SESSION 11: IN SITU TEST METHODS

Papers:

DEVELOPMENT OF A HIGH PRESSURE PRESSUREMETER FOR DETERMINING THE ENGINEERING PROPERTIES OF SOFT TO MEDIUM STRENGTH ROCKS
J.M.O. Hughes and M.C. Ervin; vol 1, 243-247

DETERMINATION OF THE ENGINEERING PROPERTIES OF THE COODE ISLAND SILTS USING A SELF-BORING PRESSUREMETER
J.M.O. Hughes, M.C. Ervin, J.C. Holden and R.J. Harvey; vol 1, 249-254

A DOWN HOLE PLATE LOAD TEST FOR IN SITU PROPERTIES OF STIFF CLAYS
J.N. Kay and P.W. Mitchell; vol 1, 255-259

Paper by J.M.O. Hughes and M.C. Ervin

Prof Ladanyi congratulated the authors for the development of the new high capacity pressuremeter, the need for which had been felt for a long time in rock mechanics. He showed a series of slides relating to similar work that he had carried out himself. He proceeded to comment on Fig.4 which showed that, under certain ground stress conditions, the rock would fail around the pressuremeter first by radial cracking to be followed later by crushing of the blocks between radial cracks. In other words, for rocks with the failure characteristics in Fig.4, the original Gibson-Anderson theory should be modified to take into account the radial cracking failure and eventually also the effect of dilatancy in the failure zone. It was noted that a complete theoretical solution for such a case was published recently (Ladanyi 1976* Figs. 1 & 2). He also mentioned that the pressuremeter device such as shown enabled the basic creep parameters to be determined, using the procedure developed and tested in another type of rock like material (Ladanyi and Johnston, 1973* Fig.3).

* Ladanyi, B. (1976) 'Quasi static expansion of a cylindrical cavity in rock' Proc 3rd Symposium : Engineering Applications of Solid Mechanics, CSCE - University of Toronto; vol 2, 219-240.

* Ladanyi, B. and Johnston, G.H. (1973) 'Evaluation of in situ creep properties of frozen soils with the pressuremeter' Proc 2nd International Conference on Permafrost, Yakutsk, USSR, North American Contribution; vol, NAS, 310-318.

Mr M. Mitchell commented that in developing and testing a new apparatus it was often useful to compare the results of the prototype with those obtained by similar and more established units. Other papers (Kay and Clegg) were cited where such a practice had been adopted. He asked the authors if they had compared their pressuremeter with the Goodman jack which he had understood to have been used extensively throughout the world since it was developed ten years ago. Mitchell believed that by doing this the advantages of the new apparatus as claimed could be verified. Mr Ervin replied that he had not seen the Goodman jack but that his co-author had. He added that the Menard pressuremeter results showed little difference.

Paper by J.M.O. Hughes, M.C. Ervin, J.C. Holden and R.J. Harvey

Prof Davis stated that he personally did not believe that even the best self-boring pressuremeter could be so good that it could bore in with a perfect fit. He described some problems in determining Po and suggested a simple method for determining Pr.

Mr N. Robertson said that it appeared that no field vane shear tests had been performed in the investigation reported. He asked whether any correlation had been performed on the undrained shear strengths as obtained by self-boring pressuremeter and by field vane shear tests on this or any other site. Referring to Fig.9, he felt that the Q_c/C_u ratio of 15 was encouraging with respect to his own experience in Queensland (although still requiring that the ratio was strongly site dependent). In Fig.9(a) the relationship $E = 200\ C_u$ had been used to obtain a relationship $E = 13.3\ Q_c$ for the elastic modulus from the static penetrometer. Mr Robertson asked whether the former relationship had been based on particular data or had simply been obtained from the generally accepted range of this relationsip. He said that the data tended to exemplify the value of the relatively cheap static cone penetrometer test particularly when used in conjunction with limited pressuremeter tests in an extended site. In reply, Mr Ervin showed a graph which gave a comparison with other available data of shear strengths obtained in Coode Island silts using a self-boring pressuremeter. He said that this had been the only attempt to correlate data and that no vane testing had been performed. With respect to Fig.9, Ervin said that the $Q_c/15$ used was his own value.

Mr G. East queried the difference between the various tests in determining the undrained Young's Modulus. All these tests had various rates of strain and mobilised different volumes of soil. He felt that some dissipation of pore pressure was highly likely during pressuremeter tests. He then asked whether, bearing in mind that compliance was negligible at high pressures, there was any significant difference between the pressuremeter shown and the high pressure Menard pressuremeter (10 MPa). In reply to the first question. Mr Ervin stated that the effect of pore pressure at depth was difficult to determine. In reply

to the second question, he said that the shape of the curve was the same.

Paper by J.N. Kay and O.M. Mitchell

Prof E.H. Davis commented that laboratory tests had an advantage over insitu testing in that the soil characteristics could be altered to obtain different results. The samples themselves however always suffered some disturbance. This could be due either to insertion of sampling tool, or to stress disturbance following removal of the sample from the natural environment. He stated that, to allow for stress disturbance, the sample should be put back into the proper stress state. On this point he questioned whether, in the triaxial stress tests performed by the authors, the samples had been put back into their original stress state. Prof Davis went on to say that he was convinced by the type of testing performed but was not clear that the test procedure for determining the effective stress or drained modulus E_s was different from determining E_u.

Mr Kay replied that the triaxial tests performed on the samples were brought back to allow for insitu stress. He said that the testing equipment, however, was limited to $K_o=1$. In reply to the second point, Kay described the difference between the drained and undrained tests and suggested that in the particular material tests, the drained test was of more interest.

Mr D. Brown complimented the authors on the experimental equipment and technique. However, he had doubts about the accuracy of some of the techniques adopted for the analysis of the results. In particular, he referred to the determination of a value of E_u which was illustrated in Fig.4 (b). The group of points used to define the slope E_u covered an interval of about 0.1mm which corresponded to 0.4 minutes and during this period Fig.4(a) indicated that a significant contribution to the settlement would have occurred progressively and would lead to a flatter slope and a lower value of E_u than the true value. He suggested that this could be reduced by using a faster rate of penetration or by a modification to the construction in Fig.4 (a) to make it suitable for a constant rate of penetration. Mr Kay agreed that there was a problem with the rate. He added that the test had been performed on relatively permeable silts and clays. He said that he would prefer another method. A modification would be to project the line back to the origin under a constant load.

Mr Pile quoted the case study of Adelaide's tallest building - the Grenfell Centre - of height 100m. At this site he stated that the consolidation settlement following completion had been zero, and that the computed elastic settlements had been double the actual settlements. The computations had been based on the elastic modulus found by conventional testing. Hence he felt that pressuremeter and plate testing were to be commended.