Earthquakes

Quite possibly one of the most if not, the most, unpredictable environmental hazard is an earthquake. The name describes its power. An earthquake is felt through the movement of the earth’s surface, in a shaking motion, caused by the tension and release of built up energy in the earth’s outer layer. During an earthquake a series of shock waves are generated by the build up of stress in the upper mantle. Generally, most worldwide earthquakes are caused by a “slip” along geographic faults. These geographic faults are found along the converging lines between the tectonic plates of the earth. Tectonic plates are made up of granitic rocks, which give them the ability to float. Since these large landmasses, or plates, can move, they will collide into one another creating earthquakes. The locations at which these plates move against one another are known as faults. Along faults are where most earthquake activity is recorded.

There are three types of plate boundaries, which are constantly moving. The first is extensional movement. Two plates moving apart from each other characterize extensional movement between plates. Earthquakes caused by extensional movement also usually have a magnitude smaller than 8.0. The second type of boundary is transform. The lateral movement and slip of two plates along one another illustrate transform boundaries. The San Andreas Fault is an example of a transform boundary. Earthquakes felt along transform boundaries are mostly shallow in depth about 25 km below the surface. The Third type of boundary is compressional. Compressional boundaries are the result of subducting, or sinking plates. In this case, the first plate will slide underneath the other while the second plate rises up overtop. In some cases along compressional
boundaries, the plates will simply collide and cause a ripple effect in the topography of the region. Compressional earthquakes can be shallow, just beneath the earth’s surface, or deep within the upper mantle as far as 700km down. Areas of converging boundaries can result in the formation of volcanoes. As the sinking plates slides under the lighter plate pockets of heated magma are generated and will rise to the surface. In the process of rising the magma displaces rock masses causing smaller “rumbling” earthquakes which can last for hours and days on end.

Along with plate boundaries there are also three types of faults, normal faults, reverse faults, and strike-slip faults. Normal and reverse faults are similar in that one block of land rises up and one sinks down. Depending on which side, hanging wall, or foot wall, moves defines the type. The hanging wall is the side of the fault that leans on top of the foot wall, which appears to look as if it is wedged underneath the hanging wall. If the hanging wall rises up over top of the foot wall, it is a normal fault, but if the hanging wall slides down the foot wall, it is a reverse fault. A strike slip fault is represented as the two sides of the fault are displaced when sliding with lateral movement in opposite directions.

One other possible cause of an earthquake is human activities. Filling reservoirs can trigger more stress in the earth’s crust. As we know, it is the build up of this stress which caused movement. The cause may be the only control we have over reducing the possibility of earthquakes. Since there is no way to predict in advance the movement of a plate there isn’t any way to forecast the release of stress. However we can differentiate between the force of strong and weak earthquakes by measuring the intensity at the center
of the earthquake also known as the focus or hypocenter. Directly above focus of the earthquake found on the surface is the epicenter.

Earthquakes are an extremely dangerous hazard. Since they occur about 800,000 times a year and are difficult to foresee. Although it may not be possible to predict an earthquake far enough in advance to make a difference, we do have a basic knowledge of where they generally occur. Between 75-80% of all recorded earthquakes are found around the edges of the Pacific plate where many subduction zones are located. The Pacific plate covers the area of the Pacific Ocean. Around its edges are the regions of most earthquake and volcanic activity. The Pacific Rim is about 40,000km long and spans up the West Coast of central, south and North America to Alaska, and east from Japan to Australia. When earthquakes strike their magnitude can be rated on a seismograph.

A seismograph is the best way to measure the devastation a particular earthquake may result in. Seismographs consist of a base, which is anchored into the ground. As the earthquake shakes the ground it creates waves which pulsate to the surface. The seismograph will move with the ground during these waves, and relay the results to the 3 closest seismograph stations of the more than 1,000 in the world. The general scale used to explain the strength of an earthquake once it has ended is the Richter scale.

In 1935, Charles Richter invented a mathematical device which used logarithmic patterns to rate the intensity of a quake on a scale of 1 to 10. Earthquakes ranging 2.0 or lower are not as harmful and known as micro earthquakes. While a rating of 4.5 and higher are more severe and hazardous. Earthquakes with a Richter scale rating of 8.0 and
higher might only be expected every 8 to 10 years. One such quake occurred in Alaska in 1964 causing millions of dollars in damage.

The Richter scale is one way of describing the magnitude of an earthquake in a numerical form, which many people influenced and affected by earthquakes have come to understand as part of common language. Yet, what do these numbers of magnitude really mean, and where do they come from? Here is another perspective on rationalizing an earthquake’s magnitude. According to the United States Geological Survey, “Magnitude is a measure of the energy produced by the earthquake and is not what you feel during the event.” Numbers cannot describe a human feeling, which could be unsteady, rocky, gentle, hard, rolling or jerky movements. What magnitude actually measures are waves, not too dissimilar from sound waves. These waves of motion describe how fast the ground is moving, the quickness with which the state of the ground changes, and the vibrations of energy being released. These are explained in velocity, peak acceleration, and frequency. Life and structures on the surface can make three observations felt from a resulting earthquake these are 1) magnitude, 2) distance from the fault/epicenter, and 3) the local soil and ground conditions.

Explaining the extremes of magnitude is simple. Obviously, bigger earthquakes cause the ground to shake more violently than smaller ones do. Also, bigger quakes give off their energy over a longer period of time and cover a larger area. As the earthquake begins at its hypocenter, or focus, the rupturing will move along fault lines creating seismic waves throughout the distance traveled. Since the speed of sound traveling through rock is less than 2 miles per second, the waves cannot travel any faster than this. Therefore, longer faults produce bigger earthquakes and cause greater amounts of
damage. Distance is the next key factor in determining surface earthquake observations. With an increase in distance from the fault, come decreasing intensity of the waves it produces. Soil is a surprising in earthquake intensity. Soils have the ability to amplify the destructive shaking effects of an earthquake. The transfer of seismic waves from rock to soil causes the waves to slow down and become bigger. Thus, the looser the soil, the stronger the shaking.

Any relation between time of day and time of year and the timing or duration of an earthquake has yet to be discovered, if there is any correlation at all. Even though earthquakes cause great amounts of damage, they do so in very little amounts of time. Earthquakes do not last very long, some as short as a few seconds. The largest recorded earthquake recorded a 9.5 reading on the Richter scale on May 22, 1960. Even though a typical earthquake only has one epicenter and one focus point, depending on the strength it may be felt from many miles away. Which is why earthquake preparedness and awareness should be taken seriously in all regions of the world.

In the last 500 years millions of lives have been lost from earthquake devastation, and since Los Angeles is known for its location so close to a major fault line, (San Andreas Fault) the Los Angeles City Fire Department has come up with its own earthquake preparedness handbook. For example, the book begins with, “During an earthquake: When you feel an earthquake, duck under a desk or sturdy table. Stay away from windows, bookcases, file cabinets, heavy mirrors, hanging plants, and other heavy objects that could fall. Watch out for falling plaster and ceiling tiles. Stay undercover until the shaking stops, and hold onto your cover. If it moves, move with it.” These sound like common sense rules for anyone caught in an earthquake. The handbook also gives
tips on what to do if an earthquake occurs while you are in a high rise building, outdoors, on a sidewalk near a building, driving, in a crowded store or other public place, in a wheelchair, kitchen, or even stadium or movie theatre.

Some may put up an argument that earthquakes have been increasing in numbers in the last 100 years. This may seem true according to trends, but it is simply an inaccurate statistic. Earthquakes have been occurring since the beginning of earth’s time. The only truth to this theory is that earthquakes have become increasingly dangerous due to increasing populations in jeopardous areas of the earth. Building construction also contributes to the devastation from an earthquake. Unreinforced concrete, which is what many houses and building are constructed from as extremely vulnerable to earthquake vandalism. Although, “Experts say buildings can be made to survive earthquakes intact.”

Scientists have been developing new materials, which are meant to withstand earthquakes. From fiber optic sensors to ceramic strips that change shape once electricity passes through them, helping structures to flex and sway with ground movement, technology is advancing in this field every day. A more simple method of earthquake proofing a building is to encase rebar, or steel rods in the center of concrete structures to help with movement.

Earthquakes happen every day all over the world. Millions of lives have been lost world wide, and the U.S. alone averages $4.4 billion in property damage every year caused by earthquakes. Some quakes are more news worthy than others depending on the area affected and magnitude of each one. Even the slightest shaking of a fault is registered on the richter scale and recorded. Hundreds of such records are recorded
every day. Earthquakes are not something that can be stopped or prevented, only prepared for as best we can.

According to the USGS, a significant earthquake is defined as any Richter scale reading of at least 6.5. In 1995, forty-seven significant earthquakes were recorded all over the world. Yet some of the most significant have happened in the U.S.S.R, China, India, Iran, and Turkey. In China, twelve earthquakes with magnitude 8.0 or greater have occurred in during the 1900’s. On July 28, 1976, 240,000 people lost their lives to an extremely strong 8.2 scale earthquake. In December of 1920, an even more impressive 8.6 scale earthquake took 100,000 lives. Even though the 1920 earthquake did not deduct as many lives as the one in 1976, we consider the 1976 earthquake to be more hazardous due to its threat to human lives and what we hold valuable. June 21, 1990, an earthquake ripped through Iran claiming 50,000 lives and registering 7.7 on the Richter scale. Turkey, December 26, 1939, 33,000 people lost their lives to a 7.9 magnitude quake. Even though we are able to register certain places as particular “hot-spots” for seismic activity, earthquakes have a probability of happening anywhere at any time.

Earthquakes are something that we must deal with especially if we chose to exist is areas of seismic activity concentration. There’s no way to predict or prevent an earthquake, but knowledge and awareness of our ever changing environment can only aid in the fight against loss of life caused by natural hazards such as earthquakes.