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Discussion on Moderator's Report

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standing the different development of superficial ruptures on grounds covered by housing which generally is much smaller than that in the free ground surface. Using information from other earthquakes like the Liao Ning (M = 7.4, February 4, 1975) the mechanism of tectonic ruptures in the top soils is assessed as being not directly associated with the deeply embedded conservative faults. The analysis of the mechanism of the recurrence of surface faulting required a real decipher work in assessing correlations with prehistorical faultings. Several other important findings should be mentioned. Velocity of ground movement near failures generally suddenly diminish and contributing to erratic behaviour in which surface rupture has nothing to do with damage on the ground level. Nevertheless, the multiple effect of the such major endamaging motion (magnitude 7.8) is referred by several papers in this session and could not be concluded in analyzing only a section outside of the whole complexity.

I am confident that later the different researchers will summarize in a national symposium or by other means for the benefit of all scientific community the multiple lessions from Tangsham earthquake and the explanation for the size of the disaster connected with this.

Discussion by Peter M. Byrne,
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Canada, on Moderator's Report.

Dr. Arulanandan in his report suggested that our method of evaluating liquefaction resistance based on dilation angle, and reported in our paper to this conference, Vol. 1, pp. 161-165, is no good because it is based on relative density and blow count. In fact, in our paper we go to some trouble to point out that neither relative density nor blow count is a very desirable measure of liquefaction resistance. This is because although relative density can readily be measured in the laboratory, it is very difficult to measure in the field. Conversely, blow counts are readily obtained in the field but are generally not appropriate in the laboratory and hence cannot be correlated with laboratory cyclic resistance data.

We are proposing instead that dilation angle be used as a measure of liquefaction resistance. Dilation angle is a measure of the rate of expansion or contraction of a sand on shearing and can be obtained in the laboratory from drained triaxial or simple shear tests. In the field it can be obtained from self-boring pressuremeter tests.

Loose sands have a low or negative dilation angle reflecting their tendency to decrease in volume during shearing whereas dense sands have high dilation angles, 20 degrees or more, reflecting their tendency to expand when sheared. By preparing samples of Ottawa sand over a range of densities and by obtaining both their liquefaction resistance from cyclic undrained tests and their dilation angle from drained tests, the liquefaction resistance was obtained in terms of dilation angle as shown in the attached Figure 1. The relative density of the samples is also shown as a matter of interest.

By determining dilation angles in the field from self-boring pressuremeter tests, an estimate of the insitu liquefaction resistance of sand can be obtained from Figure 1. This is the basic concept presented in our paper.

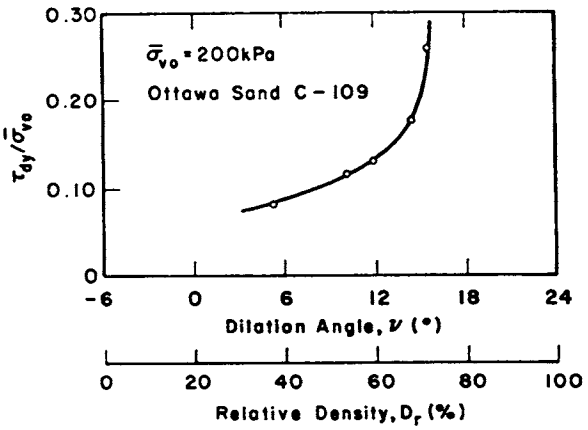

Figure 1