DYNAMIC POISSON'S RATIO OF SOIL

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SUMMARY

Poisson's ratio is very important constant for grasping information related to stress and deformation of soil. The authors therefore developed one measuring apparatus, utilizing the existing dynamic triaxial test equipment for the purpose of detecting Poisson's ratio of soil. Through experimental and theoretical review the technique has been put into practical use by the authors. In result the authors realize that the measuring method with use of the apparatus is handy and fairly effective.

This paper intends to present the ratios of various test samples measured by the system with addition of review by the authors.

INTRODUCTION

Poisson's ratio is, as well known, defined as ratio of axial strain εa to radial strain εr and expressed in the following equation.

$$\nu = -\frac{\varepsilon r}{\varepsilon a}$$

Notwithstanding that the ratio is indispensable for grasping stress and deformation characteristics of soil, example of direct measurement is rare due to difficulty in the measurement along the definition. The following is to introduce the measuring apparatus the authors developed and to compile the ratios of soils measured with use of it.

THE APPARATUS AND TEST PROCEDURES

The equipment is an axially-vibrating dynamic triaxialtest apparatus. Schematic of the measuring cell is shown in Fig. 1. In this apparatus axial strain εa is obtained by linear variable differential transformer (L.V.D.T.) and radial strain of which direct measurement is difficult is derived from measurement of volumetric strain εv. In other words, the apparatus intends to seize volume change resulted from loading onto test sample as water level change, namely fluctuation of float and to detect the fluctuation by high precision gap sensor.

Test condition is that frequency of loading be 0.25 Hz Sin wave and that it is given 10 repetitive cycles. Also, as a rule, cohesive soil is tested in undrained condition and sandy soil is done in drained condition.

TEST RESULTS

All samples used for the test were in saturated condition. Test results of cohesive soils and sandy soils are shown in Fig. 2 and Fig. 3 respectively. They are all shown as Poisson's ratio against shear strain γ. Fig. 2 is the

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results of undisturbed normal consolidation alluvial cohesive soils and shows values nearly $\nu = 0.5$ as generally told. Fig. 3 is the results of alluvial and diluvial sandy soils in either reconstituted or undisturbed condition. It shows rather increasing tendency as γ increases as shown in the figure. Also, it shows considerably wide variety of value due to difference of individual samples in their physical properties, dilatancy characteristics and, moreover, due to different drain condition resulted from rate of loading.

Fig. 4 is the result of study on strain dependence of Poisson's ratio due to difference in confining pressure and principal stress ratio concerning Montrey No. Zero Sand and Japanese Toyoura Sand. The authors noticed Poisson's ratios of sandy soils when $\gamma = 10^{-3}$ and studied the relation to confining pressure and to water content. The results are shown in Fig. 5.

The ratio can be obtained by the apparatus is in the range $\gamma = 10^{-4}$ up to 10^{-2}. In order to find the ratio where $\gamma < 10^{-4}$ the authors conducted PS logging at the same place where the test pieces were sampled. The ratio obtained from the results of the PS logging is added to Fig. 6 for ~~reference~~.

CONCLUSIONS

From the preceding results Poisson's ratio of soil is compiled as follows.

1. Whether or not soil is sand or clay the ratio shows $\nu = 0.5$ when it is saturated and kept in perfect undrained condition.
2. The ratio of sand in satisfactory drain condition shows around 0.3 and it is expressed as function of confining pressure ($\sigma c'$), principal stress ratio (R) and shear strain γ in the following equation.

$$\nu \fallingdotseq f(\sigma c') \cdot \gamma^{g(R)}$$

3. The ratio obtained by dynamic triaxial drained test has close relation with water content of the sample because all samples are not necessarily in satisfactory drain condition.

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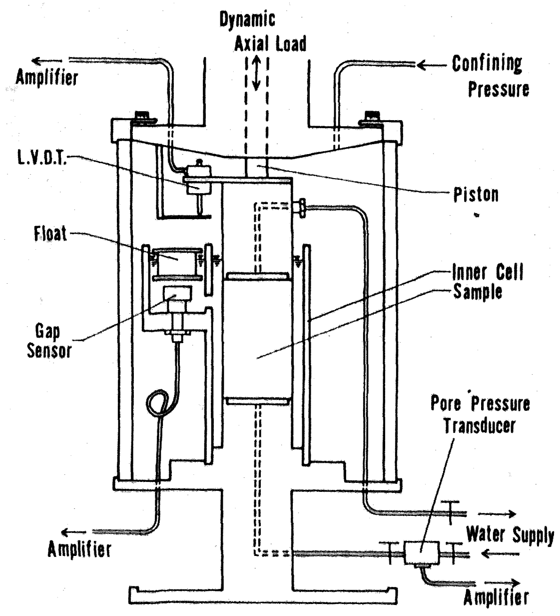

Fig. 1 Schematic view of the cell

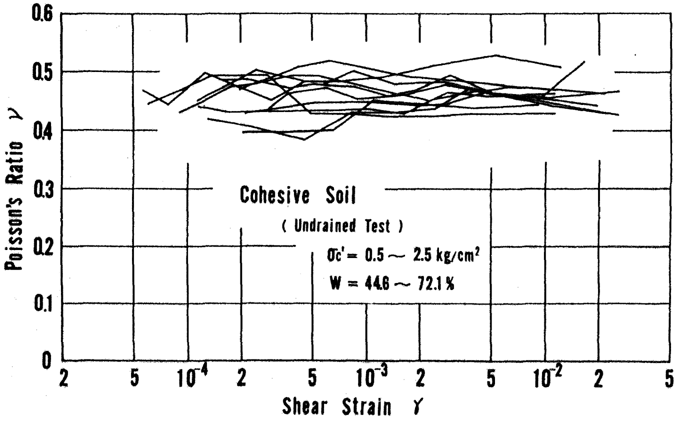

Fig. 2 Shear strain and Poisson's ratio

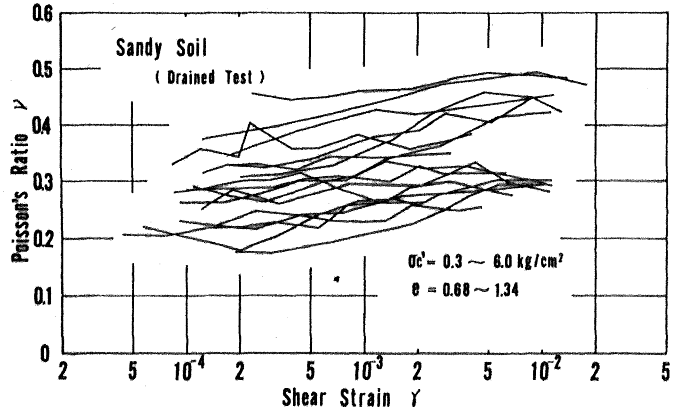

Fig. 3 Shear strain and Poisson's ratio

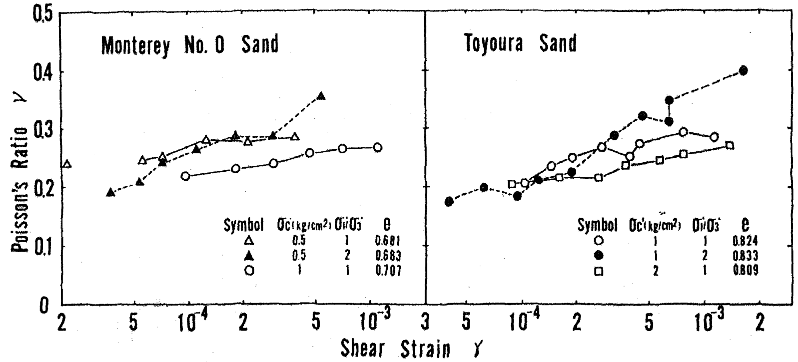

Fig. 4 Shear strain and Poisson's ratio

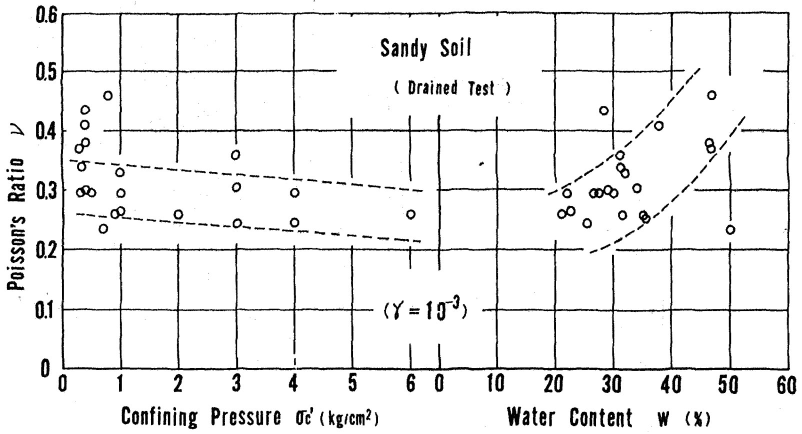

Fig. 5 Confining pressure, water content and Poisson's ratio

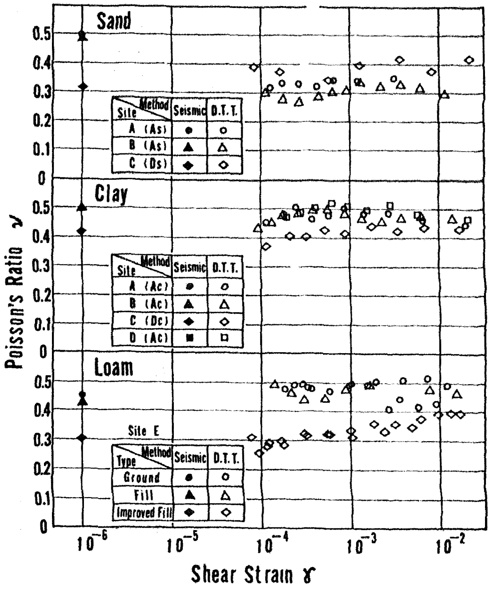

Fig. 6 Poisson's ratio obtained by seismic method and dynamic triaxial test