

The Estimation of Bearing Capacity for Dredged and Reclaimed Ground with Ultra-high Water Contents

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ABSTRACT

In this study, two-dimensional model loading tests were carried out to analyze the problem of the bearing capacity evaluation and its application range in the early stage of ground improvement in marine clay dredged deposits. If the water contents of the dredged and reclaimed ground were more than 75%, the bearing capacity of the dredged and reclaimed ground using $N_c=5.7, 5.14$ was in disagreement with the results of two-dimensional model tests. In a case like this, we recommend that the bearing capacity evaluation of marine clay deposit be estimated including the desiccated crust layer, that is, using Button's, and Brown and Meyerhof's equation for double-layered clay deposit. To estimate the application of these equations, the estimated bearing capacity was also compared with the results of the two-dimensional model tests.

KEY WORDS: bearing capacity; two-dimensional model loading tests; desiccated crust layer; dredged and reclaimed ground

INTRODUCTION

Marine clay dredged deposits undergo the process for sedimentation and self-weight consolidation after dredging. Because the surface of marine clay dredged deposits are exposed to the atmosphere, the surface of some marine clay dredged deposits goes through radiant heat and wind effect.

So, an evaporative phenomenon happens, that is, the water is diffused into the formation of water vapor from surface to air. At this time, if evaporation loss of the surface is greater than the amount of drainage by self-weight consolidation, the water contents of the surface in marine clay dredged deposits decrease. This is defined as desiccation. Desiccation phenomenon causes unsaturated condition because of the shrinkage and decrease of moisture in marine clay dredged deposits. There are marine clay dredged deposits in which the surface forms in the complex shape of cracks. Because of this phenomenon, the surface of marine clay dredged deposits holds lower water contents and higher shear strengths than does their initial condition. These layers are generally defined as desiccated crust layers. As a result, the dredged

and reclaimed ground has double-layered deposits which means that desiccated crust layers overlie very soft clay soils.

The lower layer of desiccated crust layer holds high water contents, and high compressibility. It takes long-term consolidation periods to stabilize its ground without stabilization methods. So, in such a case, it is necessary to apply preload, and vertical drain method, in marine clay dredged deposits for long-term stability. This should be considered during the estimation of stability and trafficability in the early stage of stabilization process in marine clay dredged deposits. Therefore, in this study, two-dimensional model loading tests were carried out to analyze the problem of bearing capacity evaluation and its application range. To estimate the application of Button's, and Brown and Meyerhof's equations, the estimated bearing capacity was also compared with the results of the two-dimensional model tests.

Application of $\phi=0$ Analysis in Clay Ground

The $\phi=0$ analysis, which was originally put forward by Fellenius (1927), is now becoming widely used in stability problems involving clay soils. The term " $\phi=0$ analysis" was apparently used for the first time by Skempton in 1945. The principles of the method have been outlined and critically examined by Skempton (1948), and the experimental evidence, by Golder and Skempton (1948). A summary of twelve examples using $\phi=0$ analysis is given in Table 1 by Skempton (1948b). Table 1 shows that the range of the average undrained shear strength in twelve examples is equal to 12~30kPa, and the distribution of water contents has a typical range in soft clay ground. Also, Skempton(1951) assembled the available field evidence on the ultimate bearing capacity of clays. This is assembled in Table 2. It will at once be seen that the evidence, although limited to six cases and subject to the usual lack of precision inherent in any field observations, provides satisfactory confirmation of the typical values of N_c . Also, Table 2 shows that the range of the average undrained shear strengths in six cases is equal to 6.5~38kPa. With this result, it could be assumed that water contents of the six field cases were less than 75%.