Exploration of Soil Mechanics Triaxial Test Teaching

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Abstract: The soil mechanics course offers soil density test, water content test, soil liquid plastic limit test, consolidation test, direct shear test. Triaxial test of soil is not available, but it is widely used in geotechnical engineering. In my spare time, I open the soil mechanics laboratory to teach students to learn soil triaxial experiment, which is helpful for students to adapt to the future engineering practice. The strength, deformation and pore water pressure of soil samples can be measured by Tsz30-2.0 strain - controlled triaxial apparatus. Through the experiment, students can master the purpose of the three-axis experiment, equipment composition, soil sample preparation, instrument characteristics, operation steps, data analysis, etc. Through the study of triaxial experiment, students' interest in learning, engineering practice ability and teaching quality are improved.

1. Introduction

Soil mechanics is a basic course of civil engineering specialty, and soil mechanics experiment is an important part of this course. In the course of soil mechanics, the following experiments are offered: density experiment, water content experiment, liquid plastic limit experiment, consolidation experiment and direct shear experiment. Triaxial test of soil is not available within the class, but it is widely used in geotechnical engineering. I open the soil mechanics laboratory in spare time and teach students how to use Tsz30-2.0 strain controlled triaxial apparatus to measure the strength, deformation and pore water pressure of soil samples, so as to cultivate students' practical ability, broaden students' scope of knowledge and stimulate students' interest in learning, and improve the experimental teaching guarantee system,

2. Specific Implementation Process

2.1 Firestly, I Lead the Students out of the Campus and into the Construction Site.

We understand the geological investigation and construction site conditions, the principles and operating methods of mechanical equipment used, and the equipment exploration process. We master the collection method and preservation method of experimental soil samples. We also collect a large number of geological exploration data at different exploration sites and at different stages of the same exploration site. These works supplement the contents that are not found in textbooks, enrich the teaching activities and fill in the gaps of experimental teaching knowledge. Partial collection pictures are shown below.

Through the practical investigation project, the students have the following harvest of geotechnical investigation.

One, the students clarify the operation sequence of sampling from top to bottom in geological exploration.

Two, the students made it clear that from the surface to the deep underground, the soil gradually changed into gravel and then into rock.

Three, the students realize that the soil gets harder and harder from the surface to deep underground, and the difficulty of sampling increases with depth.

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Four, the students realize that the foundation layer should be selected according to the load of the superstructure.

Five, the students know the shape of engineering geology drilling vehicle, and master the principle of static touch and hammer test.

Six, the students clearly understand the application range of thin and thick wall sampling edge.

Figure 1. Exploration of the scene

Figure 2. Soil samples of different depths

2.2 Secondly, the Practical Engineering is Taken as an Example in the Experimental Teaching of Soil Mechanics.

Through engineering examples I explain the characteristics of soil and related mechanical indicators, as well as engineering problems and so on. In this way, it reflects the real characteristics of soil, deepens students' understanding of soil properties, and achieves good results.

2.3 Thirdly, I Open the Soil Mechanics Laboratory in Spare Time and Teach Students How to Use Tsz30-2.0 Strain Controlled Triaxial Apparatus.

I instructed the students to conduct the non-consolidation and non-drainage experiment, and to measure the strength, deformation and pore water pressure of the soil samples. Through the experiment, students can clearly understand the purpose of the experiment, equipment composition, soil sample preparation, instrument characteristics, operation steps, data analysis, etc.

First, the experiment purpose is to use Tsz30-2.0 strain - controlled triaxial apparatus to test the strength, deformation and pore water pressure of soil samples. According to different drainage conditions, it can be used as unconsolidated undrained shear (UU), consolidated undrained shear (CU) and consolidated undrained shear (CD) [1].

Second, the equipment is made up of experimental machine, measuring ring, pressure chamber, three-axis measuring and controlling instrument, measurement and control cabinet, and soil sample preparation tool.

Third, preparation of soil samples. The conventional triaxial compression test is to prepare 3-4 cylinder samples. The triaxial compression test is suitable for fine grained soil and coarse grained soil with particle size less than 20mm. In order to adapt to samples of different particle sizes, the size specifications of domestic triaxial compression apparatus are shown in table 1 [1].

Table 1 Specification for triaxial compression specimens

Test sample type	Small soil sample	Medium soil sample	Large soil sample
Diameter(mm)	39.1	61.8	101

No matter the size of the sample in axial compression test, a principle is followed, that is, the ratio of height to diameter of the sample is guaranteed to be between 2.0 and 2.5. If small soil samples are used, the length of undisturbed soil samples needed for a set of triaxial compression tests should be about 40 cm.

Fourth, Tsz30-2.0 strain control triaxial instrument is a new type of mechatronics integrated instrument designed and manufactured in accordance with standard for geotechnical test methods.

One, the triaxial test can be done either at medium pressure (2MPa) or at low pressure (0-1MPa), which can meet the needs of high DAMS and large projects in water conservancy projects [2].

Two, the triaxial apparatus can be used for both fine-grained and coarse-grained soil tests.

Three, all the instruments are single-phase 220v-50hz.

Four, there is no need for air compressor or other pressure source, the instrument is controlled by sensor through measuring and controlling instrument.

Five, easy to operate, on the pressure measurement using electrical measurement number display numerical control, so the instrument hydraulic system pipelines and valves are few.

Six, instrument testing machine set testing machine and gearbox as one, with small volume, light weight, small vibration, low noise, suitablity for indoor or on-site use.

Seven, high pressure resistance and low wear resistance.

Eight, Maximum energy saving and consumption reduction, the whole machine input power is less than 300w.

Fifth, experimental procedure.

One, during the triaxial experiment, the prepared soil samples are wrapped with rubber film and placed in the pressure chamber. Then, certain ambient pressure and back pressure, as required, are applied to the soil samples. The working table, lifting plate, of the experimental machine rises at a certain rate until the soil samples are destroyed [3]. In the experiment, the force loop measures the axial force applied to the soil sample.

Two, the surrounding pressure and back pressure of the soil sample are applied with water as the medium. The pressure value is set by the measurement and control instrument and the electric pressure regulating cylinder is controlled by the sensor.

Three, pore water pressure is tracked and measured by piezoresistive sensor, and the measured value is displayed automatically on the measuring and controlling instrument panel.

Four, the axial deformation of the soil sample after compression is measured by a dial scale from 0 to 30mm.

Five, in the experiment, the volume change of the soil sample is obtained by measuring the amount of water discharged from the anti-pressure variable pipe or the volume variable pipe when adding the anti-pressure.

Sixth, observe experimental data and graphs. The relation curve of principal stress axial strain and envelope of unconsolidated undrained shear strength can be obtained by unconsolidated undrained shear strength (UU) experiment [4]. The peak point of the axial strain relation curve of principal stress is the compressive strength of soil under different confining pressures, as shown in figure 3. The envelope of unconsolidated and undrained shear strength is a horizontal line whose intersection with the vertical axis corresponds to the c value of soil strength parameter, as shown in figure 4.

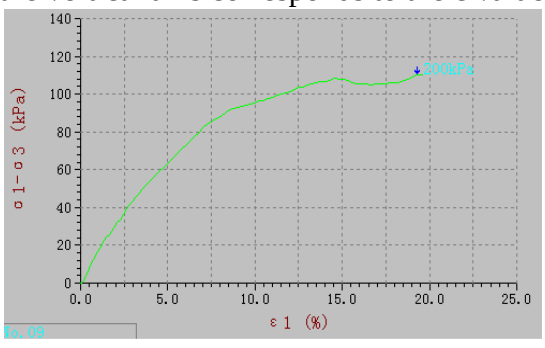

Figure 3. Axial strain relation curve of principal stress

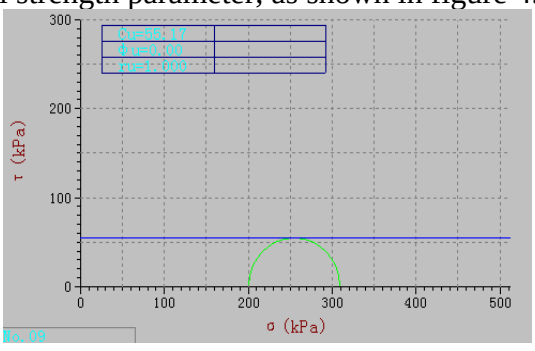

Figure 4. Envelope of unconsolidated and undrained shear strength

3. Features and Innovations

As an experimental teacher, I go deep into the first line of the practical investigation project. I strengthen the study of practical engineering and participate in the collation of experimental data of practical engineering, so as to lay a good foundation for enriching the teaching content and make the combination of theory and practice closer.

Through the experiment, let students know Tsz30-2.0 strain controlled triaxial instrument used to measure the strength, deformation and pore water pressure of soil samples. According to different drainage conditions, it can be used as unconsolidated undrained shear (UU), consolidated undrained shear (CU) and consolidated undrained shear (CD) [5]. The equipment has strict operation requirements and complex operation steps, which are connected with the computer integration module to directly display and print some physical technical indicators. The three-axis experiment has a small error and high precision, but the operation time is long, which requires group cooperation to complete the experimental task.

4. Conclusion

Through the opening of the laboratory, students can master the equipment principle, use method and mechanical parameter measurement of Tsz30-2.0 strain control triaxial instrument, thus improving students' interest in learning, enlivening the classroom atmosphere, helping students to deepen memory, and playing a good role in improving teaching quality.

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