GEO-INSTITUTE 9TH ANNUAL WEB CONFERENCE

December 2-6, 2024

The Geo-Institute Soil Improvement Technical Committee will live-stream the session "**Case Histories in Ground Improvement**" on Wednesday, December 4, at 2 PM EST. The topics include:

"Deep Dynamic Compaction on the US-191 Realignment Project, Vernal, UT"

Jacob Price and **S. Robert Johnson**

This presentation will discuss geotechnical design and construction elements of the project, which included a test fill section, settlement instrumentation, and borings with standard penetration testing performed at the same locations before and after ground improvement. US-191 north of Vernal, Utah is a two-lane highway that climbs a steep slope via a series of tight switchbacks. This stretch of highway can be difficult to safely navigate for trucks, recreational vehicles, and the public. The switchbacks are located over a major phosphate deposit that is being mined on both sides of the highway. The Utah Department of Transportation and the mining company entered a mutually beneficial public-private partnership to re-route the roadway through a gentler and safer curve over previously mined ground, after which the phosphate can be mined beneath the abandoned highway alignment. The mining company, leveraging its immense earth moving capabilities, agreed to perform rough grading of the new roadway alignment. However, methods of soil placement were predominantly highwall blasting/casting, dumping, and pushing, without consideration of uniform lifts, moisture-conditioning, nor compaction. The only compactive energy applied to the disturbed soil and the mine-placed embankment consisted of incidental and random haul traffic. Testing conducted for the project found the relative compaction of the material to vary significantly with an average of about 85 percent, leaving the potential for significant total and differential settlements under the roadway. The project team used deep dynamic compaction to reduce settlements, improving a zone 20 to 30 feet thick at the top of the mine-placed fill, then placed several feet of controlled embankment according to highway construction standards before placing the pavement section. The goal of the ground improvement was to improve the density and uniformity, and reduce settlement the potential, of the mine-placed material.

"Critical Components of Rigid Inclusions and Geo-Structural Interactions – A Case Study of Footing Design, Floor Slab Design, and Lateral Loads on Rigid Inclusion"

Derek Simpson and Mick Pockoski

The use of rigid inclusion ground improvement to support conventional foundations is becoming more widely accepted, and the engineering and construction communities are rapidly establishing, adapting, and adopting local standards-of-practice. For example, as of the writing of this abstract, the Massachusetts State Building Code (MSBC) is currently being amended to include ground improvement for the very first time, with particular focus on design and testing of Rigid Inclusions. This paper features a case history that highlights solutions to some design, testing, and construction challenges associated with rigid inclusion ground improvement. The subject project consists of a multi-story building in the greater Boston area. Relatively deep, soft soil conditions were considered unsuitable for foundation and slab support and would have resulted in excessive total and differential structural settlement if left in place without modification. Different foundation support schemes, including over-excavation/replacement, deep foundations (piles), and ground improvement were considered as possible solutions. Ground improvement was selected as the most cost-effective and schedule-friendly option and consisted of Geopier® GeoConcrete® Column (GCC) rigid inclusions. The GCCs consisted of an unreinforced concrete shaft with an expanded base and were designed to completely penetrate the unsuitable soils and terminate in the underlying natural soils. At footing support locations, the design included a 6-inch thick "Footing Pad" between the bottom of the footing and the top of the GCCs. Design challenges that were addressed included ensuring appropriate geo-structural interaction for substructures that were originally designed by the structural engineer for a uniform soil bearing/modulus. This included analyzing footing and slab shear and bending capacity, which required collaborative and iterative evaluation between the ground improvement designer, structural engineer, and project design team. Construction challenges included ensuring Working Platform stability and coordination of subsurface utilities, which were designed prior to ground improvement design.

"Application of Deep Mixing Method (DMM) for Excavation Support for an LNG Project"

Jianchun Cao and **Anil Bhandari**

Most LNG projects are developed in near-shore areas. There often exists a relatively thick layer of very soft and highly compressible fine-grained soils. The geotechnical design and construction of excavation support systems are usually associated with substantial difficulties. Deep Mixing Method with cement (DMM) can improve soil strength, lower soil permeability, reduce soil deformations, allowing for construction in difficult areas. As its first time in the US, DMM was used to support the excavations for an LNG project. This presentation documents a case history about the application of DMM for excavation support for an LNG project. In this presentation, first, the primary facilities, excavations, and site layout of an LNG project will be introduced. Next, the soil conditions, a generalized subsurface profile and soil design parameters of this specific site will be discussed. Then, the application of DMM for excavation support will be presented using the design of the deepest excavation. For example, 1) DMM was used to increase the bearing capacity of top soft soils to support the DMM installation equipment; 2) DMM walls, constructed along the excavation edge, were used as a support system to support the excavation, and as a waterproof curtain to control the soil's seepage; and 3) DMM bottom plug and tie-down anchors in the excavation area were used to resist the buoyancy and bottom blow-out. After that, an FEA (finite element analysis) model was developed to confirm the geotechnical design. FEA results, such as stability of the DMM excavation support system, deformation of DMM walls, tie-down anchor capacity, and excavation bottom heave, etc., were examined. Finally, the DMM installation QA/QC program will be discussed. A few photos taken at different points in the excavation will demonstrate the successful application of DMM for excavation support.

"A Case Study on Rigid Inclusions for Route 1&9 in New Jersey"

Jake Price, P.E. **and Robert Johnson**

The Route 1&9T/New Road project is a three-part program to relieve the notoriously congested Route 1&9 (Tonelle Avenue) in the heart of the industrial sector of Jersey City, New Jersey. Contract 1 consisted of constructing a new road over a one-mile-long stretch of unimproved land serving as part of the parking lot to a large postal facility. To get to grade, modular gravity retaining walls were specified on either side of the 54-foot-wide roadway corridor. While the proposed wall heights ranged from only 2 to 8 feet, the soils present on-site were not even suitable for a shallow embankment. The underlying soils were mixed fills and organic peat, underlain by soft clay and silt to depths of up to 75 feet.

The proposed solution presented in the project plans certainly would have worked on paper; however, Menard, having had poor experiences with RI installation and LTP compaction at or just above the groundwater table, recognized the potential difficulties, delays, and rework that would likely be required during construction of what was shown on the contract plans. As such, Menard proposed a value-engineered (VE) solution that resulted in a vast improvement in the constructability, performance, and overall cost of the system.

"Ground Improvement Case Study T.B.D." **Chris Garris**

*Description coming soon.