The Geo-Institute Unsaturated Soils Technical Committee will live-stream the *session* "Soil Desaturation Techniques for Ground Improvement: From Micro-Scale Mechanisms to Field Implementation" on Monday, December 7, at 2 PM EST. The talks include:

Talk #1: Beyond Degree of Saturation: How Pore-Scale Gas Morphology Governs the Hydro-Mechanical Response of Desaturated Soils **(presented by Nariman Mahabadi, Ph.D., Arizona State University)**

Introducing a small volume of gas into saturated soil can substantially alter pore-pressure generation, wave propagation, hydraulic conductivity, and liquefaction resistance. However, the response of a desaturated soil cannot always be explained by degree of saturation alone. At the same gas content, the gas phase may exist as uniformly distributed microbubbles, isolated pore-scale clusters, larger connected ganglia, or preferential gas pathways, each producing a different hydro-mechanical response. This presentation introduces a morphology-based framework for understanding desaturated soils, with emphasis on the micromechanics and pore-scale processes that connect gas configuration to measurable engineering behavior. The discussion will examine how gas-bubble size, spatial distribution, connectivity, and persistence influence compressional- and shear-wave propagation, pore-fluid compressibility, and hydraulic transport. Dispersed bubbles primarily increase pore-fluid compressibility, reducing Skempton's B-value and P-wave velocity while producing relatively little change in S-wave velocity when the soil skeleton and effective stress remain unchanged. In contrast, larger clusters, connected gas regions, or gas lenses may obstruct water-conducting pore throats, redirect flow, reduce hydraulic conductivity, and potentially affect S-wave velocity when they interact mechanically with the soil skeleton. Particular attention will be given to the long-term evolution of gas morphology through dissolution, Ostwald ripening, coalescence, buoyancy-driven migration, capillary trapping, and flow-induced mobilization. Microfluidic visualization, micro-CT imaging, pore-network modeling, and laboratory wave and permeability measurements will be discussed as complementary tools for linking these pore-scale processes to core-scale response. The presentation establishes a fundamental framework for interpreting the laboratory and field-scale desaturation techniques presented in the remainder of the session.

Talk #2: Desaturation through MIPS for liquefaction mitigation of silty sands **(Presented by Majid Ghayoomi, Ph.D., P.E., M.ASCE, University of New Hampshire)**

The mitigation of soil liquefaction in sand with fines presents a challenge in conventional soil improvement techniques, especially considering soil plasticity. While current liquefaction mitigation measures are mostly applicable to clean sands or open sites, development of nondisruptive techniques applicable to sands containing fines is critical. Desaturation techniques including Microbial Induced Partial Saturation (MIPS) has gained traction in recent years as an effective yet non-disruptive liquefaction mitigation strategy. This presentation explores the efficacy of MIPS to improve the liquefaction resistance of sandy soils with non-plastic and plastic fines. By leveraging the natural processes of indigenous microorganisms, this method introduces biogenic gas within the soil matrix, effectively reducing its degree of saturation. Experimental results from a series of undrained strain-controlled cyclic shear tests reveal that even a modest reduction in saturation significantly enhances the soil's stability against seismic-induced liquefaction. The investigation extends to analyzing the effectiveness of the MIPS treatment in sands with no fines, non-plastic fines, and low-plasticity clay content at different percentages, offering insights into the interaction between microbial activity, soil texture, and liquefaction potential. Accordingly, traditional excess pore water pressure predictive formulations are modified and calibrated based on degree of saturation, fines content, and fines plasticity. Further, the more fundamental impact of desaturation on dynamic soil properties are also discussed.

Talk #3: Assessing Induced Desaturation via Air Sparging as a Pretreatment for Rapid Impact Compaction: From Bench Scale to Field Application **(Presented by Leon van Paassen, Ph.D., M.ASCE, Boskalis)**

Loose sands are susceptible to earthquake-induced liquefaction. Soil compaction is among the most cost-effective methods for mitigating this hazard. However, conventional techniques for compacting sandy soils, such as dynamic compaction, rapid impact compaction, and vibro-compaction, may require substantial compaction effort and can be ineffective in increasing the relative density of sands with high silt contents. This study investigates induced desaturation as a means of improving the efficiency of soil compaction. In particular, air sparging is used to reduce the degree of saturation before compaction, thereby modifying the soil response and potentially enhancing densification during rapid impact compaction. The approach is evaluated through an iterative program of bench-scale experiments, large laboratory-scale testing, and a pilot-scale field trial in Manila, Philippines, providing insight into its feasibility and performance across multiple spatial scales.

Talk #4: Field Trials of Microbially Induced Desaturation (MID) for Liquefaction Mitigation of Fine-grained Soil: Longterm Monitoring and Retreatment **(Presented by Diane Moug, Ph.D., M.ASCE, Portland State University)**

Microbially induced desaturation (MID) is a viable ground improvement method for liquefiable soils. MID ground treatment is performed by injecting a treatment solution of calcium nitrate and calcium acetate into targeted soils. The treatment solution stimulates native microbes to perform a denitrifying reaction that primarily produces nitrogen gas. A small reduction in soil saturation, often considered to be a saturation ratio less than 98.5%, is enough to suppress porewater pressure generation during earthquake shaking and increase the soil's resistance to liquefaction. MID treatment for liquefaction mitigation is advantageous for fine-grained soils beneath existing structures since MID can be applied more economically than other ground improvement methods. A 2019 field trial of MID in Portland, Oregon demonstrated that MID can successfully desaturate fine-grained soils under field conditions. Continued monitoring at the site detected an increase of saturation ratio to above 98.5% in certain parts of the MID-targeted soils four years after treatment. This resaturation occurred faster than expected based on other field and theoretical studies. Subsequent re-treatment using the same setup as the 2019 field trial demonstrated that MID can be reapplied reduce saturation ratios back below target values. This presentation describes the long-term monitoring data and how it indicated changes in saturation. Additionally, the retreatment approach and retreatment are presented.