Measurement of shrinkage limit

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Laporan (Report)

Dr. Peter Hobbs of the British Geological Survey presented the above technical talk on Monday 15th May 2000 at the Geology Department, University of Malaya at 5.30 pm.

Abstrak (Abstract)

Introduction

Structural damage due to subsidence, as a direct result of the swelling and shrinkage of clay soils, is estimated to cost the equivalent of 1.8 billion Malaysian Ringgit annually in Britain. Research at the British Geological Survey (BGS) has involved the gathering of shrinkage and swelling data for a variety of British sedimentary soil formation. As part of this work, a new shrinkage limit test methodology has been developed.

Shrinkage limit

Traditional methods of measuring the volumetric shrinkage of clay soils have utilised Archimedes' principle requiring immersion of the specimen in a vessel of mercury. These are two such methods, described in American Society for Testing & Materials (ASTM, D427) and British Standards (BS1377: 1990, Test 6.3). These tests permit the use of undisturbed, remoulded, or compacted specimens, and are distinct from the linear shrinkage test (BS1377: 1990, Test 6.5) which permits only remoulded samples to be tested. The mercury immersion methods have fallen into disuse in many countries due to health issues. Mercury is a significant health hazard in both liquid and vapour forms. Use of these tests with tropical residual clay soils and fissured over-consolidated clay soils is also problematic due principally to entry of mercury droplets into the specimen, and hence incorrect weight and volume measurements. Despite this, the shrinkage limit remains a fundamental soil parameter of which more use should be made.

BGS research

As part of the BGS' work a new test apparatus has been developed to measure the shrinkage limit of a 100 x 100 mm cylindrical specimen. This utilises a laser rangefinder to measure a pseudo-volume and an electronic balance to measure weight, without the need to handle the specimen. Many results have now been obtained with a prototype hand-operated apparatus, including tests on two tropical residual clay soils from Java (results to be reported in Unsat2000, Singapore). Research has also been carried out with the apparatus at Leeds University, UK by M.Sc students A.A. Kadir and D. Marchese. These data have shown interesting comparative results for de-structured and compacted specimens. A fully automatic version of the apparatus, entitled *SHRINKIT*, is under construction at BGS. It is hoped to publish papers in Geotechnique in the near future. To date, the results have highlighted structural differences between sedimentary clay soils of different plasticities and residual clay soils.

Whilst it is not anticipated that *SHRINKIT* will replace the ASTM or BS test equipment, it does have the ability to research shrinkage, and possibly swelling, in an environmentally controlled and safe manner. It is particularly suited to highly structured or weak soils where preparation and handling are difficult. Each *SHRINKIT* test requires between 2 and 4 weeks to complete, depending on the sample and the controlled drying rate. However, the large specimen is more representative of the soil structure than the small BS, or very small ASTM, specimens.

Warta Geologi (Newsletter of the Geological Society of Malaysia), Vol. 26, No. 3, May-June 2000