Aftershocks of Japan disaster being felt in US earthquake planning

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Liquefaction in the recent subduction zone earthquake in Japan caused entire buildings to sink several feet lower than they had been previously. (Photo by Scott Ashford, courtesy of Oregon State University)

The repercussions of last year's subduction zone earthquake and tsunami in Japan are now being felt in the Pacific Northwest, as experts and disaster managers better understand the enormous risks facing this region, plan for the challenges ahead and prioritize the most urgent needs.

Before the event, scientists knew that similar concerns faced Oregon, Washington, northern California and British Columbia from the Cascadia Subduction Zone. But they have now seen how such long-lasting events produce soil "liquefaction" far worse than expected, the potential for devastated roads and bridges, a collapsed infrastructure and

even threats to their economic future.

“Just in Oregon we’ve got a billion dollar problem, but we don’t have a billion dollars,” said Scott Ashford, professor and interim dean of the College of Engineering at Oregon State University, and one of the international engineering experts who toured the affected area in Japan last year shortly after the disaster.

“The challenge for Oregon and our neighboring states is to prioritize the concerns, and figure out some way to preserve the most critical lifelines – key roads, airports, port facilities and utility networks,” Ashford said. “In Japan, nearly 30,000 people died, many in the days after the disaster because no one could reach them. We don’t want that to happen here, and we don’t want our economy to collapse.”

The Japanese event has galvanized some action, Ashford said, but much more remains to be done. It prompted the legislature to call for an Oregon Resilience Plan that will explore many of these issues – an emergency transportation plan, needed seismic upgrades, ways to protect life and public safety and allow a shattered region to rebuild.

OSU is working closely with the Oregon Department of Transportation and other state agencies to assist with these efforts, and also just joined the Pacific Earthquake Engineering Research Center, an initiative to collaborate with all of the leading academic institutions in this field on the West Coast.

One of the primary lessons from Japan, Ashford says, is the enormous damage done by liquefaction - a continued shaking of the ground that turns soils into mush. In events such as this, it is amplified by the sheer length of the event, an earthquake that can shake not just for 30 seconds but up to five minutes.

Many of the soils in Portland, Ore., parts of the Willamette Valley and other areas of Oregon, Washington and California are particularly vulnerable to this phenomenon, Ashford said, which can magnify the distance and extent of damage.

Liquefaction induced by the recent earthquake in Japan caused nearly three feet of settlement at this water purification plant that serves 19,000 people, breaking pipes and flooding underground structures. Measuring the damage are Jennifer Donohue, a member of the Geotechnical Extreme Events Reconnaissance team with Geosyntec Consultants, and an engineer from the Wanigawa Water Purification Plant. (Photo by Scott Ashford, courtesy of Oregon State University)

“In Japan, entire structures were tilting and sinking into the sediments, even while they remained intact,” Ashford said. “The shifts in soil destroyed water, sewer and gas pipelines, crippling the utilities and

infrastructure these communities need to function. We saw some places that sank as much as four feet."

The data provided by analyzing the Japanese earthquake is now being used by OSU and others to improve understanding of this soil phenomenon and better prepare for it. Future construction in some places may make more use of techniques known to reduce liquefaction, such as better compaction to make soils dense, or use of reinforcing stone columns.

Many areas from northern California to British Columbia have younger soils vulnerable to liquefaction - on the coast, near river deposits or in areas with filled ground. The "young" sediments, in geologic terms, may be those deposited within the past 10,000 years or more. In Oregon, for instance, that describes much of downtown Portland, the Portland International Airport, nearby industrial facilities and other cities and parts of the Willamette Valley.

The Oregon Department of Transportation has concluded that 1,100 bridges in Oregon are at risk, and fewer than 15 percent of them have been retrofitted to prevent collapse. Lateral movement is also a concern.

"Buildings that are built on soils vulnerable to liquefaction not only tend to sink or tilt during an earthquake, but slide downhill if there's any slope, like toward a nearby river," Ashford said. "This is called lateral spreading. In Portland we might expect this sideways sliding of more than four feet in some cases, more than enough to tear apart buildings and buried pipelines."

Japan had excellent building codes, researchers say, and was far better prepared for this type of earthquake than the U.S. will be. Much of the "legacy" infrastructure in the Pacific Northwest was built before these risks were known.

“The disaster in Japan just clarifies what we need to do,” Ashford said. “And it’s not something we can do in a year or two, but something that will take a decade or two. At stake are the lives of our people and the future of our economy, and that’s something that should matter to every individual.”

Provided by Oregon State University