Earthquake and Liquefaction

Is a Devils Mountain Earthquake really possible?
It’s not a matter of if, but rather when it will happen again!

Hazard Description

An earthquake is the vibration of the earth's surface following a release of energy in the earth's crust. This energy can be generated by a sudden displacement of the crust or by a volcanic eruption. Its epicenter is the point on the earth’s surface directly above the hypocenter of an earthquake. The location of an earthquake is commonly described by the geographic position of its epicenter and by its focal depth.

Most destructive quakes are caused by dislocations of the crust. The crust may first bend and then, when the stress exceeds the strength of the rocks, break and snap to a new position. In the process of breaking, vibrations called “seismic waves” are generated. These waves travel outward from the source of the earthquake at varying speeds.

Earthquakes tend to reoccur along faults, which are zones of weakness in the crust. Even if a fault zone has recently experienced an earthquake, there is no guarantee that all the stress has been relieved. Another earthquake could occur. Faults are more likely to have earthquakes on them if they have more rapid rates of movement, have had recent earthquakes along them, experience greater total displacements, and are aligned so that movement can relieve accumulating tectonic stresses.

There are a number of faults running near or through Skagit County - the Bellingham Bay—Lake Chaplain Fault, the Ross Lake Fault and the Hamilton Fault, which may or may not be active (Skagit County HMP, 2015), and the Devils Mountain Fault.

A direct relationship exists between a fault’s length and location and its ability to generate damaging ground motion at a given site.

The map below illustrates the active earthquake faults in the area, as well as the various types of soils which can be found throughout the county.

Devils Mountain

One of the most notable faults in Skagit County is the Devils Mountain Fault. Lying near Mt. Vernon, it is roughly 78 miles long, runs east to west through Darrington in Snohomish County to Vancouver Island, Canada. It is an active fault, with at least one earthquake about 2,000 years ago (Personius and others, 2014).

If a magnitude seven (M7) or greater event were to occur, it would affect 15 counties with Skagit County being the greatest impacted. Any moderate or large earthquake on the fault will likely be followed by numerous felt aftershocks and hundreds to thousands of smaller ones detectable only by sensitive instruments.

Damage levels experienced in an earthquake vary with the intensity of ground shaking and with the seismic capacity of structures. Generalized observations provide qualitative statements about the likely extent of damage for earthquakes with various levels of ground shaking (PGA) at a given site:

- Ground motions of 1 g or 2 g are widely felt; hanging plants and lamps swing strongly; damage levels are low.
- Ground motions below 10 g usually cause slight damage.
- Ground motions between 10 g and 30 g may cause minor to moderate damage in well-designed buildings, with higher levels of damage in more vulnerable buildings. At this level of ground shaking, some poorly built buildings may be subject to collapse.
- Ground motions above about 30 g may cause significant damage in well-designed buildings and very high levels of damage (including collapse) in poorly designed buildings.
- Ground motions above about 50 g may cause significant damage in most buildings, even those designed to resist seismic forces.

What causes Earthquake Damage?

Earthquakes cause damage by moving and shaking the ground, sometimes for several minutes. The shaking can damage or destroy buildings. Most damage and loss of life is a result of ground shaking. The shaking can cause landslides, ground cracks, liquefaction, and tsunamis. The combination of all of these is what makes earthquakes such a powerful hazard. Even when an earthquake happens on a fault that doesn’t reach the surface, the ground still shows signs of cracking. This cracking happens because a soft part of the ground liquefies during shaking, a process called liquefaction. Liquefaction is when wet soil loses strength because it is being shaken during an earthquake. The material becomes so weak that it behaves more like a liquid than a solid. Liquefaction has caused significant damage during earthquakes in Washington. The map below shows the type of soil in Skagit County. The softer, or more liquefiable, the soil, the greater the damage.

Over the course of time, scientists recognized that increased building codes can help reduce the impacts of earthquakes. Higher building codes are now in place throughout all of Washington; however, older buildings are still at greater risk to damage. The older the building, the greater the risk of injury and damage. The table below talks about the history of building codes in the State of Washington. Skagit County has adopted building codes intended to withstand the level of potential impact countywide. See the box to the right for more information!