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LEAKAGE ERRORS IN VARIABLE HEAD PERMEABILITY TESTS PERFORMED IN CASED BOREHOLES

Summary:

Systematic errors in field permeability tests, performed in exploratory boreholes are often ignored, even though numerous cases of erroneous measurements are reported in the literature and there is a consensus that borehole tests should be treated with caution. In most cases measurement errors are overlooked when they overestimate the ground permeability parameters and lead to more conservative design of the dewatering systems in cofferdam design. However, when the blow-out stability of the bottom of deep excavation pits is to be assessed, such errors which lead to overestimation of actual ground permeability result to an unconservative design.

This work stresses attention to errors associated with leakage of testing water during the execution of variable head tests in cased boreholes. Variable head permeability tests are routinely executed during exploratory drilling and they are very popular due to their low cost. Sealing of the testing tip is ensured by the convergence of the soil around the casing. However, this sealing is not perfect when the test is executed in lightly to moderately cemented soils/soft rocks and the loss of testing water through this imperfect sealing, result to overestimation of the water seeping into the testing tip during testing and consequently the in situ ground permeability.

Recognition and quantification of measurement errors associated with such leakages improves our ability to identify the cases where these errors become dominant and to avoid misleading test interpretations. Simple interpretative models developed in the present study demonstrate that these errors can become significant in low permeability ($k < 10^{-7}$ m/sec) cohesive soils or lightly cemented silty sands.

It is pointed out that the errors may be impossible to detect solely by inspecting the test data, especially if the head drop during testing is small. It is recommended to compare the measured permeability values with estimates based on grading data or other empirical relations and when significant differences are detected it is suggested to perform further testing in installed piezometers with reliably isolated testing tips. If the issue becomes critical for the design, it is recommended to perform pumping tests on carefully constructed pumping wells.

Key words:

Variable head permeability test, leakage errors.

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