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Abstract

NUMERICAL MODELING OF EMBANKMENT ON SOFT
MARINE CLAY STABILIZED BY VERTICAL DRAINS

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Landfills of sand and other types of soil are widely used in Macau. They represent an important percentage of land in Macau. Hence, prediction of settlement of these areas becomes valuable.

In this study, a road over a newly constructed embankment was chosen for comparing the actual settlement and calculated settlement. Two computer programs, FLAC and CRISP, were used to perform the analyses. Modified Cam-clay model was adopted for simulation of the settlement behavior of soil. The model is well formulated and investigated by other researchers. In addition, the modeling parameters can also be easily obtained based on conventional tests.

To facilitate the numerical simulation of soft marine clay with installation of vertical drains to promote rapid consolidation, effects of vertical drains were simulated using Equivalent Permeability Method for the soft soil layers proposed by the author. Using the Equivalent Permeability Method in which the permeability of the marine clay was multiplied by a vertical drain factor of 54, the soft marine clay without drains would achieve similar average degree of consolidation as those predicted with drains.

A newly constructed embankment was first analyzed by CRISP simulating the actual geometry of the vertical drains. The same site was then analyzed by FLAC with a much simpler model using the proposed Equivalent Permeability Method. Analyses

using the estimated soil parameters showed significant differences between the observed and predicted settlements due to the uncertainties of the soil parameters.

Parametric study using various combinations of virgin compression index and permeability was performed. The results of analysis were compared with the measured settlement during early stage of construction (264 days). The ordinary least squares method was applied to select the best matching calculated settlement curve.

Using the optimal parameters, the predicted settlement curves were compared with the measured settlement curves. The differences of the settlement curves between prediction and actual site measurement at the end of monitoring date (396 days) are similar by both CRISP and FLAC ($<3\%$). The optimal soil parameters obtained by parametric study are also similar as the virgin compression index value is 1.1 times the estimated value and the permeability is about 2.6 times the estimated site value by both methods. Hence, the proposed Equivalent Permeability Method is successful as a more efficient method to provide similar results comparing to those obtained by a more complicated model.