Two Northeastern engineering professors have been awarded a $1.2 million research grant to advance their work in developing a cost-effective method to prevent ground failure during earthquakes, a major cause of destruction to buildings constructed on water-saturated sandy soils.

The solution could be simple: Just add bubbles.

Mishac Yegian, a Distinguished Professor of Civil and Environmental Engineering, and Akram Alshawabkeh, a professor of civil and environmental engineering, were awarded the grant from the National Science Foundation’s George E. Brown, Jr. Network for Earthquake and Engineering Simulation.

While a number of measures exist to prevent liquefaction — when solid soil turns to liquid and can no longer hold up the structures it supports — those mitigation techniques are often prohibitively expensive and cannot be applied to sites with existing structures.

Yegian’s and Alshawabkeh’s preliminary research has demonstrated that generating gas bubbles in saturated sands — a process they call “induced partial saturation” — prevents liquefaction during earthquakes. The tiny gas bubbles, which fill the spaces between grains of sand, remain entrapped in the soil even during strong earthquakes. The bubbles absorb the pressure that an earthquake would otherwise apply to water, preventing liquefaction.

The grant will allow the induced partial saturation research to move into the field, where Yegian and Alshawabkeh plan to inject a low concentration of an environmentally-friendly chemical into the ground that, with the help of ground water flow and chemical
reactivity, will help generate oxygen gas bubbles within a sand deposit, a technique that can be used before or after a building is constructed.

The development of a cost-effective and practical method to prevent liquefaction will have a broad impact on human safety and the protection of property from the destruction of earthquakes.

“We think we have found a creative and daring solution that would have benefits in the United States and worldwide,” Yegian said. “There would be a whole new industry that could emerge from this work. Engineers so often work on buildings one at a time, but earthquakes don’t — they hit entire communities. We believe our work can help keep entire communities safe from earthquakes.”

Work funded by the grant, part of the National Earthquake Hazards Reduction Program, is being completed in collaboration with researchers from other institutions including the State University of New York at Buffalo, the University of Texas at Austin, Boise State University and the University of California at Santa Barbara.