Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

A Simple Method for Estimating the Shear Strength Ratio of Soft Peaty Soils

Hiroshi Oikawa, Toshihiro Ogino
Dept. of Civil and Environmental Engineering, Akita University
Akita, Japan
Hiroshi Itakiyo, Katsumi Ookubo
Nippon Expressway Research Institute Company Limited
Tokyo, Japan
Masaru Igarashi
Dia-consultants Co., Ltd.
Saitama, Japan
Masaki Tsushima
Dept. of Civil Engineering, Akita National College of Technology
Akita, Japan

ABSTRACT

A simple method for estimating the shear strength ratio of peaty soils is proposed after confirming the applicability of the critical state concept to peat by performing a series of constant volume ring shear tests on peat. The method does not require the traditional means such as a series of consolidated undrained shear strength tests. Required parameters are the initial in-situ undrained shear strength and the pressure-void ratio relationship of a given peat. Field data have shown the feasibility of the method.

KEY WORDS: Shear strength ratio; Undrained shear strength; Consolidation; Peaty soils

INTRODUCTION

Peat is widely distributed in the north part of Japan. Owing to an extremely low bearing capacity of this material, construction of earth structures such as highway embankments always leads to the problem of instability. So, slow-construction or stage-construction method has been widely used in Japan as a typical means of controlling stability problems on peaty grounds, though ground improvement techniques such as deep in-situ mixing or the use of geosynthetics have been combined with the method depending on the situation.

In the design of slow-construction or stage-construction, the rate of increase in undrained shear strength c_u due to the consolidation pressure p, i.e., the shear strength ratio $m(=c_u/p)$ of soft soils is one of the indispensable design parameters. This value strongly influences on not only the embanking speed but also the choice of construction method that will be combined.

In the case of clays, the shear strength ratio has been generally estimated by performing a series of consolidated undrained triaxial compression tests on a given clay. In the case of peats, however, very few tests are performed in Japan for estimating this value, because of the difficulties of sampling and conducting laboratory tests on this material, and because of the high cost for performing the tests. In practice, this value has been determined by the engineer's judgment based on his past experiences as a value in the range of 0.35 to 0.5 for peats, and 0.20 to 0.35 for organic soils. These treatments of the shear strength ratio of peats in Japan have become one of the factors of instability of embankment on peaty grounds. It is needless to say that such stability issues would be improved if the shear strength ratio of peats could be estimated more appropriately.

This paper presents a study on an easy method for estimating the shear strength ratio of peats. In this paper, the idea of the method is first presented, and then in order to evaluate the idea, test results of a series of constant volume ring shear tests are discussed. Based on these examinations, an easy method which does not require the traditional means such as a series of consolidated undrained triaxial compression tests is proposed. Satisfactory results are also shown in the application of the method to the field data.

AN IDEA OF ESTIMATING THE SHEAR STRENGTH RATIO OF PEATS

It has been well known that for clays, a linear relationship exists between the void ratio e after consolidation and logarithm of the consolidation pressure p in the range of normal consolidation. Moreover, it has been also known for a relatively long time, and it has been well evaluated by laboratory tests on many clays, that a linear relationship exists between e and logarithm of the undrained shear strength c_u in the range of normal consolidation. It is needless to say that this e - log c_u line is parallel to the e - log p line as schematically illustrated in Fig. 1. Because, the undrained shear strength c_u of normally consolidated clays is proportional to the consolidation pressure p as formulated in Eq.(1).

$$c_u = m \cdot p \tag{1}$$

Here, we perceive that the horizontal distance between these two lines corresponds to the shear strength ratio m of a given clay. Using this property, the value of m of a given soil can be easily estimated as