Tuesday 3/14/2017

9:45–11:15 a.m.

Unconventional Materials 1

Chairs: Beena Ajmera, California State University, Fullerton; Binod Tiwari, California State University, Fullerton

Dynamic Characteristics of Lightweight Cellular Concrete

Binod Tiwari and Beena Ajmera, California State University, Fullerton; Diego Villegas, Cell-Crete Corp.

Lightweight cellular concrete has been utilized in many geotechnical applications including as the backfill in retaining walls, lightweight pavements, land slip repairs, bridge approach fills and to provide shock absorption in earthquake zones. The use of this material in seismic regions requires an understanding of its dynamic properties. In this study, five different mixes of lightweight cellular concrete, with varying unit weights were tested in a cyclic simple shear apparatus. The samples were subjected to four different consolidation pressures followed by a series of fifteen strain-controlled undrained sinusoidal cyclic loads. The cyclic strains were varied from 0.08% to 1.0% double amplitude shear strains. From the results obtained, the maximum shear modulus was found to increase as the dry unit weight of the material decreased and as the consolidation pressure increased. The damping ratio was found to decrease with increasing shear strain until a threshold shear strain was reached beyond which the damping ratio increased with an increase in the shear strain. This threshold shear strain ranged from 0.25% to 0.35% for the specimens tested.

Small Strain Stiffness and Elastic Behavior of Gellan-treated Soils with Confinement

Jooyoung Im and Gye-Chun Cho, Korea Advanced Institute of Science and Technology; Ilhan Chang, Korea Institute of Civil Engineering and Building Technology

Recent studies in soil improvement have shown that the use of biopolymers are capable of significant enhancements to various engineering properties of the soil. Strengthening efficiencies, reduced permeability, and improvements to friction angle are all benefits that biopolymer use have onto the soil. However, in order to fully utilize the biopolymer technology into the fields, a full understanding of the geotechnical properties is necessary. In this study, one dimensional oedometer consolidation tests were performed with attached p and s wave sensors for elastic wave property measurements. Gellan gum biopolymer was used in this study, and its effects on the elastic properties and consolidation behavior for sandy and clayey soils were observed. Results showed that due to the high electrical sensitivity and hydrophilic properties of the biopolymers, the elastic properties and consolidation behavior of the biopolymer treated soils varied greatly from the untreated soils.

Thixotropy of a Sludge from the Cubatão Water Treatment Plant, Brazil

Juliana Keiko Tsugawa, Kelly Fiama, and Maria Eugênia Gimenez Boscov, University of Sao Paulo

A more sustainable destination for water treatment sludge (WTS) is its use in earthworks and as landfills liners. However, because of its high water content and plasticity, the investigation of WTS workability in construction procedures is mandatory. As a contribution for this purpose, this paper investigated the thixotropic effect of Cubatão WTS by means of laboratory vane tests. The experimental procedure consisted in preparing triplicate samples of sludge remolded at the liquid limit and storing them for different times to determine the gain of undrained shear strength. Results indicate that Cubatão WTS is

thixotropic. The very low remolded undrained shear strength triples after five months of storage. Despite the thixotropic regain reaching 200%, the strength is still insufficient for geotechnical purposes and additional treatments will be necessary to turn the sludge into a reusable material for earthworks.

Experimental Studies on Reinforced Bottom Ash-based Geomaterial

Sonali Nawkhare and Ram Rathan Lal Birali, K.I.T.S., Ramtek

This paper pertains results of experimental studies carried out on reinforced bottom ash based geomaterial. The proposed geomaterial is prepared by blending bottom ash with expanded polystyrene beads, waste plastic water bottle strips and a binder such as ordinary Portland cement. The mix ratios used in the experimental study were 0.2 %, 0.6 % and 1.0 %. The plastic strips were used in two different aspect ratios 0.1 and 0.2 with different mix proportions 1 %, 2 % and 3 %. The cement to bottom ash ratio was considered as 10 %. The effect of mix ratio, percentage of plastic strips and curing period on the compressive strength, stress-strain behaviour, density and secant modulus were studied and results are incorporated in the paper. The result indicated that for a particular mix ratio, the compressive strength increased with increasing aspect ratio. Nonlinear relationship was observed between compressive stress and axial strain for all the mix ratios and curing periods.

A Bio-inspired Perspective for Geotechnical Engineering Innovation

Jason DeJong, Matthew Burrall, and Daniel W. Wilson, University of California, Davis; David Frost, Georgia Institute of Technology

The rapidly emerging sub-discipline of biogeotechnics is comprised of both bio-mediated and bio-inspired technologies. Research and development over the past decade have focused primarily on bio-mediated technologies, while research on bio-inspired geotechnical technologies is still in the early stages. This paper synthesizes the advances in the broader field of bio-inspired design and highlights aspects particularly relevant to the exploration of new geotechnical engineering innovations. The structure, advantages, and challenges of both problem-based and solution-based design methodologies are presented. A hierarchical framework for the characterization of biological systems is discussed in the context of how the framework facilitates the use of bio-inspired methodologies. Finally, an example application of the bio-inspired design methodology to tree root inspired foundation and anchorage systems is explored and discussed.