Adobe material of the Sun Temple, Pachacamac, Peru – Engineering, geological classification as a challenge

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A standard engineering-geological classification of fine-grained soils consists of the determination of the grain-size distribution and Atterberg consistency limits - liquid limit w_L (%) and plastic limit w_P (%), with the calculation of the plasticity index $I_P=w_L-w_P$ (STN 73 1001: 2010). In Slovakia, sieving combined with the sedimentation using a Casagrande aerometer is a standard procedure for obtaining the grain-size distribution, requiring at least 80 to 100 g of a clayey or silty sand sample. Another 200 to 300 g are needed for the standard cone test of w_L (BS 1377: 1990). The minimum for an engineering-geological classification would be 300 g of the sample. However, less than 100 g were available from the adobe material of the Sun Temple located in the archeological complex of Pachacamac near Lima, Peru. The 2000 years old site is on the Tentative World Heritage List of UNESCO since 1996 (http://whc.unesco.org, 2014-04-30). For such a small sample, non-standard methods had to be searched for. The grain-size distribution was done by sieving combined with Sedigraph. The water adsorption by Enslin-Neff was used for the calculation of w_L and I_P according to Petkovsek, Macek & Majes (2009). This allowed the sample to be classified as silty sand with 19.5% of fine fraction (silt + clay) of low plasticity, class symbol SM. The result was confirmed by the X-ray diffraction analysis that showed kaolinite as the main clay mineral, no traces of smectite were found. Cosidering the geotechnical impact of the findings, the absence of expandable smectite is very important for the volume stability of the adobe, because the Sun Temple ruins were uncovered and left without any protection against rainfalls. On the other hand, the amount of the cohesive fraction is low, whereby the cohesion of kaolinite is lower than that of smectite, which indicates a low strength of the adobe material.

BS 1377: 1990 British Standard Methods of test for Soils for civil engineering purposes. Part 2. Classification tests.

Dieng M. A. 2006. Bestimmung der Konsistenzgrenzen mittels Wasseraufnahm

Petkovsek A., Macek M. & Majes B. 2009. A laboratory characterization of a silt and clay-bearing rocks using the Enslin-Neff water adsorption test. Acta geotechnica Slovenica, 2, 2009, 5-13

STN 73 1001: 2010 Slovak Technical Standard. Geotechnical Structures. Foundations.