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Shear Strength Envelope Characteristics of LimeTreated Clays

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Abstract : The effectiveness of lime treatment of soils has been commonly evaluated in terms of improved workability and increased undrained unconfined compressive strength in connection to road and airfield construction. The most common method of strength measurement has been the unconfined compression test. However, if the objective of lime treatment is to improve long-term stability of first-time or reactivated landslides in stiff clays and shales, permanent changes in the size and shape of clay particles must be realized to increase drained frictional resistance. Lime-soil interactions that may produce less platy and larger soil particles begin and continue with time under the highly alkaline pH environment. In this research, pH measurements are used to monitor chemical environment and progress of reactions. Atterberg limits are measured to identify changes in particle size and shape indirectly. Also, fully softened and residual strength measurements are used to examine an improvement in frictional resistance due to lime-soil interactions. The main variables are soil plasticity and mineralogy, lime content, water content, and curing period. Lime effect on frictional resistance is examined using samples of clays with different mineralogy and characteristics which may react with lime to various extents. Drained direct shear tests on reconstituted lime-treated clay specimens with various properties have been performed to measure fully softened shear strength. To measure residual shear strength, drained multiple reversal direct shear tests on precut specimens were conducted. This way, soil particles are oriented along the direction of shearing to the maximum possible extent and provide minimum frictional resistance. This is applicable to reactivated and part of first-time landslides. The Brenna clay, which is the highly plastic lacustrine clay of Lake Agassiz causing slope instability along the banks of the Red River, is one of the soil samples used in this study. The Brenna Formation characterized as a uniform, soft to firm, dark grey, glaciolacustrine clay with little or no visible stratification, is full of slickensided surfaces. The major source of sediment for the Brenna Formation was the highly plastic montmorillonitic Pierre Shale bedrock. The other soil used in this study is one of the main sources of slope instability in Harris County Flood Control District (HCFCD), i.e. the Beaumont clay. The shear strengths of untreated and treated clays were obtained under various normal pressures to evaluate the shear envelope nonlinearity.

Keywords : Brenna clay, friction resistance, lime treatment, residual
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