UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING : CIVIL*
SUBJECT	:	**GEOTECHNICAL ENGINEERING III**
CODE	:	**CEG3211**
DATE	:	SUMMER SSA EXAMINATION 2015 7 DECEMBER 2015
DURATION	:	(SESSION 1) 08:00 - 11:00
FULL MARKS	:	100
TOTAL MARKS	:	103

EXAMINER	:	PROF G C FANOURAKIS
MODERATOR	:	DR B A HARRISON
NUMBER OF PAGES	:	4 PAGES AND 4 ANNEXURES

INSTRUCTIONS	:	STUDENTS MAY BRING AN A4 SIZE SHEET OF PAPER INTO THE EXAMINATION VENUE. THIS SHEET MAY CONTAIN EQUATIONS / FORMULAE WHICH HAVE BEEN ORIGINALLY HANDWRITTEN (NOT PHOTOCOPIED) ON BOTH SIDES. PROGRAMMABLE CALCULATORS ARE PERMITTED (ONLY ONE PER STUDENT). WHERE RELEVANT, TAKE ACCELERATION DUE TO GRAVITY AS 10 m/s^2.
REQUIREMENTS	:	GRAPH PAPER

QUESTION 1

A 200 m long steel sheet-piled trench through estuarine sand is shown in Figure 1 (attached). In order to establish the pumping capacity required to attain a water level of 6 m below the natural ground, a constant head permeability test was carried out on the sand, the results of which are shown below.

Quantity of water collected	350 ml
Head difference in manometer	70 mm
Duration of test	5 minutes
Distance between manometer taps	100 mm
Diameter of sample	100 mm

1.1 Determine the coefficient of permeability in mm/sec. (3)

1.2 Due to symmetry of the problem, half of the flow net indicating the flow into the trench has been drawn. Assuming a coefficient of permeability of 4×10^{-4} m/sec, determine the contractor's required pumping capacity for the trench. (5)

1.3 Assuming the contractor ordered a 0,1 m^3/sec pump, but then encountered sand with a permeability of 8×10^{-4} m/sec, determine the depth below ground level to which the excavation could be pumped. (2)

1.4 Determine the hydraulic gradient at the surface of the excavation. Is failure due to piping likely to occur? (Motivate your answer). (6)

[16]

QUESTION 2

An exploratory drill hole was made in a 10 m thick layer of stiff saturated clay having a specific gravity (G) of 2.7 and moisture (w) of 33 %. It was observed that a sand layer underlying the clay was under artesian pressure. Water in the drill hole rose to a height of 3,5 m above the top of the sand layer. If an open excavation is to be made in the clay, how deep can the excavation proceed before the bottom heaves?

[8]

QUESTION 3

3.1 An Unconfined Compression Test (UCS) was carried out on a cylindrical soil sample having a diameter of 38 mm and a length of 76 mm. At failure a load of 200 N was recorded and the sample had shortened by 9 mm. What are the unconfined compression strength and the undrained shear strength of this soil? (5)

3.2 The following results were obtained from drained shear box tests on a silty sand:

Normal Load (N)	250	500	1000
Shear Force at Failure (N)	218	254	328
Displacement at failure (mm)	3	4	5

The dimensions of the shear box were 60 mm x 60 mm.

3.2.1 Find shear strength parameters c and φ. (10)

3.2.1 If a specimen of the same soil was tested in triaxial compression at a cell pressure of 300 kPa with a back pressure of 100 kPa, at what deviator stress would failure occur? (6)

[21]

QUESTION 4

Referring to Figure 2 (attached), calculate the magnitude and position of the resultant thrust acting on the wall.

The mass of the base may be ignored. The numerical integration of the stress diagram for the concentrated load should be carried out in 1 m increments.

[25]

QUESTION 5

A strip footing is to be designed to carry a load of 900 kN/m at a depth of 0,5 m in a gravelly sand with shear strength parameters of c' = 0 and φ' = 30 °.

Determine the width of the footing if a factor of safety of 3 against shear failure is specified and assuming that the water table may rise to foundation level. Above the water table the unit weight of the sand is 18 kN/m^3 and below the water table the saturated unit weight is 20 kN/m^3.

[10]

QUESTION 6

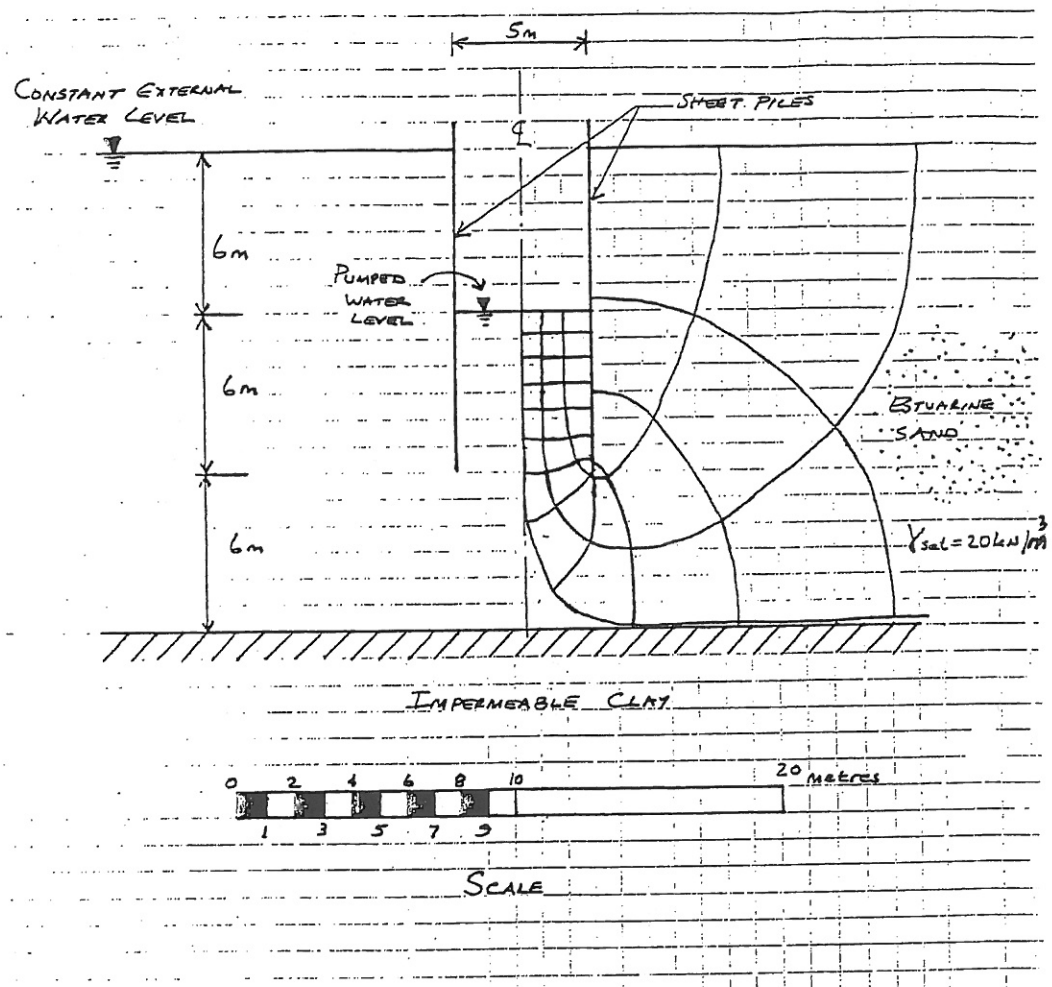
With reference to Figure 3:

6.1 Determine the immediate settlement at the centre of the foundation, assuming a net bearing pressure of 300 kPa and using the attached charts. (15)

6.2 Estimate the consolidation settlement of the foundation due to the clay layer, assuming the increase in stress at the centre of the layer is 70 kPa and that the compression index and specific gravity for the clay are 0,25 and 2,75, respectively. (8)

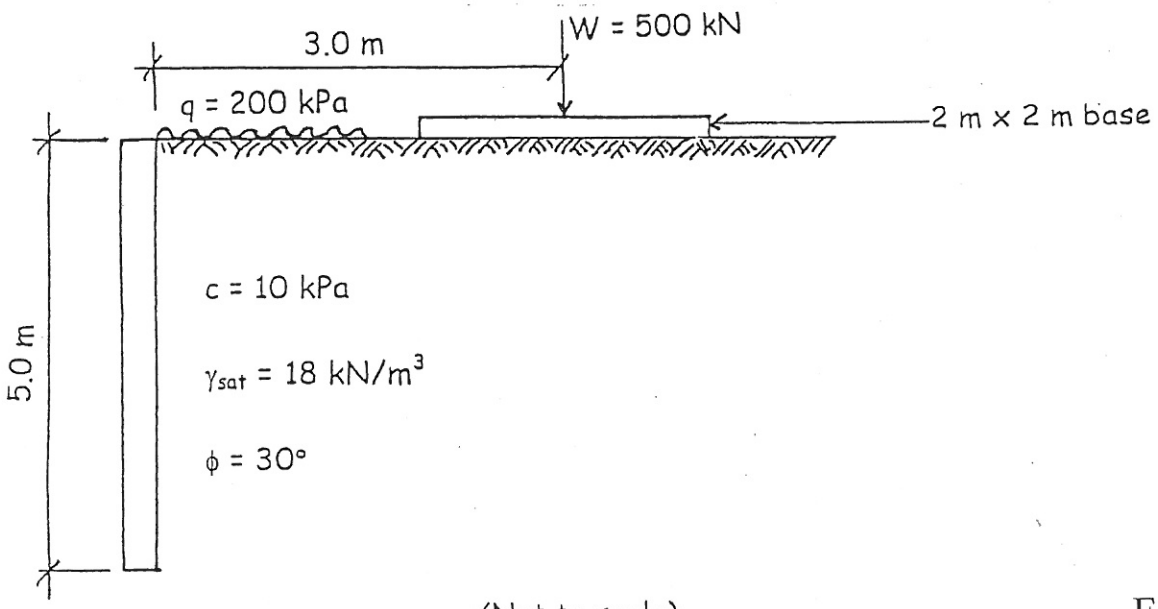
[23]

TOTAL : 103



Flow into long sheet-piled trench through estuarine sand

Figure 1



(Not to scale)

Figure 2

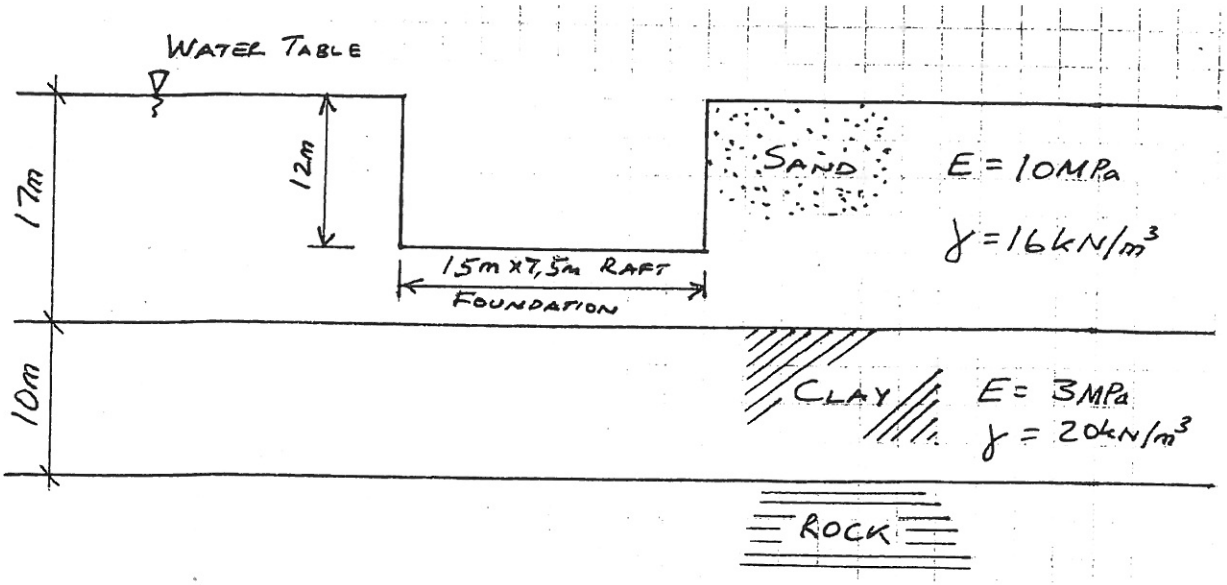
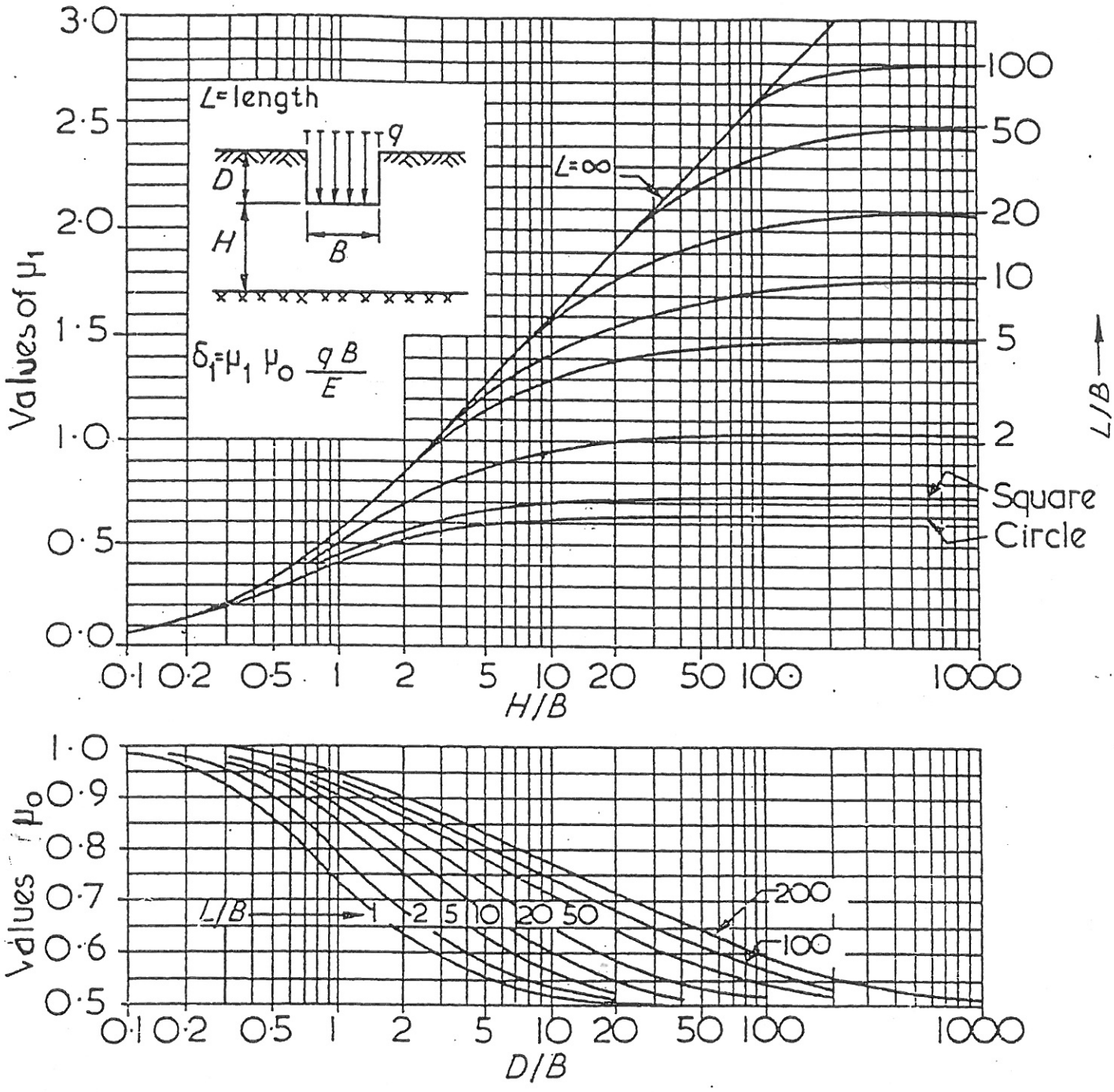

WATER TABLE
17m
12m
1.5m x 7.5m RAFT
FOUNDATION
SAND
E = 10MPa
γ = 16kN/m³
10m
CLAY
E = 3MPa
γ = 20kN/m³
ROCK

Figure 3

ϕ	0^0	5^0	10^0	15^0	20^0	25^0	30^0	35^0	40^0	45^0
N_c	5.7	7.3	9.6	12.9	17.7	25.1	37.2	57.8	95.7	172
N_q	1.0	1.6	2.7	4.4	7.4	12.7	22.5	41.4	81.3	173
$N\gamma$	0.0	0.5	1.2	2.5	5.0	9.7	19.7	42.4	100	298

Terzaghi's Bearing Capacity Coefficients



Diagrams for the factors μ_0 and μ_1 used in the calculation of the immediate average settlement of uniformly loaded flexible areas on homogeneous isotropic saturated clay, after Janbu, Bjerrum and Kjaernsli (1956)