SESSION 8: SOIL PROPERTIES

Papers:

THE WATER JET PENETRATION TEST : A FIELD TEST OF LOESS ERODIBILITY
S.P.A. Harrison and J.K. Hill; vol.1, 163-164

COMPACTION PROPERTIES OF BAY OF PLENTY VOLCANIC SOILS
S.M. Parton and A.J. Olsen; vol.1, 165-169

FRICTION AND COHESION PARAMETERS FOR HIGHLY AND COMPLETELY WEATHERED WELLINGTON GREYWACKE
M.J. Pender; vol.1, 171-175

THE BEHAVIOUR OF A COMPACTED TERTIARY SILTSTONE UNDER SEISMIC LOADING
D.V. Toan and J.P. Blakeley; vol.1, 177-183

Paper by S.P.A. Harrison and J.K. Hill

Prof Yamanouchi commented that, in Japan, a device similar to the water jet penetration test was contrived in 1968. However the test method was stopped since it did not give a good indication of erodibility. This could be shown by the comparison of test results from two soils, a pumice soil (Shirasu) and a less erosive soil (decomposed granite soil). Mr Hill agreed that there was a problem with water jet penetration when material was greater than sand size. They had found a tendency to get a bi-modal result, the first mode based on penetration of the finer material, which in the case of loess is silt, and the second mode based on the granular material. So in material of mixed size fractions the test was probably of limited use.

Mr Redmayne asked whether the author had investigated the sensitivity of the test to variations in test conditions such as water pressure, jet fan angle, and distance of nozzle from loess face, and whether the author foresaw any application for this test in other deposits such as silt and sands. Mr Hill confirmed that various distances to the loess face and various nozzle sizes, together with other factors, had been examined. This standard condition had been settled on because it was found that the jet diameter gave a penetration response which could cope with a range of resistances and was economical in the use of water. It was a very arbitrary procedure.

Paper by I.M. Parton and A.J. Olsen

Dr L.D. Wesley commented that aspects which should usually be emphasised when evaluating soils often did not apply to volcanic and residual soils and the effects of drying processes varied for different test methods. Water content should not be taken as a major indicator of the suitability of volcanic material. Indeed, in some situations tests were not required. In Indonesia in the 1920's a high allophane clay was used in the construction of a dam without comprehensive laboratory testing, and it proved to be successful. However trained inspectors were required.

Mr M.T. Mitchell suggested that the drying of soils to zero water content was possible only under conditions of zero humidity. The authors had indicated that BS1377 allowed complete air drying of compaction test samples. He disagreed with this interpretation. An important consideration raised was the question of what was a conservative standard. He suggested that the justification of laboratory based procedures on the grounds that they led to a conservative standard, was in his opinion a dangerous one. In many cases it would lead to added costs to be borne by the contractor. This would then lead to a deterioration of the relationship between the contractor and the designer/inspector. Mr Olsen said that the standard was open to interpretation. The reasons why they had had to resort to air drying methods was to get sensible results. Dr Parton added that, provided the contractor maintained control, dried soil approaching optimum moisture content could be little different from the required values.

Dr J.G. Hawley commented that the paper furnished examples from a particular site of the phenomena described by K.R. Birrell in the Transactions of the Royal Society of New Zealand 1951 under the title "Physical Properties of New Zealand Volcanic Ash Soils"

Paper by M.J. Pender

Dr L.D. Wesley and Mr P.A. McAnally commented that the cohesion value might be a function of the specimen size. Dr Wesley mentioned work that had been done at Imperial College in which it was found that specimens with diameters considerably greater than 100mm were required to obtain a representative value of the cohesion parameter. Back analysis of observed failures had been found to give cohesion values which related well to the values obtained from large specimens. Mr McAnally referred to statistical considerations which also suggested that large specimens might be required to get a reliable measurement of cohesion. The author agreed that this was probably true for the Wellington greywacke, but he could not see the resources being available to do tests on large specimens. Not only would this require large triaxial equipment, which was available in NZ, but also large sampling equipment. Because of the nature of the material it was not possible to carve large block samples from pits as could be done for a heavily overconsolidated clay. Since the first results suggested that the effective stress ....

friction angle could be predicted with some confidence, back analysis of an observed failure could be used to determine which cohesion value was operational. However, as effective stress parameters were required it was necessary to have good information on the in situ pore water pressures at the time of failure. This was not likely to be available for the Wellington materials.

A member of the audience asked Dr Pender to indicate why he believed that cohesion was variable. It was suggested that the data he presented might equally support the view that the test method was inadequate to determine an, in fact, relatively constant (or predictably variable) cohesion. The author replied that the test method, the consolidated undrained triaxial test performed on a number of specimens, provided information from which the effective stress friction angle and cohesion could be determined. The major finding of the paper was that the friction angle correlated well with the void ratio or density of the material whereas the cohesion did not. Perhaps the cohesion correlated with some other variable not considered, or as mentioned in the presentation of the paper, perhaps the cohesion parameter was very sensitive to the small sampling and specimen preparation disturbance whilst the friction angle was not. If the variability of the cohesion was a consequence of limitations in the measuring system one would expect similar uncertainty to be apparent in the friction angle.

Dr Raisbeck asked whether Dr Pender had considered using a power law equation of the type $y = ax^n$ for the strength envelope. He believed that the data indicated that the mean value at the lower stress levels gave an unconservative strength for design. The author replied that he had not considered using the power law failure envelope as the data indicated, quite clearly, that for the wide range of stresses at failure a linear model was more appropriate. He had pointed out during the presentation of the paper that at very low effective stresses the failure points tended to fall below the linear extrapolation through the failure points at higher stresses.

Dr R.W. Johnston commented that, in a similar manner to Dr Pender, the values of c' and ø' of the Melbourne Mudstone had been correlated with the degree of weathering. However, instead of using the void ratio as a weathering index the saturated moisture content had been used. Comparing the values of c' against moisture content it could be seen that there was little correlation but the cohesion values for the Melbourne material were much higher than those for the Wellington material. This was not really surprising since cohesion was a function of many variables including the stress history, the bond type and cementation. These were understandably different in the two rock types. However, when comparing tan ø' with moisture content, it could be seen that the two materials behaved similarly, since ø' was a frictional property and since both the Melbourne mudstone and Wellington greywacke were composed of a significant silt sized component, this agreement might be expected.

Dr B.W. Riddolls of the Engineering Geology section of the DSIR Geological Survey informed the author that the mode of weathering of the Wellington greywacke was rather unusual. The matrix seemed to weather first leaving a predominantly sandy/silty soil which would not be expected to have a large cohesion. The weathering of other rock types tended to produce more clay size particles, and consequently a more cohesive soil. This would be accentuated with the weathering of a mudstone such as the Melbourne material described by Dr Johnston.

Paper by D.V. Toan and J.P. Blakeley

Mr P.J. Millar noted that Dr Toan had stated that pore pressure measurements were made during the cyclic loading stage of the tests. He assumed that these were taken at the base of the cell. He asked whether Dr Toan could give the magnitude of the pressures measured and whether he thought that these water pressures measured at the base of the cell gave an accurate measurement of the pore pressure within the specimen. Dr Toan confirmed that the pressures were measured at the base of the cell.