Liquefaction after Japanese Earthquake Larger than Expected

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The level of soil liquefaction that took place as a result of the Japanese earthquake has surprised researchers who have been studying the damage.

Liquefaction is when saturated soils — specifically, recent sediments, sand, gravel or fill — lose their strength and integrity and begin to flow like water during an earthquake. When this happens, foundations shudder and structures can shift or even sink. And, as a result, liquefaction significantly enhances the damage done as a result of the earthquake.

Tremendous Liquefaction in Japan

The broad extent of the liquefaction observed over hundreds of miles was daunting to experienced engineers who are normally not so affected by disaster sites, having recently been involved in the clean-up in Chile and New Zealand.

“We’ve seen localized examples of soil liquefaction as extreme as this before, but the distance and extent of damage in Japan were unusually severe,” said Scott Ashford, a professor of geotechnical engineering at Oregon State University and a member of this research team.

“Entire structures were tilted 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.”

A preliminary report about some of the damage in Japan has just been concluded by the Geotechnical Extreme Events Reconnaissance, or GEER advance team, in work supported by the National Science Foundation, and has raised questions for governments in other locations that could suffer a subduction earthquake.

Why Such Significant Liquefaction in Japan?

The level of liquefaction in Japan is a result of the length of the earthquake itself. Some degree of liquefaction is always expected during an earthquake, but the extended duration of the Japanese earthquake — some 5 minutes — increased the level of liquefaction and thus the damage caused.

“With such a long-lasting earthquake, we saw how structures that might have been okay after 30 seconds just continued to sink and tilt as the shaking continued for several more minutes,” Ashford said. “And it was clear that younger sediments, and especially areas built on recently filled ground, are much more vulnerable.”

“There’s no doubt that we’ll learn things from what happened in Japan that will help us to mitigate risks in other similar events,” Ashford added. “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.”