shocks. These aftershocks always follow an earthquake.

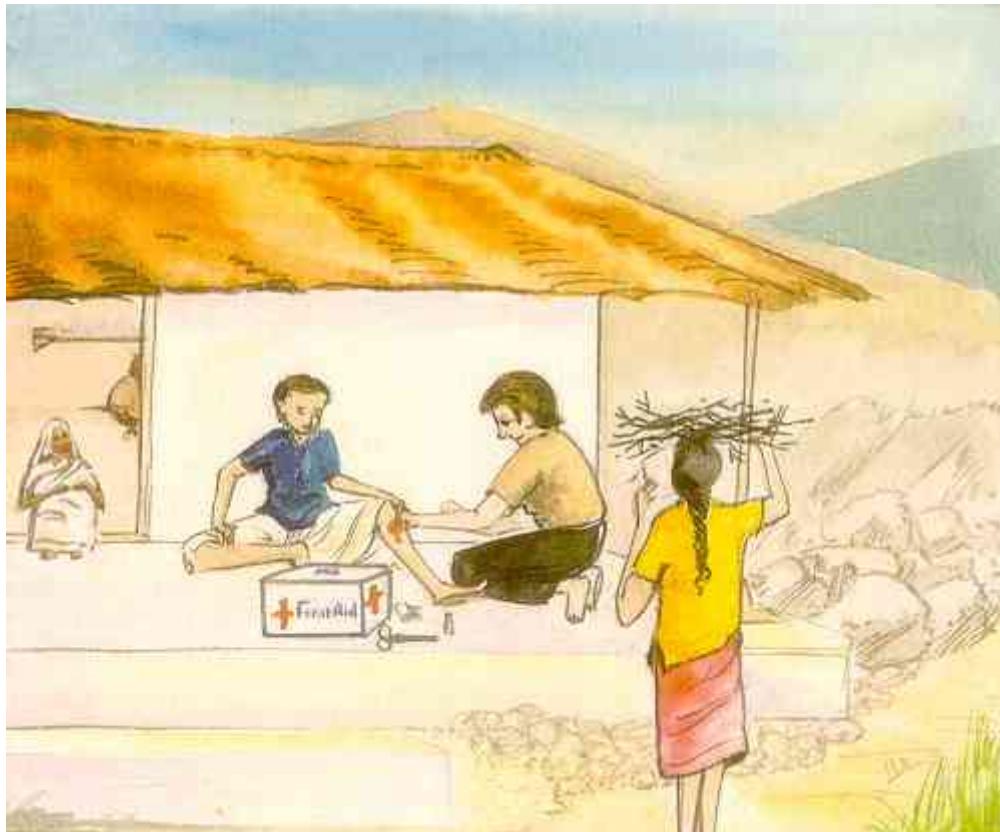




Avoid the following in an earthquake

- Do not crowd around damaged areas or buildings.
- Do not waste water. It will be needed for fire fighting.
- Do not move the seriously hurt people.

- Wait for medical help to arrive.
- Do not spread rumors. They lead to panic and worsen the situation



PREDICTION OF EARTHQUAKES

Many phenomena are considered to be earthquake precursors, such as dilatancy or swelling of rock, fore shocks, ground creep and animal behaviour.

The Haicheng earthquake, which occurred in China in 1975, was successfully predicted. It had magnitude 7.3. Only 4 lives were lost. However, successes in earthquake prediction are very few and far between.