YIELDING OF LIME STABILIZED CLAYS

Member	A. Satoh	Saga University
Member	B. Buensuceso	Saga University
Member	N. Miura	Saga University

I INTRODUCTION

In the study of the stress-strain behavior of soils, regions of elastic and plastic strains are delineated by the yield stress. Fig. 1 shows the yield curve for Leda clay as reported by Mitchell (1970). More recently, Diaz-Rodriguez et al (1992) found that the characteristic shape as that in Fig. 1 applies for numerous clays with friction angles ranging between 17.5 to 43 degrees. This paper presents the results of an experimental study carried out for the purpose of verifying the concept of yielding on lime stabilized clays. To determine the yield curve for lime stabilized clays, a series of triaxial consolidation tests using a variety of stress paths, were conducted.

II EXPERIMENTAL DETAILS

The base clay used was soft Bangkok clay, with the following physical properties: ω=86%; ω_L=104%; I_P=63%; and G_s=2.68. Lime stabilized samples were prepared with quicklime contents of 5% and 10% (percent of dry weight of soil) and cured for one month. Triaxial tests were done on 38mmϕ x 76mm high specimens. Prior to consolidation, specimens were saturated using a back pressure of 2 kgf/cm^2. A total of 12 stress-controlled, anisotropic consolidation tests were carried out, along stress paths corresponding to constant stress ratios η (=q/p') from 0 to 1.25. For the anisotropic consolidation tests, the changes in cell pressure and the axial load were applied simultaneously such that a constant stress ratio was maintained throughout the consolidation process.

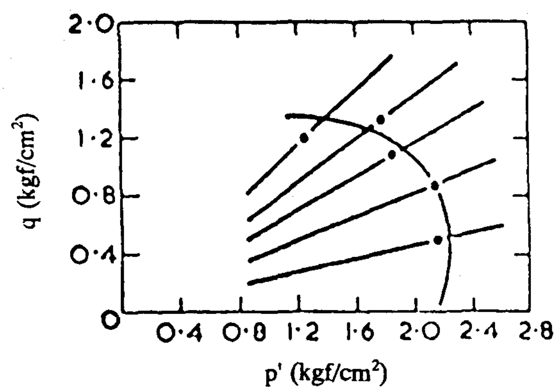

Fig. 1 Typical yield curve for natural clay (After Mitchell, 1970)

III RESULTS AND DISCUSSIONS

Figure 2 shows typical volumetric strain-mean normal stress ($p'=(\sigma_1'+2\sigma_3')/3$) relationships observed in anisotropic consolidation tests, with η=0 to 1.25. From the ε_v-log p' curves, volumetric yield points were estimated, in a manner similar to the Casagrande method of determining the preconsolidation pressure for oedometer tests. The values of (q,p') at yield for various stress ratios are shown in Fig. 3. In addition, stress paths for another series of consolidated undrained triaxial compression tests carried out by Buensuceso (1990) are superimposed in Fig. 3. These stress paths for samples consolidated to p_o'=0.5 and 1.0 kgf/cm^2 (<p_y') correspond to elastic behavior up to failure, and the peak strengths were then used to approximate the upper part of the yield curve in the overconsolidated range.

The volumetric yield loci for lime stabilized clay are of elliptical shape, and not centered on the p'-axis but on a line corresponding to some high value of stress ratio. This characteristic shape of yield curve is similar to the limit state curves for natural clays presented by Mitchell (1970) and Diaz-Rodriguez et al (1992).

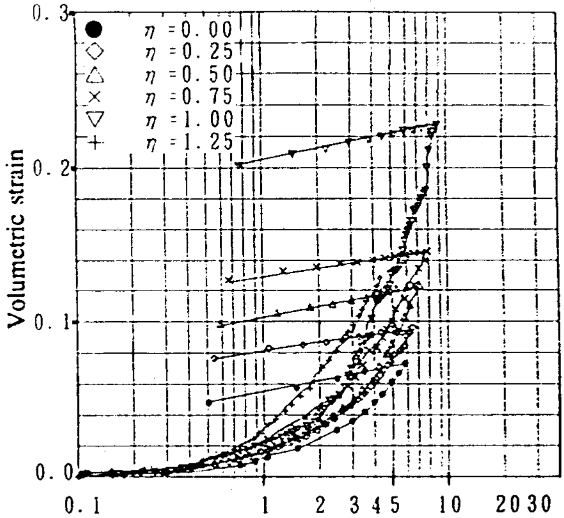

Fig. 2 Volumetric strain–mean normal stress relationships

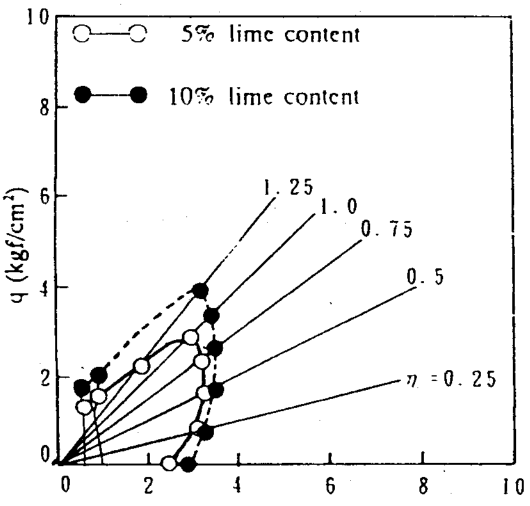

Fig. 3 Yield curves for lime stabilized clays

The magnitude of yield curves for natural clays have been reported to be controlled by the preconsolidation pressure of the clay (Diaz-Rodriguez et al, 1992). Since lime stabilization has been found to result in significant increases in preconsolidation stress (Buensuceso et al, 1991), the stress region of the elastic behavior for lime stabilized clays can be expected to be much larger after stabilization. The yield curve in Fig. 3 indicates elastic behavior for lime stabilized clays even up to moderately high stresses of several kgf/cm^2. Compared with 5% lime content, Fig. 3 also shows that the addition of a higher lime content of 10% results in the expansion of the yield curve, although the characteristic shape is retained. Such findings provide some justification on the use of elastic properties for lime stabilized soil columns for the analysis of settlements of DJM improved ground (Sakai et al, 1991).

IV CONCLUSIONS

The results presented in this paper show the validity of the concept of yielding for lime stabilized clays, and suggest the possibility of the yield curve approaches to the modelling of the behavior of lime stabilized ground. It was also shown that the magnitude of the yield curve defines a relatively large stress region of elastic behavior, which may justify the use of elastic properties for lime stabilized columns for the analysis of settlements of DJM improved ground.

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