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Standard Test Method for Laboratory Determination of Strength Properties of Frozen Soil at a Constant Rate of Strain[1]

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INTRODUCTION

Knowledge of the stress-strain-strength behavior of frozen soil is of great importance for civil engineering construction in permafrost regions. The behavior of frozen soils under load is usually very different from that of unfrozen soils because of the presence of ice and unfrozen water films. In particular, frozen soils are much more subject to creep and relaxation effects, and their behavior is strongly affected by temperature change. In addition to creep, volumetric consolidation may also develop in frozen soils having large unfrozen water or gas contents.

As with unfrozen soil, the deformation and strength behavior of frozen soils depends on interparticle friction, particle interlocking, and cohesion. In frozen soil, however, bonding of particles by ice may be the dominant strength factor. The strength of ice in frozen soil is dependent on many factors, such as temperature, pressure, strain rate, grain size, crystal orientation, and density. At very high ice contents (ice-rich soils), frozen soil behavior under load is similar to that of ice. In fact, for fine-grained soils, experimental data suggest that the ice matrix dominates when mineral volume fraction is less than about 50 %. At low ice contents, however, (ice-poor soils), when interparticle forces begin to contribute to strength, the unfrozen water films play an important role, especially in fine-grained soils. Finally, for frozen sand, maximum strength is attained at full ice saturation and maximum dry density (**1**).[2]

1. Scope*

1.1 This test method covers the determination of the strength behavior of cylindrical specimens of frozen soil, subjected to uniaxial compression under controlled rates of strain. It specifies the apparatus, instrumentation, and procedures for determining the stress-strain-time, or strength versus strain rate relationships for frozen soils under deviatoric creep conditions.

1.2 Values stated in SI units are to be regarded as the standard.

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.3.1 For the purposes of comparing measured or calculated value(s) with specified limits, the measured or calculated value(s) shall be rounded to the nearest decimal or significant digits in the specified limits.

1.3.2 The procedures used to specify how data are collected/recorded or calculated, in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analytical methods for engineering design.

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.19 on Frozen Soils and Rock.

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[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

***A Summary of Changes section appears at the end of this standard**

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