Determination of Undrained Strength for Contractive Coal Combustion Residuals for Seismic Assessment

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EERI, New England Chapter, Lecture Series
Wednesday October 20, 2021, 1:00 – 2:00 PM (Eastern Time)

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Abstract: The evaluation of slope stability for Coal Combustion Residuals (CCR) impoundments is becoming increasingly important as multiple failures involving undrained behavior of granular materials have recently occurred. Seismic loading is a load case where undrained behavior can be triggered that causes a rapid increase in mobilized shear stress or a rapid decrease in effective stress if contractive saturated materials are present. This rapid loading can trigger liquefaction within a CCR layer which would require considering the residual shear strength for the CCR material. Undrained strength parameters for CCR materials can be highly variable. Cone penetration tests (CPTs) are simple and relatively inexpensive, however CPT measurements is an indirect measurement which must be converted to strength through semi-analytical-empirical correlations. Such correlations are reasonably well understood for natural clays and sands but there exists only limited correlation data for CCR materials. To improve our understanding of the shear strength of CCR materials, a program was developed to collect CPT data from five CCR impoundments and companion "undisturbed" tube samples for laboratory strength testing Laboratory testing was done to measure both monotonic and post-cyclic undrained strength in direct simple shear devices. All the laboratory tests showed contractive behavior. CPT data were also used to estimate the peak and residual strength of the CCR material using available correlations. Generally, reasonable agreement was obtained by the two independent approaches but with significant scatter. This study summarizes the approaches used to apply Best Applicable Practices to make a reliable determination of peak and residual undrained shear strength of CCR materials and provides recommendations on improving available methods to determine undrained shear strength of contractive materials.

Biographies:

Seda Gokyer Erbis is a Project Engineer/Assistant Project Manager for Geocomp Corporation - Massachusetts Consulting Group. She has been with Geocomp for six years, holding a doctoral degree in Geotechnical Earthquake Engineering. She has been leading the project management and technical efforts for one of Geocomp's largest consulting projects on seismic assessment of coal ash impoundments. She has over seven years of experience in geotechnical earthquake engineering, especially in advanced laboratory testing. She has authored and co-authored several publications in peer-reviewed ASCE and ASTM journals and conference proceedings.

Mr. Lavorati is a Project Engineer at Geocomp Corporation - Massachusetts Consulting Group. He is responsible for a range of project activities including geotechnical design, laboratory testing, data management, computer-based modeling, field investigations, and project management. He has been involved with different aspects of engineering work, from litigation review to design analysis to information research. He has extensive modeling experience in a variety of geo-structural and presentation software packages, including AutoDesk, GeoStudio, Rocscience, DEEPSOIL, and FLAC, amongst many others.