Different coarse-grained contents affect mechanical characteristics of frozen soil under freeze-thaw cycles

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Frozen soil in nature is a multiphase composite geomaterial consisting of mineral solid particles, ice crystals, unfrozen water, and porous air. In cold regions, the deformation properties of frozen soils with different coarse-grained contents change significantly under the freeze-thaw cycles.

Recently, a research team from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences (CAS) conducted a series of cryogenic triaxial compression tests to investigate the deformation characteristics of frozen soil at -10℃ experiencing freeze-thaw cycles.

The study was published in *Acta Geotechnica* on Feb. 24.

The researchers proposed a micromechanical-based constitutive model to describe the mechanical response of frozen soils with different coarse-grained contents subjected to different freeze-thaw cycles.

Low-temperature triaxial compression tests on frozen soils demonstrated that the variability of mechanical and deformation properties was closely related to the confining pressure, coarse-grained contents, and freeze-thaw cycles.

They found that for a given coarse-grained content and the freeze-thaw period, the stress-strain response was nonlinear, elastoplastic with strain hardening and volumetric compaction followed by dilatancy.

In addition, the confining pressure was also an important factor affecting the mechanical properties of frozen soil. Therefore, the researchers used the proposed model to predict the stress-strain curves and volumetric strain curves of frozen soil under 0.3 MPa and 1.4 MPa confining pressures, respectively.

Results showed that the proposed model could well predict the relation between deviatoric stress and axial strain, and the relation between volumetric strain and axial strain.

More information: Dan Wang et al, Micromechanics-based binary-medium constitutive model for frozen soil considering the influence of coarse-grained contents and freeze–thaw cycles, *Acta Geotechnica* (2023). DOI: 10.1007/s11440-023-01831-6

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