

## **Earthquakes: Interesting Facts and F.A.Q.**

- Earthquakes kill approximately 8,000 people each year and have caused an estimated 13 million deaths in the past 4,000 years.
- The moment magnitude scale (MMS) replaced the 1930s-era Richter scale in the 1970s as the method of measuring the size of earthquakes in terms of energy released.
- In Japan mythology, a giant catfish called Namazu is responsible for earthquakes.
- The Indian Ocean earthquake in 2004 generated enough energy to power all the homes and businesses in the United States for three days.
- An average earthquake lasts around a minute.
- Parkfield, California, is known as “The Earthquake Capital of the World” and has a bridge that spans two tectonic plates.
- Earthquakes are mostly caused by geological faults, but they can also be caused by landslides, nuclear testing, mine tests, and volcanic activity.
- In ancient Greece, people believed that the god of the sea, Poseidon, caused earthquakes. When he was angry, Poseidon would strike the ground with his trident and set off an earthquake. His unpredictable, violent behavior earned him the nickname “Earth-Shaker.”
- More earthquakes happen in the Northern Hemisphere than in the Southern Hemisphere.
- In Hindu mythology, Earth is held in place by eight gigantic elephants, all balanced on the back of turtle, which itself stands on the coils of a snake. If any of these animals shift or move, an earthquake occurs.
- The worst avalanche triggered by an earthquake occurred in Peru in 1070. A 250-foot (850-meter) wave of ice, mud, and rock fell down the mountain in Huascarán at 250 miles (400 km) per hour. It carried away entire villages and killed more than 18,000 people.
- The world’s worst landslide started by an earthquake occurred in 1920 in the Kansu province in China. The landslide killed about 200,000 people.
- The highest tsunami caused by an earthquake happened in Japan in 1771. A tsunami 278 feet (85 meters) high struck Ishigaki Island.
- The shape of a pagoda is known for resisting damage from earthquakes.
- The term “tectonic” is related to the word “texture” and is from the Greek tektonikos which means “pertaining to building,” from the Proto-Indo-European base \*tek, “to make.”

**Q. I am thinking of buying a house at “X” address...is it near a fault?**

We receive this inquiry often and are glad that these inquiries have been on the rise, as they reflect increased awareness of the earthquake threat in Utah.

Many people associate main earthquake damage with nearness to a fault. Although fault proximity is a major concern, strong ground shaking and other earthquake hazards are more widespread and can cause damage over large areas many miles from the fault.

In addition, fault rupture at the ground surface is expected only in large (magnitude 6.5 and greater) earthquakes, which are less frequent than moderate earthquakes that may still cause extensive damage from ground shaking.

Therefore, we often surprise the inquirer with more information than they probably expected. Earthquake risk to any particular home depends on what and where the earthquake hazards are, as well as when and how the house was constructed.

**Q. What are the main earthquake hazards?**

**Ground shaking:** is the most damaging and widespread earthquake hazard, can occur almost anywhere and is difficult to avoid (but house retro-fits can minimize damage), induces most of the other earthquake hazards, and can cause damage to houses in earthquakes as small as magnitude 5.0, which on average occur once every four years somewhere in Utah and once every 10 years in the Wasatch Front region (most recent event was the 1992 magnitude 5.8 St. George earthquake).

**Soil liquefaction:** is caused by ground shaking in areas with sandy soil and shallow ground water, means that the soil liquefies and acts more like a fluid than a solid, can cause a house to settle, crack, or tip, is most likely to occur near streams and other bodies of water, and can occur in earthquakes of about magnitude 5.0 and greater.

**Slope failure (landslides and rock falls):** can occur on unstable slopes within a few miles of a magnitude 4.0 earthquake, which on average occur once every year in Utah, can occur more than 100 miles from a magnitude 7.5 earthquake, and is expected in mountain and canyon areas and valley slopes having susceptible rock/soil types.

**Surface fault rupture:** occurs during large earthquakes of about magnitude 6.5 and greater, which on average occur once every 50-120 years somewhere in Utah and once every 300-400 years on the Wasatch fault in the urban Wasatch Front area (last large earthquake in Utah was in 1934, magnitude 6.6, at the north end of Great Salt Lake; last large earthquake on the Wasatch fault in the urban area was approximately 500 years ago), typically offsets the ground surface vertically on each side of the fault, forming fault scarps (steep breaks in slope) that can be over 10 feet high, causes the mountain side of the fault to rise and the valley side to drop, may deform the ground surface for hundreds of feet from the fault, chiefly on the valley side of the fault, and causes tectonic subsidence, which is the broad, permanent tilting of the valley floor down toward the fault scarp.

**Flooding:** from dam failure would cause the greatest damage, from stream or canal blockage or diversion could cause major damage, and from tectonic subsidence could happen in several ways. A large earthquake on the Wasatch fault could cause subsidence as far as 10 miles from the fault, and Great Salt Lake or Utah Lake may flood eastern shoreline areas. Subsidence could

also cause the ponding of water in areas with a shallow ground-water table. In addition, tilting of the ground surface could compromise gravity-flow structures such as canals or sewer lines.

**Q. What should I consider before buying a house?**

What earthquake hazards are present (hazard maps are available for inspection at most Wasatch Front county planning departments and at the UGS).

How frequently each type of hazard occurs.

What effects each hazard may have on a house.

House construction—for example, year built and type of material. Houses constructed before 1975 are not built to today's earthquake building codes, but they can be retrofitted to make them more resistant to ground shaking. In general, unreinforced brick or masonry houses are more susceptible to damage than wood-frame houses.

What options are available for minimizing damage. Many retrofit procedures are relatively inexpensive and often can be performed by the experienced do-it-yourself homeowner (see the Utah Division of State History Web page listed below).

**Q. When and where do large earthquakes occur in Utah?**

Large earthquakes (magnitude 6.5 to 7.5) can occur on any of several active segments of the Wasatch fault between Brigham City and Levan. Such earthquakes can also occur on many other recognized active faults in Utah. During the past 6,000 years, large earthquakes have occurred on the Wasatch fault on the average of once every 400 years, somewhere along the fault's central active portion between Brigham City and Levan. The chance of a large earthquake in the Wasatch Front region during the next 50 years is about 1 in 4.

"It is useless to ask when this [earthquake] disaster will occur. Our occupation of the country has been too brief for us to learn how fast the Wasatch grows; and, indeed, it is only by such disasters that we can learn. By the time experience has taught us this, Salt Lake City will have been shaken down..." - G. K. Gilbert, 1883

**Q. What would happen if a magnitude 7.5 earthquake occurs along the Wasatch fault?**

Future large earthquakes will break segments of the fault about 20 - 40 miles long and produce displacements at the surface of up to 10 - 20 feet. Strong ground shaking could produce considerable damage up to nearly 50 miles from the earthquake. The strong ground shaking may be amplified by factors up to 10 or more on valley fill compared to hard rock.

Also possible are soil liquefaction, landslides, rock slides, and broad permanent tilting of valley floors possibly causing the Great Salt Lake or Utah Lake to inundate parts of Salt Lake City or Provo.

How much damage would be caused by a large earthquake on the Wasatch Front?

If the earthquake were to occur on a central part of the Wasatch fault, Utah should expect damage to buildings to exceed \$4.5 billion in Davis, Salt Lake, Utah and Weber counties. This may only represent 20% of the total economic loss.

Unreinforced masonry buildings (for example, brick homes built before 1960) are particularly vulnerable to ground shaking and are expected to account for 75% of the building losses.

Surface faulting and ground failures due to shaking during a large earthquake will cause major disruption of lifelines (utilities, water, sewer), transportation systems (highways, bridges, airports, railways), and communication systems.

**Q. Do we need to worry only about large earthquakes causing damage?**

No. A moderate-sized earthquake that occurs under an urbanized area can cause major damage.

Magnitude 5.5 - 6.5 earthquakes occur somewhere in Utah on the average of once every 7 years.

Estimates of damage from a "direct hit" to one of the Wasatch Front's major metropolitan areas reach \$2.3 billion for a magnitude 6.5 earthquake, and more than \$830 million for a magnitude 5.5 earthquake.

Since 1850, at least 15 independent earthquakes of magnitude 5.5 and larger have occurred in the Utah region.

**Q. When were the largest historical earthquakes in Utah?**

Since settlement in 1847, Utah's largest earthquakes were the 1934 Hansel Valley earthquake, north of the Great Salt Lake, magnitude 6.6, and the 1901 earthquake near the town of Richfield, estimated magnitude 6.5.

**Q. How often do earthquakes occur in Utah?**

About 700 earthquakes (including aftershocks) are located in the Utah region each year. Approximately 2% of the earthquakes are felt. An average of about 13 earthquakes of magnitude 3.0 or larger occur in the region every year. Earthquakes can occur anywhere in the state of Utah.

**Q. How many earthquakes occur in the Wasatch Front region?**

About 500 earthquakes are located in the Wasatch Front region each year. About 60% of the earthquakes of magnitude 3.0 and larger in Utah occur in the Wasatch Front region.

**Q. When was the last earthquake?**

Worldwide: In the last minute, somewhere in the world.

Utah: Within the past 24 hours, somewhere in the state.

(The last large earthquake in Utah occurred on the Wasatch fault north of Nephi about 400 years ago.)

**Q. When were seismographs first installed in Utah?**

In 1907, by James Talmage at the University of Utah. A skeletal statewide network began in 1962. Modern seismographic surveillance in the Wasatch Front began in 1974. Computerized recording of earthquake data began in 1981.

**Q. Do earthquakes occur only on visible faults?**

No. Many of the active faults in Utah are deep below the earth's surface, and are not visible to us.

**Q. Is the Wasatch fault the same type of fault as the San Andreas fault in California?**

No. The San Andreas fault slips horizontally with little vertical movement. This is called a strike-slip fault. The Wasatch fault slips in a primarily vertical direction, with the mountains rising relative to the valley floor. The Wasatch fault is a so-called normal fault. All earthquakes produce both vertical and horizontal ground shaking. Usually the horizontal shaking is more energetic and more damaging because structures generally resist vertical loads, like gravity, more easily.