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Delayed Consolidation Effect Dependent on Permeability of Sand Mat

Young-Su Chae
University of Suwon, Suwon, Korea
Byung-Sik Chun
Han Yang University, Seoul, Korea
Young-Nam Kim and Sung-Jin Kwon
Dong-A Engineering Co., Seoul, Korea

ABSTRACT

Sand mat plays a role as an horizontal upper drain layer and an interception layer which cut off a rise of ground water from subsurface. It is also used to obtain a trafficability. However, it is difficult to obtain good quality sand in Korea because of not only the exhaustion of sand due to the construction of earth structures but also a strengthened restriction on the gathering of sand with respect to the environmental protection. As construction equipments are run, consolidation process is delayed due to the permeability change of upper drain layer resulting from the reduced void ratio of the sand mat.

The purpose of this study is to understand the sensitivity of factors which have influenced on delayed consolidation. In other words, resisting factors such as the unit weight (related to the void ratio), the thickness and the drain distance of sand mat were studied. To this end, the values from numerical analysis are compared with measured ones at Yangsan site in Korea.

KEY WORDS : Consolidation, Sand mat, Soft ground, Vertical drain method

1. INTRODUCTION

Recently, the construction of structures on soft ground are increasing and the structures are getting larger and larger. Rapid shortening of construction period is required. Therefore, the increase of ground strength and the stabilization of ground settlement have been studied. Especially in Korea, vertical drain method has been studied intensively to improve soft ground condition.

Sand mat must be paved with a sufficient thickness to quickly dissipate void water developed by vertical drain out of embankment region, to guarantee a trafficability of construction equipments, and to protect drain cap here. It is general that the design should be executed with assumption that the permeability of sand mat is infinitely large. However, when it is difficult to obtain good quality sand, it is common that less permeable sand is used. Considering that even highly permeable sand which satisfies the design specification (k> 1×10^{-3}cm/sec) has shown flow resistance in case of long drainage distance, it is natural that slightly poor permeable sand result in longer flow resistance. Excess pore water head was measured at Yangsan, Korea where a sand mat with low permeability was employed. In this case, flow resistance may well be generated. In real, excess water head has been observed at Yansan site in Korea. Therefore, in this study, we examine the measured values of resisting factors to permeate which are developed by the reduced void ratio of horizontal drain material. We also studied sensitivity of the factors which have influence on the delayed consolidation by comparing the measured values with those of the numerical analysis. An economic and efficient way to minimize the delayed consolidation effect was sought.

2. THEORY OF VERTICAL DRAIN METHOD

Based on Terzaghi's one dimensional consolidation theory, the time required for a clay layer to consolidate is proportional to the square of drain distance. Therefore, if the drain distance of a clay layer can be shortened, a rapid consolidation can be obtained. Based on this theory, sand drain was already constructed at San Francisco by Proter (1930). Since then, the theoretical study on vertical drain method has been executed with a symmetrical multidimensional consolidation theory. However, this theory is difficult to be expressed by a numerical method and to be used simply. Based on Terzaghi's consolidation theory, Barron(1948) suggested that the mean