1D CONSOLIDATION OF SOIL AT SUMARI UTTARAKHAND CONSIDERING VARIABLE COMPRESSIBILITY

Saurav Raturi, Ayush Nautiyal, Shashank Bhatra

Department of Civil Engineering, National Institute of Technology Uttarakhand, Srinagar (Garhwal) India

Contact: shashankbhatra991@gmail.com

Abstract

The linear and elastic consolidation theory developed by Terzaghi is commonly used for evaluation of consolidation characteristics of fine-grained soils. As several simplifying assumptions have been made in the derivation of Terzaghi's theory, the application of this theory in many practical problems, especially those involving soft clays, may lead to significant errors. In particular, the assumption of constant value for coefficient of consolidation, C_v, during consolidation process is one of the major limitations in Terzaghi's theory. In this paper, soil sample from the village Sumari near Srinagar Garhwal, Uttarakhand where the permanent campus of NIT Uttarakhand will be constructed has been considered. Finite difference approach is utilized for solving one-dimensional non-linear partial differential equation. Two coefficients (C_n and α) are computed to describe changes in soil characteristics and incorporate the changes in C_v during consolidation. In order to understand the consolidation behaviour considering variable compressibility a simple problem has been considered. It has been observed that the degree of consolidation is over-estimated on consideration of constant coefficient of consolidation C_v and thus may have a substantial impact on the long-term behaviour of the structure resting over ground exhibiting such behaviour.

Keywords: Consolidation; Compressibility; Permeability; Non-linearity; Finite Difference Method; Partial Differential Equation.

1 Introduction

In order to predict the progress of consolidation with time in cohesive soils, the oedometer test is usually performed to determine consolidation characteristics of soil and Terzaghi's linear theory is commonly used for evaluation of the results. Terzaghi (1922) and other researchers assumed coefficient of consolidation constant as consolidation progresses. Barden and Berry (1965), Davis and Raymond (1965) and Xie et al. (2006) established a nonlinear consolidation theory with a variable coefficient of volume compressibility and permeability during consolidation. In some cases, Wei (1987) and Xu (1987) observed that in order to compute foundation settlement hyperbolic model proved to be superior to $e - \log \sigma'$ model. The reason for this was attributed to the fact that former represented the constitutive relationship of soft clay better than the latter. Shi et al. (2001) validated the hyperbolic model for instantaneous loading with laboratory results. Sridharan and Sridharan and Nagaraj (2004) tried to predict the coefficient of consolidation (C_v) based on index properties of soils. They reported that the coefficient of consolidation has a correlation with the shrinkage index, I_s, and proposed a simple equation for the determination of C_v using shrinkage index only. Lekha et al. (2003) derived a theory for consolidation of a compressible medium of finite thickness neglecting the effect of self-weight of soil and creep effects but considering

https://doi.org/10.2749/newdelhi.2023.1529