A 1-g Earthquake Simulation Model Evaluating the Impact of P-waves and S-waves on the Occurrence of Liquefaction-Induced Lateral Spread

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Liquefaction-induced lateral spread is a dangerous soil phenomenon that can cause immense amounts of damage to communities worldwide. This phenomenon is not well studied and has led to the destruction of countless roads, buildings, and critical infrastructure systems. This project aimed to increase the knowledge on this subject by determining the minimum slope at which lateral spread would occur in angular 100-mesh sand. A special testing chamber was used to simulate worst-case conditions, while a two-axis shake table generated P and S waves by causing 1.4 cm of displacement in the X and Z directions. The shake table replicated a magnitude 6.6 earthquake while four MMA-8451 accelerometers, placed on the testing chamber, determined the replicated ground acceleration. The experiment consisted of filling the testing chamber with water and sand following specific procedures, allowing it to sit undisturbed for 22 hours to equalize the water table, then subjecting it to 20 seconds of shaking. Five tests were run at each of the tested slopes, resulting in 25 data sets and 70 hours of data collection. The minimum slope at which isolated and complete lateral spread occurred in this experiment was one degree. At a three-degree slope, all tests experienced isolated or complete lateral spread; at a four-degree slope complete lateral spread occurred in all the tests. These results highlight the small slopes at which lateral spread occurs and indicates the need for careful evaluation of any site with a high liquefaction potential. This research and methodology can be used to help determine boundary conditions for future numerical modeling and lead to more accurate and universalized predictions.

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