Selection of a suitable indicating fluid proved difficult. Mercury was rejected because its high specific gravity would cause undesirable changes in pressure as the mercury moved in the indicator. These changes would be particularly significant at low pressure deficiencies. Carbon tetrachloride (S.G. = 1.6) is ideal from a specific gravity point of view. However, carbon tetrachloride is colourless and hence it became necessary to find a dye which is miscible with carbon tetrachloride and immiscible with water. Machine oil fulfills these requirements, but it was found that on standing for a few days a milky deposit formed at the interface between the water and the mixture of oil and carbon tetrachloride. Iodine also proved unsuccessful as it was found to react with the brass reservoirs thereby rendering the carbon tetrachloride colourless within a few minutes. After experimenting un成功fully with a number of other dyes, a benzol soluble dye was found which proved entirely satisfactory. This dye imparts a very opaque blue colour to the carbon tetrachloride and is completely immiscible with water. A piece of brass was left standing in the mixture for a few weeks without any visible deterioration.

Some concern was felt over the strength of the capillary tube. The indicator was therefore subjected to a test using water to transmit the pressure. The glass tube failed at a pressure of 750 p.s.i. This was felt to give an inadequate factor of safety, at a working pressure of 600 p.s.i. A search was made for capillary tube with thicker walls, but none was found. It was then decided to try the effect of annealing the glass. After annealing, the indicators were again tested and the failing pressure was found to have increased to about 1500 p.s.i. This is considered adequate for a working pressure of 600 p.s.i. If at some future date, it is intended to increase the working pressure, the indicating tube will have to be modified in some way.
(v) **Calibrated compensating plunger:** The two essential requirements of this plunger are:

(a) There must be no leakage past the plunger.

(b) The plunger must operate smoothly and freely at pressures of 600 p.s.i.

Obviously it is out of the question to seal a moving plunger successfully against a pressure difference of 600 p.s.i. It was therefore decided to tap the cell fluid supply at a point beyond the null balance indicator, where volume changes are not important, and to lead this fluid in behind the plunger (see figure 5.1 or 5.2). In this way the pressures on both sides of the plunger are identical and there is no pressure gradient to cause leakage past the plunger. The seal between the plunger spindle and the cylinder is made by means of two 'O' rings (see figure 5.9). A small leak past this point would not be important since its effects are transmitted to a point outside the volume measuring circuit. The walls of the cylinder are \( \frac{1}{4} \)" thick so as to reduce elastic distortions to a minimum. The movement of the plunger can be measured to within \( 0.25 \times 10^{-3} \) in. by means of a graduated thimble mounted on the plunger spindle, which moves over a scale engraved on the outside of the cylinder. The compensating plungers were tested to 2000 p.s.i. and, even at this pressure, proved completely leak free and could be operated without any effort.

5.8 **Layout of apparatus.**

Two complete units, each comprising a raised atmosphere and triaxial consolidation set up, were built. These were mounted in a temperature controlled cabinet. The pressure for each 'top hat' is supplied from a separate reservoir (3 litre ex R.A.F. oxygen cylinders.) This arrangement was adopted in order to keep the volume of air in each circuit to a minimum.
so that in the event of an explosion only a small quantity of energy would be released. The pressure in each reservoir can be controlled from a central manifold. The laboratory compressed air supply is used for pressures up to 100 p.s.i. A compressed air cylinder is used for obtaining pressures in excess of this.

The various components of the apparatus were connected up using \( \frac{1}{4} \)" O.D. copper tubing and special Ermetto high pressure couplings. Klinger valves were used throughout and have proved very successful provided they are greased thoroughly before installation. While connecting up the apparatus great care was taken not to introduce vertical bends in which air bubbles could be trapped. The lengths of tube between the null flow indicator and the 'top hats' were kept to a minimum in order to reduce elastic distortions as much as possible.

Plate VII shows a general view of the apparatus. The mercury manometers are used for measuring pressures up to about 15 p.s.i. For pressures in excess of this, 600 p.s.i. gauges are used. Ideally two ranges of pressure gauges should be used, one for pressures up to 100 p.s.i. and the other for pressures up to 600 p.s.i. Plate VIII is a photograph of a single unit. The 'top hat' on the right together with its null flow indicator and calibrated compensating plunger is used for the raised atmosphere tests while the set up on the left is used for the standard consolidation tests.

5.9 De-airing and flushing of apparatus.

It is essential that all free air should be removed from the compensating cylinder and the null balance indicator before running a test. The following procedure was found to be quite satisfactory:

Valves 2 and 3 (see Fig. 5.1 and 5.2) were closed. De-aired, distilled water was then drawn into the
so that in the event of an explosion only a small quantity of energy would be released. The pressure in each reservoir can be controlled from a central manifold. The laboratory compressed air supply is used for pressures up to 100 p.s.i. A compressed air cylinder is used for obtaining pressures in excess of this.

The various components of the apparatus were connected up using ¼" O.D. copper tubing and special Ermetto high pressure couplings. Elaser valves were used throughout and have proved very successful provided they are greased thoroughly before installation. While connecting up the apparatus great care was taken not to introduce vertical bends in which air bubbles could be trapped. The lengths of tube between the null flow indicator and the 'top hats' were kept to a minimum in order to reduce elastic distortions as much as possible.

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PLATE VII
General view of Apparatus

PLATE VIII
Dual Unit for Raised Atmosphere and All-round Compression Testing.
system by means of the compensating plunger. Valve I was then closed and valves 2 and 3 opened. The supply pressure was increased to 60 p.s.i. and the apparatus was allowed to stand for about 30 minutes to allow time for the solution of free air bubbles. Valve 2 was closed and water was drawn into the system through valve 3. In this way any air in the upper reservoir of the null balance indicator was drawn into the line connected to the compensating plunger. Valve 3 was then closed, valve 2 opened and water plus any free air was driven out of the system through valve 2. Valve 2 was again closed and valve 3 opened and water was flushed through the null balance indicator and out of valve 3. Any free air in the lower reservoir was flushed out during the process. Valves 2 and 3 were then opened and the pressure in the water was released. The whole system was tested for air bubbles by closing valve 2 and applying a pressure of about 10 p.s.i. to the water through valve 3. Elastic deflection of the system resulted in a movement of about 1/4 inch in the null balance indicator. Any deflection greater than this indicated the presence of free air. The above procedure was repeated until the system was quite air free.

5.10 Calibration of apparatus.

(i) Compensating cylinders: The compensating cylinders have a nominal bore of 1 1/2 inches. It was decided to calibrate each compensating cylinder over the full length of its travel in case the machining was not quite accurate. Calibration was achieved by drawing de-aired water into the compensating cylinder until the plunger was at the limit of its travel. Water was then displaced from the cylinder by winding the plunger forwards in 1/4 inch increments. The quantity of water displaced for each increment of movement was obtained by weighing. A graph of volume against plunger reading was then drawn. Figure 5.10 shows a typical calibration curve for a compensating cylinder. The theoretical curve calculated on the
basis of a uniform 1/4 inch bore is also shown.

(ii) Elastic distortions of the 'top hats' and volume measuring equipment: Although very heavily constructed, the apparatus showed considerable elastic distortions under load. The volume changes due to these elastic distortions were measured during a 'dummy' triaxial compression test on a 3 inch diameter by 1 inch high piece of steel. A typical curve of plunger reading against pressure is shown in figure 5.11.

5.11 Performance of the apparatus.

In general the apparatus just described performed satisfactorily. However, as is to be expected with entirely new apparatus, certain components gave trouble. It was found that unless the joint between the sintered brass disc and the recessed raised atmosphere sample base was very neat the osmotic membrane tended to puncture when subjected to high pressures. This trouble was overcome by running molten sealing wax into the joint. At all times considerable quantities of air were found to pass through the membrane. This was first thought to be due to inefficient clamping. However, tightening down of the clamping ring had no effect and the phenomenon is attributed to dissolved air coming out of solution on the low pressure side of the membrane. Although the presence of this air could not have affected the accuracy of the apparatus it probably decreased the rate of transfer of water through the membrane thereby increasing the lengths of time to reach equilibrium.

Air coming out of solution in the cell fluid also gave considerable trouble when measuring volume changes during raised atmosphere tests. It was found that after the sample had been under test for a few days it would suddenly appear to increase in volume rapidly. The only explanation for this is that air would diffuse through the rubber membrane surrounding the sample and come out of solution in the cell fluid. This
problem only became apparent in tests lasting for more than two or three days. Bishop (1960) mentioned that air was known to pass through rubber latex and in 1961 Bishop and Donald described some triaxial apparatus in which the sample and membrane were surrounded by mercury. The mercury prevented air diffusing from the sample to the cell fluid. In view of the limited time available and the time consuming nature of the proposed tests it was decided to forgo experimenting with apparatus modifications and to measure the sample volume mechanically using a vernier callipers and dial gauge.

The system adopted for measuring volume changes of the sample was found to work perfectly for normal triaxial consolidation tests and short term raised atmosphere tests. There appears to be no reason, therefore, why the system should not work once air is prevented from diffusing through the rubber membrane. A method for doing this by making use of a mercury bath, similar to the one proposed by Bishop and Donald (1961), is outlined in a later section dealing with apparatus improvements.
REFERENCES TO CHAPTER V.


Proc. 5th Int. Conf. S.M. and P.E., Paris (in press)

Road research Note 3464/JDC April, 1959.

Croney, D. and Coleman, J.D. (1960): "Pore pressure and suction in soil."
Proc. Conf. on Pore Pressure and Suction in Soils.
Jennings, J.E. and Burland, J.B. (1960): "Rand Soil-Pressure Cell for Low Pressures High Accuracy at Long-Term Stability."
Jrnl. of Scientific Instr.
Vol. 37 p. 193

Russam, K. (1959): "An investigation into the soil moisture conditions under roads in Trinidad, B.W.I."
Geotechnique, 9, 57-71.
SECTIONAL ELEVATION OF 'TOP HAT' AND BASE PLATE

PLAN OF BASE PLATE

DETAILS OF HIGH PRESSURE ALL-ROUND COMPRESSION APPARATUS
SECTIONAL ELEVATION

PLAN WITH CLAMPING RING REMOVED

DETAILS OF BASE FOR RAISED ATMOSPHERE TEST
SECTIONAL ELEVATION

PLAN

DETAILS OF STANDARD SAMPLE BASE
**PLAN**

**DETAILS OF SAMPLE END PLATE**

**ELEVATION**

**PLAN**

**DETAIL OF FITTING TO TAKE SAMPLE DRAIN LEAD THROUGH 'TOP HAT' BASE**
SECTIONAL ELEVATION

DETAILS OF CALIBRATED COMPENSATING PLUNGER (GRADUATED THIMBLE NOT SHOWN)
TYPICAL CALIBRATION CURVE FOR ELASTIC DISTORTIONS IN THE 'TOP HAT' AND VOLUME MEASURING SYSTEM

FIG 5.11
Chapter VI

EXPERIMENTAL PROCEDURE AND RESULTS

1. Description of the soils tested.

The three types of soil used in this investigation were a silty sand, a sandy silt and a silty clay. Soils lying in the silt range were chosen because it is in this range that the validity of the principle of effective stress is in doubt.

The silty sand was a reddish brown soil used in the construction of the Buldersdrift road. The silt can be described as a 'synthetic' soil as it consisted entirely of very fine quartz particles derived from the mechanical crushing of quartzite. The silty clay was derived by mixing the sandy silt just described with firing hematite in the proportions 81:1 by weight.

The properties of the three soils are given in Table 6.1 and the grading curves are shown in Figure 6.1.

Table 6.1

SOIL PROPERTIES

<table>
<thead>
<tr>
<th>Soil</th>
<th>Silty sand</th>
<th>Sandy silt</th>
<th>Silty clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>16.4</td>
<td>-</td>
<td>46.4</td>
</tr>
<tr>
<td>2.2</td>
<td>12.1</td>
<td>-</td>
<td>35.4</td>
</tr>
<tr>
<td>2.7</td>
<td>5.0</td>
<td>3.7</td>
<td>2.7</td>
</tr>
<tr>
<td>3.0</td>
<td>2.63</td>
<td>2.73</td>
<td>3.73</td>
</tr>
<tr>
<td>3.4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Clay fraction</td>
<td>7</td>
<td>3</td>
<td>23</td>
</tr>
</tbody>
</table>
Chapter VI

EXPERIMENTAL PROCEDURE AND RESULTS

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The silty sand was a reddish brown soil used in the construction of the Kuldersdrift road. The silt can be described as a 'synthetic' soil as it consisted entirely of very fine quartz particles derived from the mechanical crushing of quartzite. The silty clay was derived by mixing the sandy silt just described with Wyoming bentonite in the proportions 4:1 by weight.

The properties of the three soils are given in table 6.1 and the grading curves are shown in figure 6.1.

Table 6.1
SOIL PROPERTIES.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Silty sand</th>
<th>Sandy silt</th>
<th>Silty clay</th>
</tr>
</thead>
<tbody>
<tr>
<td>L.L. %</td>
<td>36.2</td>
<td>-</td>
<td>56.4</td>
</tr>
<tr>
<td>P.I. %</td>
<td>13.2</td>
<td>-</td>
<td>35.4</td>
</tr>
<tr>
<td>L.S. %</td>
<td>10.0</td>
<td>5.2</td>
<td>8.7</td>
</tr>
<tr>
<td>S G.</td>
<td>2.65</td>
<td>2.73</td>
<td>2.75</td>
</tr>
<tr>
<td>% clay fraction</td>
<td>7</td>
<td>3</td>
<td>23</td>
</tr>
</tbody>
</table>
6.2 Consolidometer tests on silt

(1) Preparation of samples: The silt, in an oven dry condition, was first thoroughly broken up using a pestle and mortar. A quantity of the silt was then weighed out and mixed with distilled water which was added slowly to give a moisture content of 35 percent. Preliminary tests had shown that a water content of 35 percent was sufficient to allow a small quantity of bleeding as the slurry settled.

A 3½ inch diameter by 1½ inch high sample mould was greased lightly with vaseline and placed on a saturated porous stone. The slurry was now carefully spooned into the sample mould until level with the top. Great care was taken to ensure that no air bubbles were trapped in the soil. The sample was then allowed to stand open to the atmosphere for a few days during which time it was weighed at frequent intervals.

Once the sample had reached constant weight it was removed from its mould and trimmed to a diameter slightly larger than 3 inches. The sample was then gently pressed into the 3 inch by 1 inch consolidometer ring and the ends trimmed level with the ring. The trimmings were used for moisture content determinations.

The sample was then placed in the consolidometer between two air dry sintered brass discs. All joints were carefully sealed with vaseline and the cell was covered with a plastic membrane bedded on vaseline by rubber bands. The sample was allowed to 'bed down' for 24 hours under a load of 0.01 tons/sq.ft. before commencement of the test.

(ii) Samples soaked at constant applied load. In this test the sample was subjected to increments of applied load at 24 hour intervals. The deflections resulting from each increment were noted. At a given applied pressure the sample was soaked by adding water through the bottom porous disc. The specimen was allowed to stand for 24 hours after which time the
deflection was noted. Additional load increments were then applied in the usual manner until a maximum of 16 tons/sq. ft. was reached.

Five specimens were tested in the above manner. All five samples were prepared and tested at the same time so as to keep conditions as nearly as possible identical. The only variable in the four tests was the load at which soaking took place. These loads were 0.1, 2, 4, 8 and 16 tons/sq. ft. respectively for the five samples. The e-log p plots for the five samples are shown in figure 6.2. Also shown is the 'virgin' consolidation curve obtained from a standard consolidation test on the silt in an initially slurried condition.

(iii) Samples soaked at constant void ratio. As in the previous set of tests the samples were subjected to increments of applied load. However, instead of soaking at specific constant applied loads the samples were soaked at constant volumes. This was done by clamping the loading beam in a fixed position during the soaking operation thereby preventing any volume change. After the sample had been allowed to soak for 24 hours the load required to keep the sample at constant volume was measured. This was done by carefully removing weights from the loading beam until it showed signs of lifting away from the rest on which it had been clamped. The loading beam rest was then lowered a small amount and the deflection gauge was observed. Any tendency for the sample to compress was counteracted by removing weights from the loading beam. The equilibrium load was obtained when the rest could be removed entirely without any compression of the soil occurring.

Four samples were tested in the above manner. As in the previous test the samples were prepared and tested at the same time. The loads at which soaking was begun were 2, 4, 8, and 16 tons/sq. ft. The results of the four tests are plotted in the form of e-log p curves in fig. 6.3 together with the saturated compression curve and virgin compression
curve. It can be seen that a certain amount of volume change occurred on soaking. This was unavoidable since the process of finding the correct load is one of trial and error.

(iv) **Double consolidometer test on very compact silt**

Two identical samples of silt were consolidated from a slurry under an applied load of 16 tons/sq.ft. The specimens were then unloaded and one of the samples was removed and dried in the atmosphere. The other sample was kept soaking under a load of 0.01 tons/sq.ft. when the first sample had reached equilibrium with the atmosphere it was trimmed to fit snugly into a 2½ inch diameter sample ring and placed in the consolidometer between dry porous brass discs. Both the soaked sample and the air dried sample were then subjected to increments of load up to 16 tons/sq.ft. The air dry sample was then soaked at constant applied load (16 tons/sq.ft.) and the deflection noted. The saturated and air dry e: log p curves for the test are plotted in fig. 6.4 together with a portion of the virgin compression curve.

6.3 **All round compression tests on air dry silt.**

Four samples of silt were prepared as described in section 6.2(1) and placed in 3 inch diameter by 1 inch high moulds. These were allowed to stand in the atmosphere until they had reached constant weight. Each sample was then tested in all round compression. The procedure for testing each sample was as follows:

The sample to be tested was carefully measured up with vernier callipers and weighed. It was then placed on the standard triaxial consolidation sample base fitted with an air dry porous brass disc. The end plate used for this series of tests was fitted with a drainage load to facilitate soaking while the specimen was under load.

After carefully de-airing the null balance indicator and compensating plunger the 'top hat' was
bolted in place and the cell was filled with de-aired water. The sample was allowed to come to equilibrium under a small head of water before the test was commenced.

The specimen was subjected to increments of all round pressure and 24 hours was allowed between each increment. The volume change resulting from each increment of load was read off on the calibrated compensating plunger. At a specific value of all round pressure the sample was soaked by forcing water up through the base plate and out through the end plate. The back pressure usually required to do this was about 5 p.s.i. As soon as water began to issue from the end plate the back pressure was reduced to zero and the sample was allowed to soak for 24 hours. The volume change resulting from the wetting up of the sample was recorded and further increments of load were then applied in the normal way up to a maximum of 10 tons/sq.ft.

At the end of the test the all round pressures were reduced to zero and the sample was immediately removed from the apparatus, weighed, oven dried and weighed again.

Four samples were tested as described above. The applied loads at which soaking took place were 0.324, 1.02, 3.24 and 10.2 tons/sq.ft. The results are shown in the form of $c_0 \log p$ curves in fig. 6.5. An attempt was made to obtain a virgin saturated compression curve for the silt but no way of supporting the slurry during the initial stages of consolidation could be found. However a test, which will be described later, for determining the $c_0 \cdot pF$ curve for the material gives some indication of the slope of the initial portion of the virgin curve. This curve is plotted on fig. 6.5 and the extrapolated portion is shown by means of a broken line.
6.4 Triaxial compression tests on silt at various moisture contents.

The procedure for this series of tests was to allow a sample of silt, prepared in a 3 inch by 1 inch mould, to dry out to a suitable moisture content. The sample was then placed on a sheet of plate glass under a bell jar and left for four days to allow time for the moisture conditions within the sample to equilibrate. The sample was then subjected to increments of all round pressure up to 10.2 tons/sq.ft. in the triaxial compression apparatus. After reaching equilibrium at 10.2 tons/sq.ft. the sample was soaked for 24 hours. The cell pressure was then released and the sample was removed for water content and dry weight determinations.

Three samples were tested in this series. The degrees of saturation of the three samples were 89.0%, 58.4% and 42.5%. The results for the three tests together with the extrapolated virgin curve are shown in fig. 6.6.

6.5 Determination of pF: moisture content curve for silt.

The raised-atmospheric-test sample base was used for this experiment. The sample base without clamping ring was placed in a large beaker of water and boiled for about an hour so as to drive any free air out of the sintered bronze disc. The membrane was then lightly clamped over a 2 inch diameter filter paper resting on the bronze disc. This was done with the sample base still under water.

The sample base assembly was then removed from the water and bolted into the 'top hat' base. The membrane clamping ring was screwed down firmly and the membrane was then left to 'bed down' under an air pressure of about 50 p.s.i. for 24 hours. After 'bedding down' the membrane clamping ring could usually be tightened down a little.
The sample of silt was prepared by standing a 2 inch diameter by ½ inch high brass ring on the sample base. The inside of the ring was lightly greased with vaseline. The silt slurry was then spooned into the mould and smoothed off level with the top. The 'top hat' was bolted down and the sample was subjected to pF 2 for about 4 days. At the end of this period the sample was removed from the mould, weighed and placed in the apparatus again under pF 2. The sample was weighed each day until it had reached constant weight. The air pressure was then raised to pF 2.5 and the sample allowed to come to equilibrium. The process was repeated until the sample was at equilibrium at pF 4.5. The sample was then oven dried and weighed and the equilibrium moisture content at each pF value calculated. It was found that the sample took approximately 7 days to come to equilibrium under any increment of air pressure. The whole test therefore took approximately six weeks to complete. The pF vsw curve for the silt is plotted in fig. 6.7.

6.5 Void ratio: pF curve for silt.

In chapter V it was mentioned that the system for measuring volume changes in raised atmosphere samples could not be used owing to problems associated with the diffusion of air through the rubber membrane surrounding the sample. It was therefore decided to use the apparatus as a conventional pressure membrane apparatus and measure the sample dimensions directly. The diameter of the sample was measured with vernier callipers and the changes in thickness were measured with a dial gauge which was fastened to a rigid tripod (see plate IX).

The sample base and membrane were assembled as described in the previous section. A 2½ inch diameter 1 inch high mould, lightly greased with vaseline, was placed on the sample base and the silt slurry was spooned into it and smoothed off level with the top. The sample was then subjected to a pF of 2.0 for 4 days. The mould was then removed and a ½ inch square thin glass target was pressed into the top of the sample. The
PLATE IX

Measurement of change of thickness of sample in pressure membrane apparatus
tripod with dial gauge attached was mounted on the 'top hat' base and the positions of the three legs of the tripod were carefully marked. A reading of the dial gauge on the glass target was taken. The diameter at the top and the bottom of the sample was measured with vernier callipers. The air pressure over the sample was again raised to pF 2.0. The dimensions of the sample were measured each day until no further volume change occurred. The air pressure was then raised to pF 2.5 and the sample allowed to come to equilibrium once more. The process was repeated up to pF 4.5.

At the end of the test the overall dimensions of the sample were carefully measured with vernier callipers. The sample was then weighed, oven dried, measured up once more and then weighed. The whole test took about 7 weeks to complete; 8 days being required for the sample to come to equilibrium under each increment of load. The curve of e against pF for the soil is shown plotted in fig. 6.8.

6.7 All round compression tests on silty clay at various initial pressure deficiencies.

Samples of silty clay were prepared by thoroughly remoulding the soil at its liquid limit. The soil was then placed in a 3 inch diameter by 1 inch high mould taking care not to entrap any large air voids in the specimen. The sample was trimmed to the length of the mould and the trimmings were used for water content determinations.

The sample base for the raised atmosphere test was assembled in the usual manner and the sample to be tested was extruded onto the membrane. 3 inch diameter by 1 inch high samples of this material were found to be self supporting even at the liquid limit. The 'top hat' was bolted in place and the air pressure over the sample was raised to the required value. The sample was left in this condition for about 3 weeks. It was then removed, weighed and returned to a raised air pressure condition. Thereafter the sample was weighed
Author: Burland J B
Name of thesis: The Concept Of Effective Stress In Partly Saturated Soils. 1961

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