

## **ABOUT EARTHQUAKES**

An earthquake is a natural phenomenon like rain. Earthquakes have occurred for billions of years. Descriptions as old as recorded history show the significant effects they have had on people's lives.

### **Definition of an earthquake**

In simple terms, an earthquake is caused by the constant motion of the earth's surface. The earth's rock layer is broken into large pieces. These pieces are in slow but constant motion. They may slide by each other smoothly and almost imperceptibly.

From time to time, the pieces may lock together and energy that accumulates between the pieces may be suddenly released. The energy that is released travels through the Earth in the form of waves. People on the surface of the earth then experience an earthquake.

Earthquakes are the sudden, rapid release of energy stored in rocks.

## **EARTHQUAKE EPICENTRES**

The epicentre of an earthquake is the place on the Earth's surface directly above the focus or (hypocentre), the place inside the earth where the quake originates. Earthquake foci are usually somewhere between the surface and 100 km in depth. In some areas, however, the foci may be as deep as 700 km.

Maps of earthquake epicenters show that most earthquakes have occurred in certain well-defined regions of the Earth. Because these regions tend to be relatively long and narrow they are sometimes referred to as earthquake belts.

One large belt of epicentres run through the Mediterranean Sea, Asia Minor, and the Himalayan Mountains and into the eastern Indian Ocean. A second large belt runs northwards through the western Pacific Ocean, the Japanese Islands, the Aleutian islands and the west coasts of North and South America. The longest belt of earthquake epicentres runs through the central regions of most ocean basins.

## **LAYERS OF THE EARTH**

To really understand how earthquakes happen we must understand the make-up of the Earth. The simplest way of describing the Earth's layers is to compare the globe to a hard-boiled egg. It has a crust something like the shell, a middle layer or mantle – something like the white – and a core that is something like the yolk. The crust and the upper portion of the mantle are often referred together as the lithosphere or rock sphere.

## **Crust and Lithosphere**

The Earth's crust varies in thickness from about 65km on the continents to only about 10km on the ocean floors. The lithosphere is the outer solid portion of the Earth that includes the crust and the uppermost part of the mantle. The lithosphere has an average depth of 100 km.

## **Lower Mantle and Core**

Directly below the lithosphere is the **asthenosphere**, a region of the mantle with a plastic, semisolid consistency which reaches to about 2900 km below the surface.

The solid, metallic inner core goes the rest of the way to the center of the earth. Both are composed primarily of iron and nickel.

# **THE EARTH'S PLATES**

Scientists think that the lithosphere broke into pieces, called tectonic plates, some 3.8 billion years ago. Most earthquakes are caused by large-scale movement of these lithospheric plates, and occur at boundaries between the plates. Experts recognize seven to twelve major plates and a number of smaller ones. The plates take their names from continents (the North American Plate) from oceans (the Pacific Plate) and from geographic areas (the Caribbean Plate).

## **Slow and Steady Motion**

The plates are in very slow but constant motion, so that, seen from above the Earth's surface might look like a slow moving spherical jigsaw puzzle. The plates move at a rate of 2-15 cm, or several inches, in a year.

## **Three Kinds of Plate Movements**

The movement of the plates is generally one of three kinds, spreading, colliding or sliding. When plates are spreading or separating from each other, we call the movement divergent. When they are colliding, or pushing each other, we call the movement convergent. Movement in which plates slide past each other is called lateral plate movement. Earthquakes can accompany each of the three types of movement

# **FAULTS AND FOLDS**

As a result of [plate motions](#), the built up stress and strain within the rocks of the lithosphere may cause great warps or folds in rock layers. Where rock is strained beyond its limit, it will fracture and the rock mass on either side will move abruptly.

## What is a Fault?

A fault is a fracture within the Earth's crust along which a significant movement has occurred. Faults are often classified according to the direction of movement and whether that movement is predominantly horizontal or vertical. Displacement or movement of rock along a fault can occur as a result of vertical or horizontal fault movement. Vertical fault movement changes the elevation or height of a rock mass on one side of the fault in relation to the rock mass on the opposite side. Rock masses on one side of the fault can also shift horizontally in relation to the opposite side. Vertical fault movement may result in cliffs along the fault line. Horizontal or sideways fault movement may cause roads and river banks to change their position.

## Folding Rock Layers

Folding is another way that rock layers respond to stress. They may crumple sideways, without fracturing, like wrinkles in a rug. Small folds can be seen in specimens of sedimentary rock; larger examples of folded rock layers can be seen in mountainsides and road cuts.

# PHYSICAL RESULTS OF EARTHQUAKES

As the [plates of the Earth's surface](#) move, warping slowly, up, down and sideways in relation to each other, we may feel these movements as earthquakes. The waves of energy they release not only shake the Earth, but also alter the nature of many soils, giving them an unstable liquid-like consistency. Then structures sink or tip, and hillsides topple.

## Land Shifts and Scarps

Sections of ground may be elevated or may subside during an earthquake. Sometimes one side of a [fault](#) will rise or sink, creating a scarp (an earthquake caused cliff). Scarps may be lifted again and again in successive earthquakes, with the uplifts in any one earthquake ranging from a few centimeters to several metres or more.

## Landslides

Unstable hillsides may slump or slide during or after the shaking. Rocks may break loose and slide downhill, sometimes creating rock avalanches. The potential for landsliding is highest in soft sediments on steep slopes; where seasonal rainfall is high, vegetation is shallow, rotted or sparse; the rate of erosion is high; and where ground shaking is intense.

## Water Changes

The underground water system may also be disturbed by an earthquake, causing fluctuations in water pressure and stream volume, and the appearance or disappearance of

springs. Well water levels or temperature can change, and the water can become cloudy and muddy. Underground oil and gas deposits could be similarly disturbed.

### **Seiches**

When an enclosed body of water such as a bay, a dam, a swimming pool, or even a pan of water is rocked, the water may begin to slosh back and forth rhythmically. During this phenomenon, known as a "seiche" (pronounced sash), the water surges from one side to the other often gaining in intensity and may overflow its basin before gradually slowing down and stopping.

### **Soil Liquefaction**

Loose soils with a high water table (water in the soil close to the surface) may experience the phenomenon of liquefaction. As the earthquake's vibrations pass through the loose soil, it becomes like quicksand. Heavy objects such as buildings and other structures situated over such areas may sink or tilt into the liquefied soil. Hillsides or earth-filled dams situated over such an area could also collapse. The effect is temporary, but the results can be very damaging.

### **Tsunamis**

Tsunamis (pronounced soo.nah.me) is a Japanese word that means "wave in the harbour".

Tsunamis are caused by earthquakes undersea or near the coastline strong enough to rock the sea floor and disturb the mass of water over it. These movements generate waves that travel at speeds up to 800 km (500 miles) per hour.

In deep water, on the open ocean, tsunamis cause no damage and are hardly noticed. When they meet shallow water, however, they can batter coastlines with waves as high as 60 meters (200 ft.).

Tsunami damage is very similar to damage caused by hurricanes and other kinds of storm waves

## **DURING AN EARTHQUAKE**



Earthquakes can happen at anytime, anywhere. There is a chance, when an earthquake hits, that you may have a few seconds between the realization that this is an earthquake and the time when the shaking stops. This is when your advanced planning becomes important. If you know what to expect and what to do, you can make the right decisions that may mean the difference between injury, life or death.

### **Take Cover in the Nearest Space**

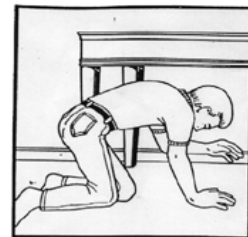
Take cover where you are. If you are outside during an earthquake take cover there, do not rush indoors or vice versa.

Protect yourself from things that may fall on top of you, whether it is broken glass or a whole building. Once you take over in your safe place, stay there until the shaking stops, earthquakes seldom last longer than a minute although it seems longer.

### **Duck, Cover and Hold**

Practice the Duck, Cover and Hold procedure until it becomes second nature.

**Duck** – get under a sturdy piece of furniture, making yourself into a little ball (do not duck under beds or other objects that could collapse).



**Cover** – keep your head and eyes protected from falling or flying objects. Cover your head with one hand.



**Hold** – with your other hand, hold onto the piece of furniture. If it moves, move with it. Stay under shelter until you are sure the shaking has stopped.



If you cannot shelter under furniture or a doorway, move against an interior wall if you are indoors, duck, put your arms over your head and across the back of your neck for protection. If there is a book, pillow, tray or other protection at hand, hold it over your head and neck.

It is better to break your arms than to have something fall on your head or neck which will probably result in unconsciousness, paralysis, brain damage or death.

### **Door Way for Protection**

If you are not near any sturdy furniture, take cover in a sturdy doorway. The extra construction around a doorframe makes it one of the strongest parts of a building. Also there is rarely anything over a doorway to fall on you. Avoid doorways, however, that have transoms or air conditioners above them.

Brace yourself in a doorway with your back against the hinges of the door, feet spread wide apart for balance, leaning across to hold onto the opposite side.

Beware of the door which can swing back and forth during an earthquake. Brace yourself and try to hold off the door with your shoulder or hip and hold on tight, feet spread wide apart for balance, leaning across to hold onto the opposite side.

Beware of the door which can swing back and forth during an earthquake. Brace yourself and try to hold .

### **Find a Safe Place**

The safest place to take cover during the earthquake will depend on where you are.

### **Outside**

If you are outside during an earthquake, move to the nearest open area, away from tall buildings, fences, trees, utility poles and electric wires. Drop, sit or lie down until the shaking stops.

Although large cracks in the ground have been known to open up, these are extremely rare and there has been no authentic proof that people have been swallowed by the earth during an earthquake.

### **In a Car**

If you are driving when an earthquake starts, slow down carefully and come to a stop, but not under power lines, street light, utility poles, or tall buildings. Do not stop on or under bridges. The car may shake, but it probably will not tip over if it's on flat ground.

## **WHAT TO DO AFTER AN EARTHQUAKE**

### **At Home**

1. Wear heavy soled shoes. If you are bare footed, put on shoes before you walk anywhere after an earthquake.
2. Check for injuries. Check yourself and other family members for injuries and seek medical attention for serious conditions.
3. Do not use the telephones unless there is a serious injury. Rescue workers will need all available lines. If the receiver is off the hook, replace it. If you do not get a dial tone, DO NOT jiggle the hook; that could further jam the wires.
4. Check for fire. If possible one person or group should check for injuries while another immediately checks for fires. Don't light matches or candles. Leaking gas and spilled flammable products can be ignited by flames, pilot light or electrical shorts.

If you smell gas or have reason to suspect that lines might be broken, immediately disconnect the cylinder.

5. Stairs may have weakened after an earthquake. When evacuating check these carefully before placing your full weight on them.
6. Check the building. Carefully inspect the interior and exterior of the building. Look for cracks in the walls, shifted posts or pillars and cracks in porches and sidewalks. If you see anything other than minor cracks, evacuate the building immediately and do not re-enter the building until it has been checked for safety by a professional.
7. Once your home is secure, check with your neighbours to see if they need assistance.
8. Listen to your radio for evacuation orders and other information.

## **Away From Home**

If you are in your car, at a movie or store, or some place where you do not feel safe, you will probably try to go home. Stay where you are for a while and wait for aftershocks and information on the radio. Remember that aftershocks, particularly those following a big earthquake can cause a lot of damage. Overpasses, bridges and some buildings might survive the main shock, but fall during an aftershock.

After an earthquake that causes damage, drive only if you are away from tall building and bridges, and then your driving should only be to safety or to render assistance. The roads should be kept open for emergency vehicles.

When you arrive home, do not rush in. Look at the building from a distance for damage; if it looks okay make a closer inspection. If it still looks undamaged, open the door and smell for gas. If you don't smell gas, enter and check for other fire hazards.

## **In the Darkness**

If you find yourself alone in the dark after an earthquake, take a few minutes to recall the location of exits and the layout of the building. Plan your escape route and then move slowly, using your hands to guide you. If you heard the sound of breaking glass during the earthquake, wrap your hands in a jacket or other material to protect them. Carefully exit the building, take cover if there are any aftershocks and be alert for the smell of leaking gas.

# **MEASURING EARTHQUAKES**

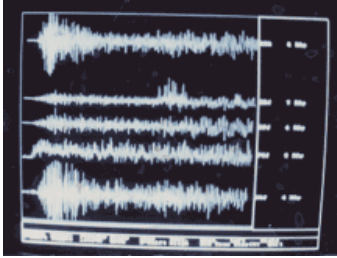
Two scales are commonly used to measure earthquakes, the Mercalli and the Richter. The Mercalli Scale, the older of the two, measures the intensity of the earthquake, i.e. the impact of a quake on people and their property. Richter Scale measures the magnitude or amount of energy released by the earthquake.

## **A Measure of Intensity**

This speaks to the observed effects of an earthquake over a limited geographical area. Intensity scales assign whole numbers usually from 1 to 12 to describe these observed levels of shaking. An intensity of 1 means the earthquake was not felt, while 12 means absolute and total destruction. In Jamaica we formerly used the Modified Mercalli Scale (1956 version). Now we will use the European Macroseismic Scale (1992) which has been developed and tested over a period of years by a working group of the European Seismological Commission. The EMS makes the imprecise and subjective nature of

assigning intensities more robust and straightforward with regard to earthquake effects on humans, objects and buildings.

### **A Measure of Magnitude**



A measure of size for earthquakes based on recordings of ground motions by instruments. The first magnitude scale was devised by Charles Richter in 1935. He used the logarithmic scale (which scales numbers by a factor of 10) to accommodate the wide range of ground motions which earthquakes can cause, and this has persisted to the present. Scales today are based on various aspects of the seismograms as told by the following names: body-wave magnitude, duration magnitude, and moment magnitude. Jamaica uses the latter two scales for magnitude. Moment magnitude is the most true indication of the size of an earthquake because it is based on the amount of movement on the [fault](#).

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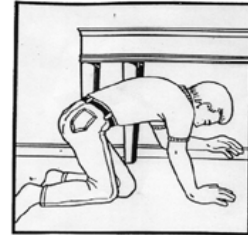
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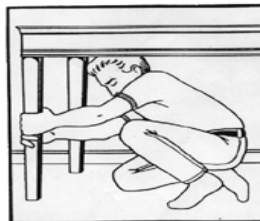
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