True Triaxial Experiments of Coarse-grained Soils

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ABSTRACT

A new kind of true triaxial apparatus developed by Hohai University is introduced firstly, in which new load system with compound load plates are applied. The new test apparatus forms the ambient pressure by filling gas in the pressure chamber, the deviatoric stress $\sigma_1-\sigma_3$ of the sample was inflicted through the piston-cylinder of the axial pressure, and the deviatoric stress $\sigma_2-\sigma_3$ of the sample was inflicted through the pressure equipment of intermediate principal stress. So the first and the intermediate principal stress were composed by the overlapping of the ambient pressure and the deviatoric stress “$\sigma_1-\sigma_3$” and “$\sigma_2-\sigma_3$”. Series of true triaxial tests on fine gravel were performed based on the new apparatus.

The testing process was designed to simulate the real stress state of soils under complex stress state. In each team of tests, both the third principal stress $\sigma_3$ and intermediate parameter $b$ were kept unchanged and the first principal stress was increased until the failure occurs. There performed four groups of tests with different ambient pressure of 100kPa, 125kPa, 150kPa and 200kPa, with the constant ambient pressure in each group, intermediate parameter $b$ has been given the value of 0, 0.25, 0.5 and 0.75. On the basis of the tests, the influence of intermediate principal stress on the stress-strain relationship was studied. The relationship between the three principal strains and the strength parameters $\varphi$ and $M$ are analyzed.

KEY WORDS: Coarse-grained soils; true triaxial experiments; stress states; the intermediate principal stress.

INTRODUCTION

The conventional triaxial tests are widely used to investigate the deformation and strength behavior of various soils in the geotechnical engineering, and often the conventional triaxial apparatus is the fundamental testing device. With this type of devices, the load is usually applied from the major principal stress direction, the minor principal stress is supported by water pressure in the pressure chamber, however, the intermediate principal stress is neglected.

In fact, soil elements are under complex stress state in most conditions, the behavior of soil under general three-dimensional stress states is quite different from that of soil in axial-symmetric stress state, and thus a new kind of test method is demanded to take the influence of the intermediate principal stress into account, the method, which can reflect the real situation of soils relatively, is named the true triaxial experiment method. A number of true triaxial apparatuses are developed so as to do the true triaxial experiments, the appropriate soil constitutive models are required to describe the stress and strain relationship according to the tests results, and then to perform finite element analysis further. Therefore, true triaxial experiments are necessary.