

## SESSION 9: SOIL PROPERTIES

### Papers:

THE EFFECTS OF DRAINAGE CONDITIONS AND CONFINING PRESSURES ON THE STRENGTH OF MELBOURNE MUDSTONE

H.K. Chiu and I.W. Johnston; vol.1, 185-189

CEMENT AND LIME STABILISATION OF MELBOURNE PAVEMENT SUBGRADE SOILS

J.E. Holland and C. Griffin; vol.1, 191-195

THE RELATIONSHIP BETWEEN MATRIX AND SOLUTE SUCTION, SWELLING PRESSURE AND MAGNITUDE OF SWELLING IN REACTIVE CLAYS

K.C. Pile; vol.1, 197-201

LOOKING FOR EXPANSIVE MINERALS IN EXPANSIVE SOILS: EXPERIMENTS WITH DYE ABSORPTION USING METHYLENE BLUE

G.S. Xidakis and I.J. Smalley; vol.1, 203-206

Paper by H.K. Chiu and I.W. Johnston

Dr M.J. Pender took up the comment by the authors and the information presented in Fig. 6 which tended to suggest that the mudstone displayed some of the features associated with the critical state idealisation of soil behaviour. He applied his mathematical model for the stress - strain behaviour of overconsolidated soil to the results given by the authors. The undrained triaxial test result for an effective consolidation pressure of 33.2MPa was used to fit the model parameters. It was then possible to calculate the undrained and drained response for other effective consolidation pressures. Although difficulties were experienced in the location of the critical state line (because the data provided in the paper were not sufficient for this) the general features of the behaviour were modelled well.

Dr Johnston replied that the use of critical state model for mudstone material was as yet undeveloped. Dilation had not been fully accounted for. This appeared to be due to the dilation having two components, the normal granular dilation component and another which appeared to be due to cracking of the material.

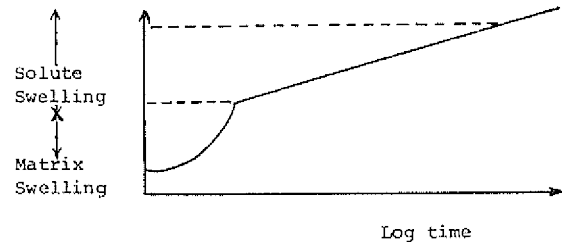
Mr M.C. Ervin asked if the reduction in the 'B' parameter with increasing confining pressures in Fig.1 could be explained. Dr Johnston replied that high confining pressures compressed the soil skeleton thus increasing intergranular contact points and decreasing the volume of the voids. Hence the ratio of compressibility of soil skeleton to water decreased, and 'B' was no longer equal to unity.

Dr Chappell commented that the curves in Fig.6 and 7 had a similarity to the work performed by Bieniawski (1965). In relation to critical state theory, where non-linearity began, one could use Rowe's stress dilatancy theory to determine the friction angle. That is, once non-linearity began, mechanistic processes were prevalent and minimum energy applied, while prior to this the critical state process was predominant. Dr Johnston replied that this approach had been used to determine the properties of harder materials and was being considered for the mudstone material. The results

appeared promising, but it was too early to draw any firm conclusions.

Paper by K.C. Pile

Mr P. McAnally commended the author for presenting a simple method of measuring the effects of matrix and solute suction. He suggested that matrix swelling occurred on a different time scale and hence it should be possible to separate it out on a swelling versus log time plot.



If the test was allowed to continue for sufficient time, the magnitude of solute swell could be estimated. The time involved in tests 8 and 9 and the value of the pressure during this time were queried. Mr Pile replied that the consolidation process was recorded as a straight line on a logarithmic plot. This could be due to salt diffusion. Tests 8 and 9 were performed over 13 days. However, during the last week there was no movement; the pressure during this time remained at 1kPa.

Prof I.B. Donald commented that, in consolidation testing of Yarra Delta Coode Island silty clay, distilled water was commonly used in the oedometer. This clay could have salt contents in the pore water of 40-60 g/litre; ie, 2.5 times sea water. If pairs of tests were carried out with pure water and salty water, very little difference showed up for test times of the order of a week, but if secondary consolidation was under investigation the measured rate was very dependent on the salt concentration used (roughly a factor of 2 was involved). Mr Pile measured his solute suction on a pure water extract. Was he confident that this water had the same ionic content as the pore water, or could salt sieving have produced appreciable diffusion? Mr Pile

replied that three methods of extraction were used to check the occurrence of salt sieving. These gave different results. The normal method was filtration/dilution. In a triaxial test the same answers were obtained. Therefore, under high pressure, salt sieving was not a problem.

Paper by G.S. Xidakis and I.J. Smalley

Mr G. Boyd asked whether the dye test was a real measure of clay type or was a better measure of the degree of dispersivity of a clay rich material, irrespective of mineral type. He also asked whether the contention that the dye absorption was a function of specific surface area could be shown in relative amounts of dye absorption with the series montmorillonite-illite-kaolinite. Dr Smalley replied that the dye absorption

technique was useful in distinguishing montmorillonite from low surface area clays but was not mineral specific. The properties predicted using this technique might not differentiate between allophanes and montmorillonites. Thus, a mineral analysis was necessary.

Dr B. Richards said that the CSIRO Division of Soils in Adelaide had tested a material where x-ray diffraction did not detect the presence of montmorillonite, but DTA did. The reason for this was that a saline solution could leach the potassium ions out of the illite giving an inter-stratified clay with properties like montmorillonite, thus clouding the x-ray picture. Therefore a gamma probe was used to determine inter-stratification. Dr Smalley replied that if cobalt was used for an x-ray target the presence of montmorillonite could be found.