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Insitu Estimation of Swelling Pressure Using Inundated Plate Load Test for Marls/ Clays of Duqm Area - A Case Study

Mohd. J. Ahmed, K.M.Musthafa and Sreedevi.S

Arab Center for Engineering Studies, Dubai, m.ahmed@aces-dubai

The Duqm area is located about 600 km away from Muscat, in the Central Eastern part of Sultanate of Oman. The site investigations revealed the geology of the site. The geology consists of recent to sub-recent sabkhas (soft alluvial deposits of Clay SILT) and gravelly/ detrital deposits as soil deposits and rocks like the lower Tertiary arenites & calci-rudites of Sirab formation, underlain by the upper Mesozoic chalky marls with limestone interbeds of varying thickness. The average water table is at +7 m MSL (with considerable variations).

The laboratory tests conducted on the chalky marls indicate high swell pressures in the range of 130 to >300 KPa and a rock mass permeability in the range of 10^{-6} to 10^{-7} m/sec. Evaluation and classification of the likely geo-hazards as indicated by the site features, field and laboratory test results, relegates geo-risks as High to Very high swelling characteristics of the chalky marls as foundation rock mass for the proposed +100m dia. oil tanks.

The likely high swelling pressure of the marl rock determined from the laboratory results did not respond to the changing initial moisture content of the samples. Noting that the swelling potential measured for samples tested in the laboratory depends greatly on the initial moisture content and how far it is from saturation (swelling potential for saturated clay is zero), and noting the significant consequences of such very high swelling potential range on the selection of the foundations, it was recommended to confirm the swelling pressure with a reliable in-situ test- the inundated Plate load tests on the exposed chalky marls.

Insitu swelling pressure tests were conducted to confirm the swell potential of the marl rocks in order to resolve uncertainties associated with the lab testing and the subsequent conclusions/ impact on the design of foundations from the clay marl rock.



by the inundated marls.

Figure 1: Typical set up of plate loading test, Duqm

Based on the above observations, 5 Plate Load Tests (PLT) were conducted to confirm the SP using in situ condition. Inundated tests include adding fresh water to the loaded sample area on site, at the same time applying the pressure externally to hold the loaded plate in place (by increasing the pressure against the swell). The applied additional pressure is equivalent to the swell pressure exerted

The swelling pressures obtained from in situ conditions range between 104 -185 KPa against 130-300 KPa determined in the laboratory. A variation of 20 to 40% has been noticed between the results from laboratory and insitu tests. The insitu test is reliable and simulates the actual severe conditions and is

typically recommended where reliable measurements are necessary, particularly for expansive clay-rocks. The effect of cementation can reduce the potential for swelling as indicated from Index Parameters.

Therefore, it can be concluded that for the most severe conditions of full inundation of the lightly loaded foundations, the expected heave (uplift) is expected to be "<0.1-0.2%" and for heavily loaded foundations the expected settlement is stated to be "around 0.3%" of uplift.

References:

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