Numerical simulation of unsaturated soil triaxial test based on a soil-water-air coupled analysis incorporating a void ratio-dependent SWC model

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ABSTRACT

In this study, to examine mechanical behavior of unsaturated soil, a series of triaxial tests was conducted and the soil-water-air coupled finite deformation simulation was performed. The simulation made use of a soil-water-air coupled finite deformation analysis code [1] incorporating the elasto-plastic constitutive equation, SYS Cam-clay model [2], in which suction effect is newly taken into account, and a soil water characteristic (SWC) model which is dependent on void ratio. The simulation treated a triaxial test as the solution for an initial and boundary value problem. A series of processes of suction decreasing, isotropic consolidation, and exhausted-drained shearing was simulated from a single initial condition using a single set of material constants.

Figure 1 shows the experimental and simulated results for the suction decreasing and isotropic consolidation processes. The plots "○" in the figures show the state just before isotropic consolidation process. The simulation reproduced well the experimental results including variation with time. In the case of suction p^s = 10 kPa, the experimental results showed volumetric compression behavior with water absorption even under the constant suction condition, which can be simulated by using the void ratio-dependent SWC model. In the experiment of the exhausted-drained shearing, volumetric compression behavior with water absorption were also observed, which can be simulated well, though the results are omitted here because of space limitation. Thus, the simulation reproduced well both the mechanical and hydraulic behavior.

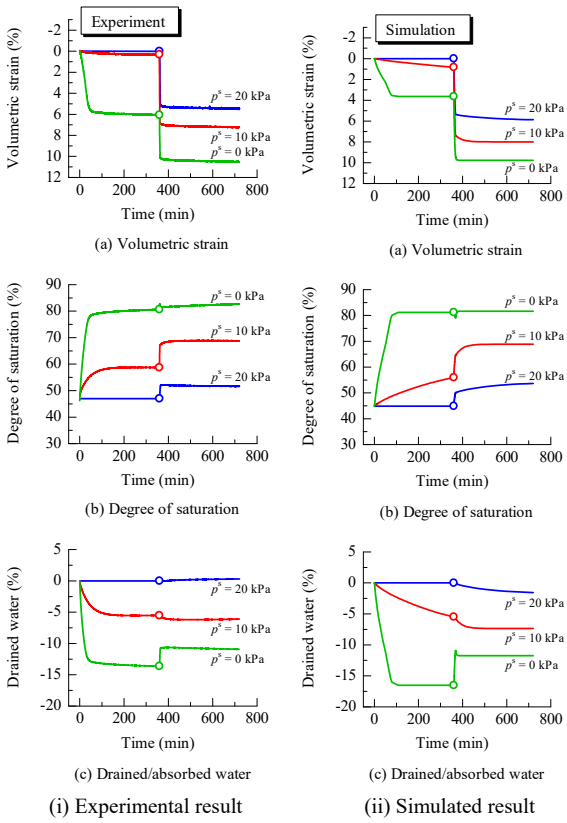

Fig. 1. Results of suction decreasing and isotropic consolidation

REFERENCES

[1] Noda, T. and Yoshikawa, T., "Soil-water-air coupled finite deformation analysis based on a rate-type equation of motion incorporating the SYS Cam-clay model" *Soils and Foundations*, Vol. **55**, No. 1, pp. 45–62, (2015).

[2] Asaoka, A., Noda, T., Yamada, E., Kaneda, K. and Nakano, M., "An elasto-plastic description of two distinct volume change mechanisms of soils" *Soils and Foundations*, Vol. **42**, No. 5, pp. 47–57, (2002).