GEO-INSTITUTE
7th ANNUAL LIVE STREAMING WEB CONFERENCE

The Geo-Institute Soil Improvement Technical Committee will live-stream the session "*Case Histories in Soil Improvement for Civil Infrastructure*" on Thursday, December 8, at 2 PM EST. The topics include:

"Case Histories on the use of Rigid Inclusions and Dynamic Compaction for Municipal Solid Waste Sites," ***Sonia Swift***, P.E., M. ASCE *and* ***John Myers***, P.E.

One of the benefits of rigid inclusions (RI) is that they can be installed through a variety of soil types, including sites that contain municipal solid waste (MSW), uncontrolled fill, and construction debris. While the design methodology used for sites with these variable materials is very similar to the methodology used for typical soils, the variability of MSW is well-documented in literature, which makes the parameter selection a challenge. The makeup of the MSW, the landfill cover used, the amount of voids, and the amount of primary and secondary consolidation that will occur are all key parameters to consider in the design. Additionally, we know that a large amount of settlement occurs during construction because the applied load results in a rearrangement of the soil matrix, which fills many of those voids. To hasten that process, dynamic compaction (DC) has often been used on sites with MSW fill prior to rigid inclusion installation. The use of DC results in an overall stiffer matrix that will undergo less settlement during and post-construction and results in lowering the site. The site is then generally filled with higher quality material than the MSW, which allows for better load transfer into the RIs. Due to the uncertainty associated with MSW fill, full-scale, instrumented load tests are performed, often comparing areas improved with DC only to areas improved with both DC and RIs. In the past, we have successfully installed RIs through multiple MSW sites. This presentation will provide a brief case history of three projects where dynamic compaction was combined with rigid inclusions to reduce long-term settlement. We will present specific project information and the results of the instrumented full-scale load tests.

"*WooSox Residential Development: A Case Study on Rigid Inclusion Quality Control*," ***G. Allen Bowers, Jr.***, Ph.D., PE, M.ASCE

Rigid inclusions are a more brittle ground system in that the elements are generally orders of magnitude stiffer than the matrix soils, thus it is imperative that each element in a rigid inclusion system perform as intended. To ensure this, a robust quality control (QC) program must be implemented to verify the satisfactory construction of every element. This presentation focuses on the quality control program that was implemented during the construction of the rigid inclusion elements that are supporting a nearly completed seven level mixed-use residential development in Worcester, MA. There were multiple geotechnical challenges on this project including heavy building loads, up to 11 feet of fill, and a subsurface that consisted of up to 55 feet of very soft organic soils. The ground improvement design utilized GeoConcrete (GCC) rigid inclusion elements for foundation and slab support. GCC integrity was paramount given the high capacity required of the elements. Demonstrating the ability to maintain the shaft diameter of every pier in the thick organic deposit was key to ensuring the rigid inclusion system performed as designed. Included in this presentation is an overview of the project and ground improvement design. The robust quality control program, which included pre-production installations and testing, monitoring of every pier during construction, and real-time data tracking is discussed in depth. This presentation ultimately demonstrates how a properly implemented and robust QC program can lead to confidence in the performance of rigid inclusion systems.

"*Stabilization of Subgrade Materials via Accelerated Carbonation,*" ***Aaron Gallant***, Ph.D., P.E., M.ASCE

Challenging subsurface conditions often dictate the need to excavate and/or replace shallow subgrade soils or to modify the native materials' insitu properties via soil stabilization methods. Chemical stabilization typically involves field mixing of alkali-based additives in the soil to create a binder that improves the strength and stiffness of the subgrade. Soil carbonation is an alternative to conventional chemical stabilization methods, whereby carbon dioxide gas is introduced and consumed to produce a carbonate binder that precipitates and cements the soil. Via large-scale laboratory experiments it was demonstrated that soil carbonation can increase the strength and stiffness of subgrade soils to practical depths typically associated with stabilization of subgrade materials for roadways. Additionally, environmental testing was performed to investigate the durability of carbonated frost-susceptible soils subjected to multiple freeze-thaw cycles. It was found that carbonated subgrades were durable under these conditions. Aside from the mechanical benefits associated with soil carbonation, the consumption of carbon dioxide gas also reduces net carbon emissions associated with production of stabilizing agents typically mixed in the soil—which aligns with larger societal objectives.

"Ground Improvements for Georgia Ports Mason Mega Rail Project," **Guoming Lin**, Ph.D., G.E., D.GE.

The Port of Savannah's Mason Mega Rail Project is an 85-acre intermodal facility that comprises 18 tracks for simultaneous operations of six 10,000-foot-long trains. Upon completion, it will be the largest on-dock rail facility for a port authority in North America which will help boost the Garden City Terminal's (GCT) rail capacity to one million container lifts per year. A majority of the Mason Mega Rail site was an unregulated industrial landfill over low-lying land along a major drainage canal. The banks of the canal are underlain by very soft and compressible soils. The new rails were laid over the landfill, and two new rail bridges were constructed to cross the canal. The landfill debris and the soft marine deposits present major challenges to ground stability and settlements.

The following six ground improvement techniques were employed to treat the landfill material and mitigate the settlement and stability concerns: dynamic compaction of the landfill, undercut and geogrid stabilization for wetlands, driven prestressed concrete piles for rail-mounted gantry (RMG) cranes and two rail bridges, rigid inclusions for embankment stability, surcharge with wick drains for drainage structures with high fill, geocell MSE walls along the edge of the rail yard. These innovative measures saved about $12 million over the conventional approaches. This presentation outlines the project design process, subsurface conditions and associated challenges, geotechnical considerations of various ground improvement options, and experience and lessons gained from their applications of the ground improvement technologies.

"Twin Ports Interchange - Test Column Supported Embankment," ***Rich Lamb***, P.E., M.ASCE

This presentation reports on the design, construction, and instrumentation for a Test Column Supported Embankment Project constructed for the Twin Ports Interchange Project located in Duluth, Minnesota. The primary objective of this unique, design-phase test project was to measure lateral ground displacements resulting from the placement of a large array of full displacement grouted columns used to support highway embankments placed over highly compressible soils. This concern was introduced by the Construction Management General Contractor (CMGC) and their geotechnical expert following experience with significant lateral displacements on existing foundation elements from similar construction on a large highway project in New Jersey. The test project consisted of installing a test array of sixty-three heavily instrumented full displacement grout columns within the project limits. In addition, an instrumented load transfer platform and 15 ft. tall test embankment was constructed over these columns to model the effectiveness of the column supported embankment design. The test column project was constructed in the summer and fall of 2019. The instrumentation demonstrated significant lateral ground movement during column installation in sensors nearest the column array, and the ground improvement design was adjusted accordingly.