The mechanical behaviour of frozen earth materials under high pressure triaxial test conditions

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O. B. Andersland, Michigan State University and Bernard D. Alkire, Michigan Technological University

The Authors are to be commended for their work on a difficult experimental problem and the useful data which have been derived therefrom. Some additional work at Michigan State University supports their results and appears to provide some insight concerning unanswered questions in the low stress region. All samples tested by the Authors were ice-saturated which served to emphasize the influence of pressure melting and ice-water phase transition on the mechanical behaviour of the frozen soil. The other extreme would be dry samples which should give a behaviour similar to unfrozen soils under high pressures.

Data showing the influence of confining pressure and an intermediate degree of ice saturation on peak deviator stress for 20-30 Ottawa sand are given in Fig. 1. A uniform increase in peak deviator stress, regardless of the confining pressure, shows that the change in strength is primarily because of an increase in ice content. Pressure melting appears to have a negligible effect for confining pressures of 700 lb/sq. in. since the increase in peak deviator stress was the same for the two values of ice saturation. The significance of this data becomes more apparent when maximum principal stress ratio is plotted against confining pressure for the three levels of ice saturation shown in Fig. 2. Comparisons with data for the unfrozen Ottawa sand show that the cohesive component because of the ice becomes very small at confining pressures approaching 1000 lb/sq. in. This would suggest that at stresses greater than 1 kip/sq. in. the shear strength

Fig. 1. Relationship between deviator stress at failure and ice saturation for Ottawa sand at four levels of confining pressure

Fig. 2. Relationship between principal stress ratio at failure and confining pressure for Ottawa sand at three levels of ice saturation