UNIVERSITY COLLEGE LONDON

University of London

EXAMINATION FOR INTERNAL STUDENTS

For The Following Qualifications:-

B.Eng. *M.Eng.*

Civil Eng 1003: Soil Mechanics part I

COURSE CODE	:	**CIVL1003**
UNIT VALUE	:	**0.50**
DATE	:	**04-MAY-05**
TIME	:	**10.00**
TIME ALLOWED	:	**3 Hours**

05-C0233-3-110

TURN OVER

CIVL1003 SOIL MECHANICS 1
First year BEng/MEng
Examination 2005

Time allowed: 3 HOURS

Answer FIVE questions

The unit weight of water may be taken as $10\,kN/m^3$.

Q1 (a) Determine the angle at which an infinite slope of sand with unit weight $20\,kN/m^3$ and angle of friction of $30°$ can just remain in equilibrium when water flows parallel to the slope and when the top flow line is at the soil surface.

[10 mark]

(b) Figure Q1b shows a circular excavation in clay which overlies sand. Determine the depth, *d*, to which the clay can be excavated before uplift of the soil occurs.

Determine the upward flow rate just before uplift occurs if the permeability of the clay is $10^{-6}\,m/s$.

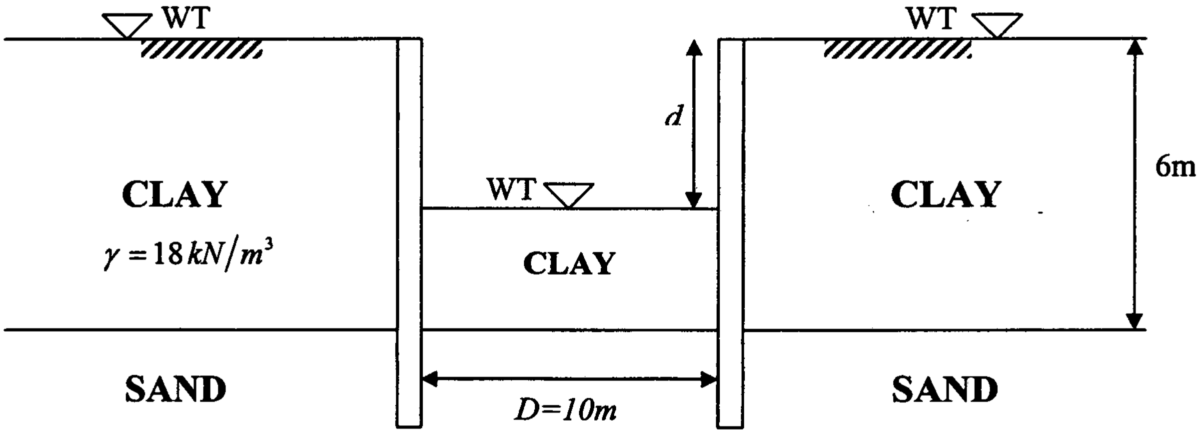

Figure Q1b

[10 marks]

TURN OVER

Q2 Figure Q2 shows a soil profile in which soft clay separates two layers of sand. Additional water supply to a community was achieved by pumping from the lower sand stratum.

Under steady pumping the water table remains at the sand surface while water in a standpipe placed in the lower sand layer rises to a height of 4m.

By finding the average change in effective stress in the clay layer determine the settlement of the clay.

[15 marks]

The coefficient of volume compressibility, m_v, of the clay is $5\times10^{-4}\ m^2/kN$.

If pumping ceased determine the resulting heave if $m_s = 1\times10^{-5}\ m^2/kN$.

[5 marks]

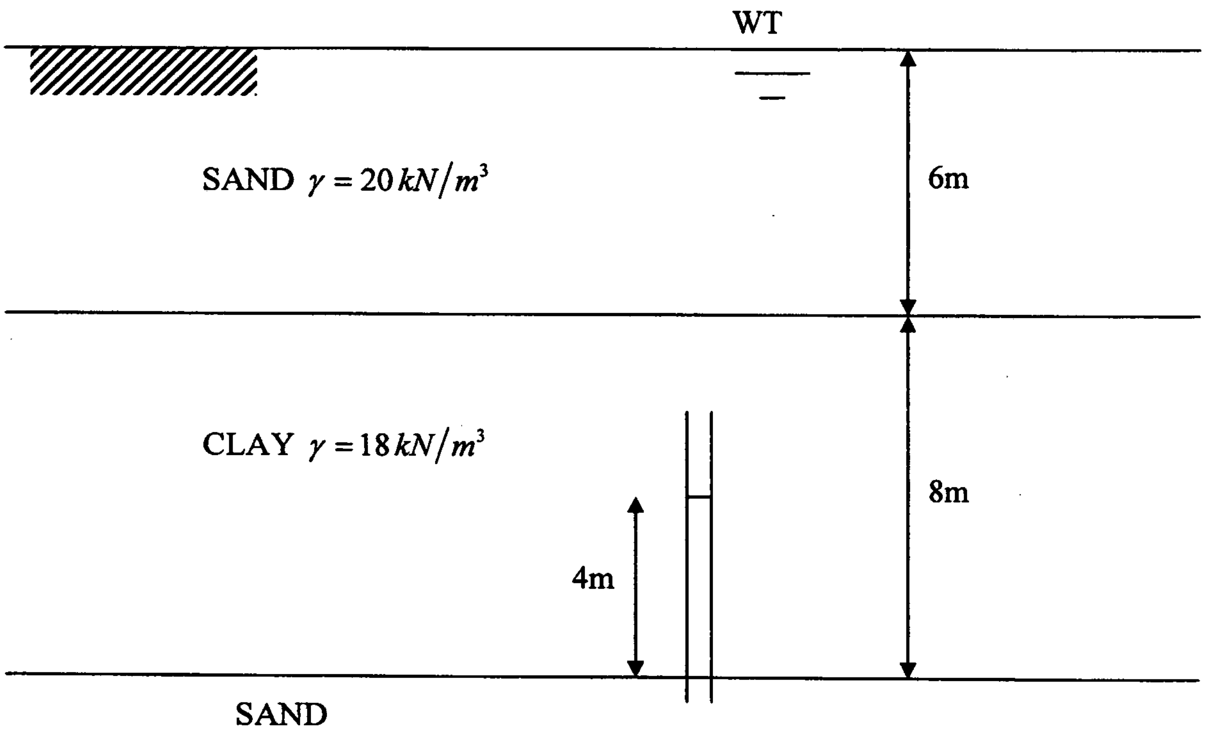

Figure Q2

CONTINUED

Q3 Figure Q3 (included separately) is a scaled section of an "L" shaped retaining wall. Some time after construction the drain, *D*, became blocked. Draw a "square" flow net on the figure when the drain is blocked and determine the water pressure at the two ends of the base of the wall.

[15 marks]

Discuss how the blocking of the drain affects the flow net and the stability of the wall. **(Return the flow net with your answer book).**

[5marks]

Q4 A triaxial test was performed on a sample of sand. Initially a cell pressure of 140 kN/m^2 and a pore water pressure of 80 kN/m^2 were applied to the specimen which was then allowed to drain. With the cell pressure held constant, an increasing deviator stress under undrained conditions was applied until failure of the sand occurred. Measurements of deviator stress and pore water pressure during the test are shown below.

Deviator Stress $(\sigma_1 - \sigma_3) kN/m^2$	0	20	40	60	80	100	120	140	160	180
Pore Water Pressure (u) kN/m^2	80	80	78	75	72	68	64	59	54	50

Choose suitable parameters to sketch the effective and total stress paths and draw the effective stress circle at failure to determine the angle of friction of the sand

[15 marks]

Explain the reasons for pore water pressure change during the test.

[5 marks]

TURN OVER

Q5 A rigid wall, propped at the surface, is to support sand in the manner shown. Propose the likely failure mechanism and determine the factor of safety of the wall. Take the unit weight of sand as $20\,kN/m^3$ and its angle of friction as $30°$. Comment on the factor of safety.

[20 marks]

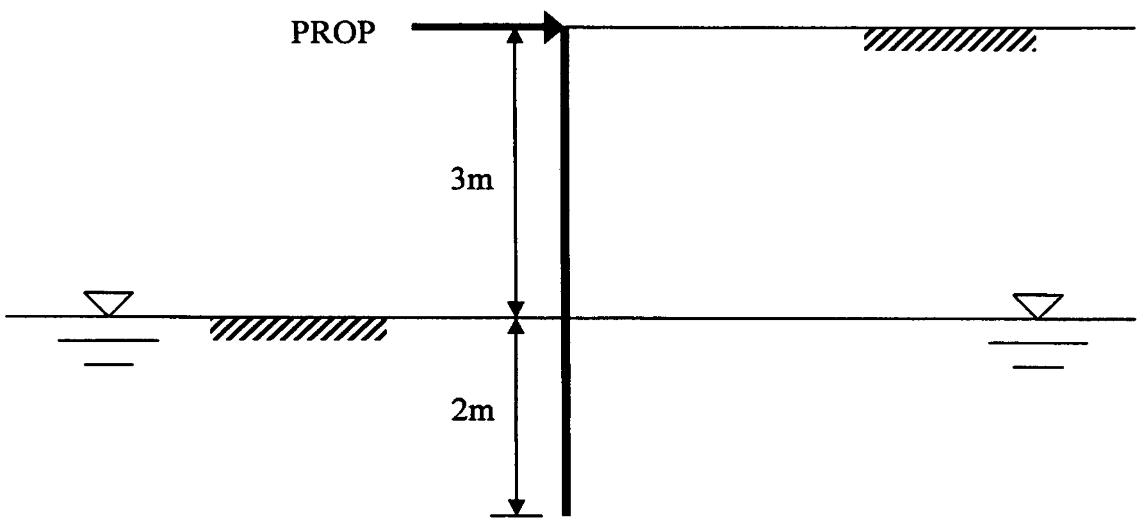

Figure Q5

Q6 A 20m diameter oil tank that will provide a vertical stress of $150\ kN/m^2$ is to be constructed on the soil profile shown below. It is intended to keep settlement small whilst limiting excavation.

After estimating possible settlements, choose an appropriate siting of the tank; then discuss those factors that need consideration to ensure that the soil and tank remain stable during and after all stages of construction.

Detailed calculations are not required, unless they assist in explaining the necessary precautions required during construction.

[20 marks]

Depth	Soil Type	Soil Properties
0m		Water Table at Surface
1m	Made Ground	
6m	Soft Clay	$\gamma = 19\ kN/m^3$ $\varphi = 20°$ $S_u = 20\ kN/m^2$ $m_v = 5 \times 10^{-4}\ m^2/kN$ $k = 10^{-9}\ m/s$
12m	Stiff Clay	$\gamma = 20\ kN/m^3$ $\varphi = 22°$ $S_u = 100\ kN/m^2$ $m_v = m_s = 1 \times 10^{-5}\ m^2/kN$ $k = 10^{-9}\ m/s$
	Dense Sand	$\gamma = 21\ kN/m^3$ $\varphi = 36°$ $k = 10^{-4}\ m/s$

Q7 Explain in detail how the angle of dilation relates to the peak and critical state angles of friction of sand.

Explain how in clays the residual angle of friction develops and why the value is so low.

[15 marks]

Give engineering examples, for both sand and clay, of when the various angles of friction are used.

[5 marks]

END OF PAPER

CANDIDATE NUMBER ____________

SEAT NUMBER ____________

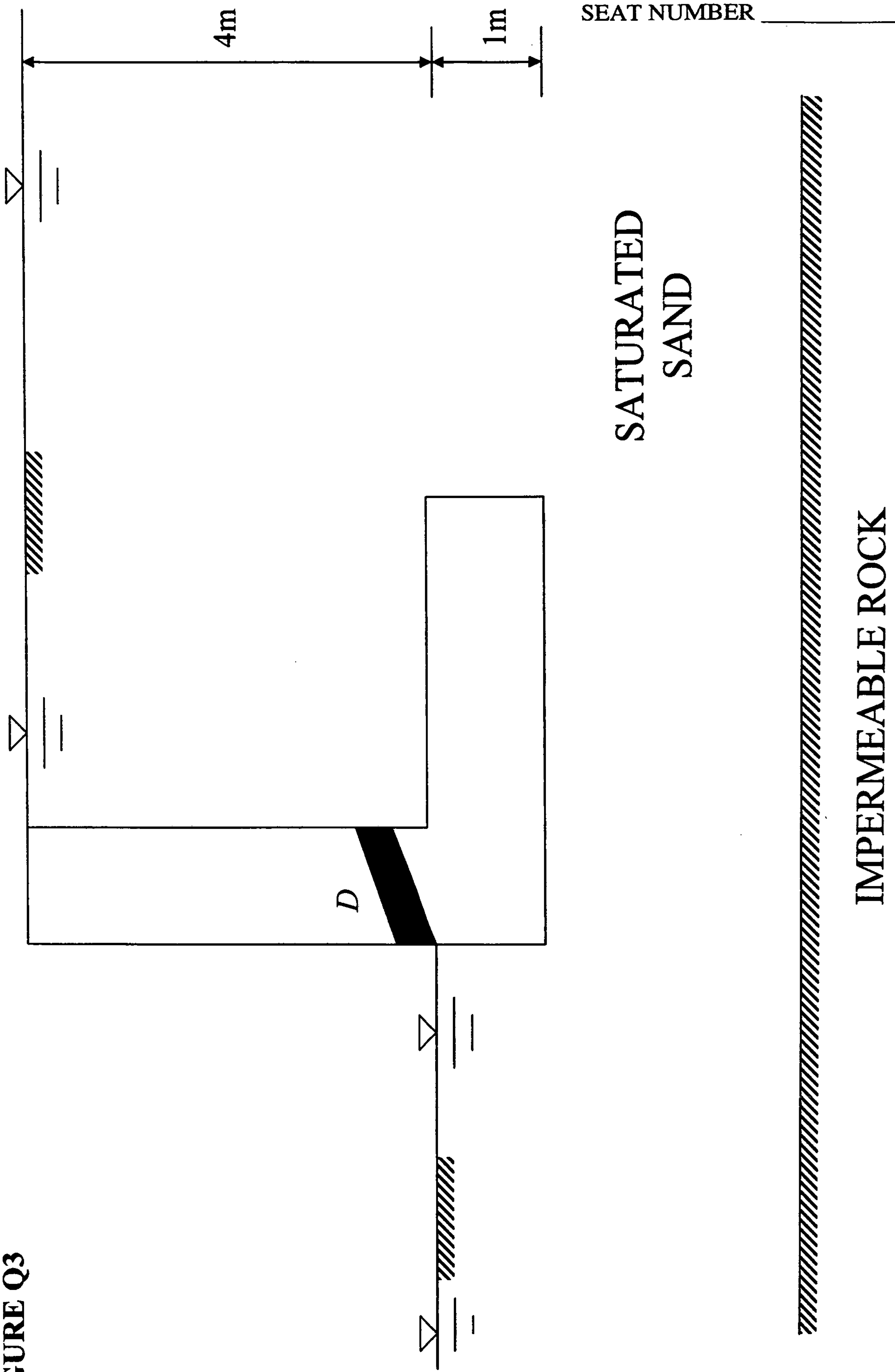

FIGURE Q3

CIVL1003