PhD Thesis Defense

Effects of Cement Treatment on the 1-D Consolidation Behavior of a Highly Organic Soil

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November 21, 2006 - CIVL 1113 -10:30 a.m.

Highly organic soils pose significant problems to the geotechnical profession often requiring innovative design solutions and special construction procedures. The research performed addressed one construction methodology - deep soil mixing - that has been widely used in soft clays, but that, especially in the US, has found limited use in organic soils.

The study utilized constant rate of strain (CRS) and incremental loading (IL) tests to study the one-dimensional compression behavior of a soil with 40-60% organic matter in its natural intact and reconstituted state, as well as following treatment with cement. Testing of the soil in its intact state relied on high quality block samples and showed that the natural soil displays intermediate behavior between that typical of inorganic soft clays and that observed in peats. The soil showed a high tendency to creep, with Ca/Cc of 0.095, at the high end of values reported in the literature. Comparison of the compression results for the natural and the reconstituted soil served to evaluate the degree of structuring of the natural soil, which was found to be consistent with that typical of natural sedimentary inorganic clays.

To investigate the effects of cement treatment on the behavior of the soil, tests were conducted varying the cement dosage (8% 100% by dry mass of the soil, consistent with soil mixing practices), the curing surcharge (48, 96, and 192 kPa) and curing duration (14 and 28 days). Substantial changes in the 1-D consolidation behavior derive from the hydration of the cement and the structure developed within the soils. Increasing cement percentages was found to cause a marked increase in the preconsolidation stress (dependent also on the curing stress), a stiffer behavior in the initial recompression region, a slight increase in the compression index, an increase in the hydraulic conductivity and the coefficient of consolidation, and a marked reduction in the creep coefficient and the Ca/Cc ratio.

The work included an in depth characterization of the treated and untreated soil both in terms of the organic fraction and the inorganic substrate using XRD, FTIR, and elemental analyses (LECO tests).