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Mitigation of Soil Liquefaction with Magnetic Fields

This study focused on mitigating liquefaction in soil by applying magnetic fields to soils containing iron particles. Liquefaction profiles were determined for three soil types containing different relative amounts of silt and sand which were used in the mitigation study. Liquefaction was studied in a shaking chamber which emulated the shaking frequency and magnitude of an earthquake. Magnetic fields were applied to the soil samples by adding iron particles to the soil and placing a sheet of magnets under the shaking chamber. The magnetic force reduced the magnitude of liquefaction in sandy soil by 50% during the 80 second test and delayed the onset of liquefaction (but did not alter the final magnitude) in a blended silt/sand soil. A model of the forces in the shaking system showed that the magnetic force exerted on an iron particle was 300 times greater than the force exerted by gravity. A remote sensing study was carried out to determine whether liquefaction in situ followed a similar trend to liquefaction observed in the shaking chamber. Satellite images, taken before and after an earthquake in Gisborne, New Zealand, were studied using a false color composite to identify soil slides that occurred during the earthquake. Slide areas were located on a geo-referenced soils map and were determined to occur in sandy soils, similar to the sandy soil studied in the shaking chamber. The magnetic force mitigation strategy that reduced liquefaction in sandy soils would be applicable to regions that exhibited liquefaction during the NZ earthquake.