UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACHELOR OF ENGINEERING TECHNOLOGY *ENGINEERING : CIVIL*
SUBJECT	:	**GEOTECHNICAL ENGINEERING 2B**
CODE	:	**GTECIB2**
DATE	:	SUMMER SSA EXAMINATION 06 JANUARY 2020
DURATION	:	(X-PAPER) 08:00 - 11:00
FULL MARKS	:	100
TOTAL MARKS	:	100

EXAMINER	:	PROF G C FANOURAKIS
MODERATOR	:	DR B A HARRISON
NUMBER OF PAGES	:	4 PAGES AND 3 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 x 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 x 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?

[10]

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QUESTION 3

In a consolidated undrained triaxial test, carried out on two soil specimens, the following results were recorded.

Sample	Cell Pressure (kPa)	Deviator stress at failure (kPa)	Pore water pressure at failure (kPa)
1	196	147	137
2	392	294	276

3.1 Determine the cohesion and angle of friction, in terms of both total and effective stress. (10)

3.2 Determine the normal stress and total shear on the failure plane in Sample 1. (4)

[14]

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 1,0 m increments.

[25]

QUESTION 5

Briefly discuss measures that may be taken to treat slope failures.

[8]

QUESTION 6

A rigid foundation is 4 m x 4 m in size and transmits a load of 300 kN to a clay at its founding depth of 2 m. The clay, which is normally consolidated, has an E of 18 MPa and extends to a depth of 10 m.

Calculate the immediate settlement at the centre of the foundation.

[9]

QUESTION 7

A soil sample was recovered from the centre of a 6 m thick clay layer having a saturated moisture content of 35%. The specific gravity of the clay was determined as 2,7. The water table was at ground surface.

The results of the consolidometer test carried out on the clay sample are shown in Figure 3.

7.1 Determine the over-consolidation ratio (OCR). (6)

7.2 Calculate the recompression (C_r) and virgin compression (C_c) indices. (9)

7.3 If a uniform surcharge applied to the surface of the clay caused a 50 kPa increase in stress at the middle of the clay layer, determine the consolidation settlement using $m_v = 3 \times 10^{-4} m^2/kN$. (3)

[18]

TOTAL : 100

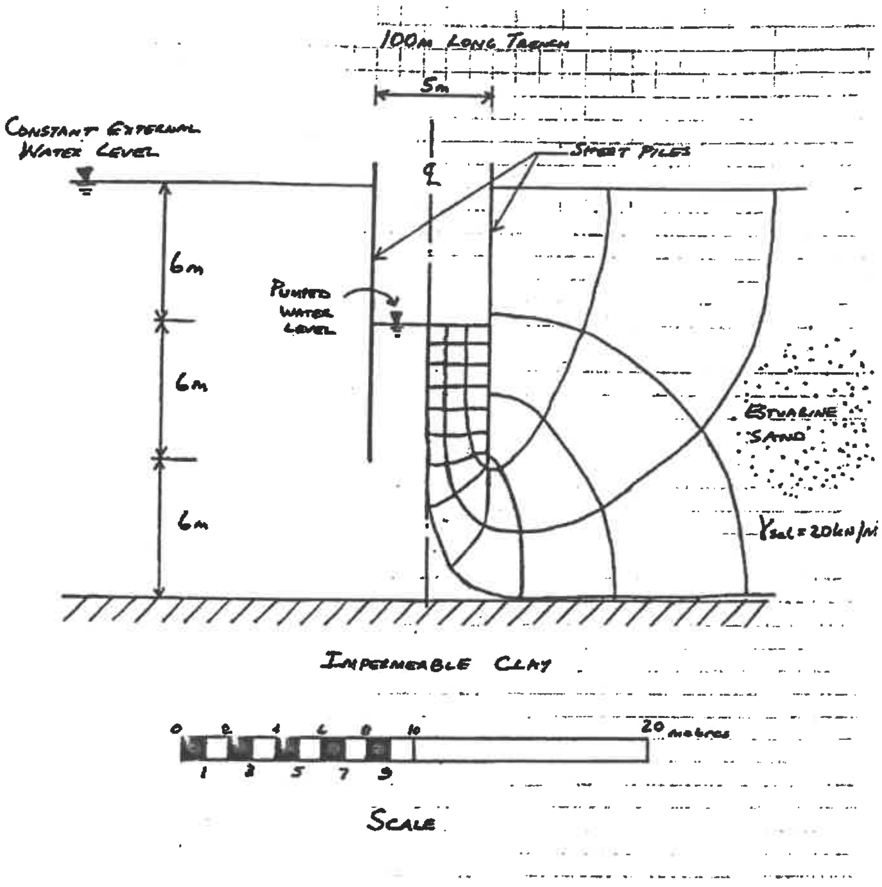
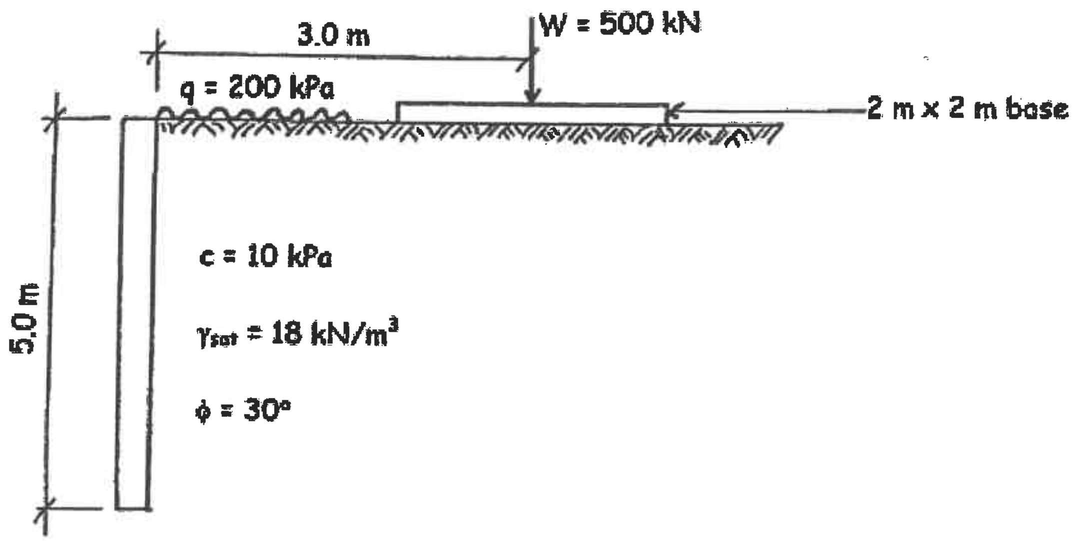


Figure 1 Flow into long sheet-piled trench through estuarine sand



(Not to scale)

Figure 2

Figure 3

NAME:

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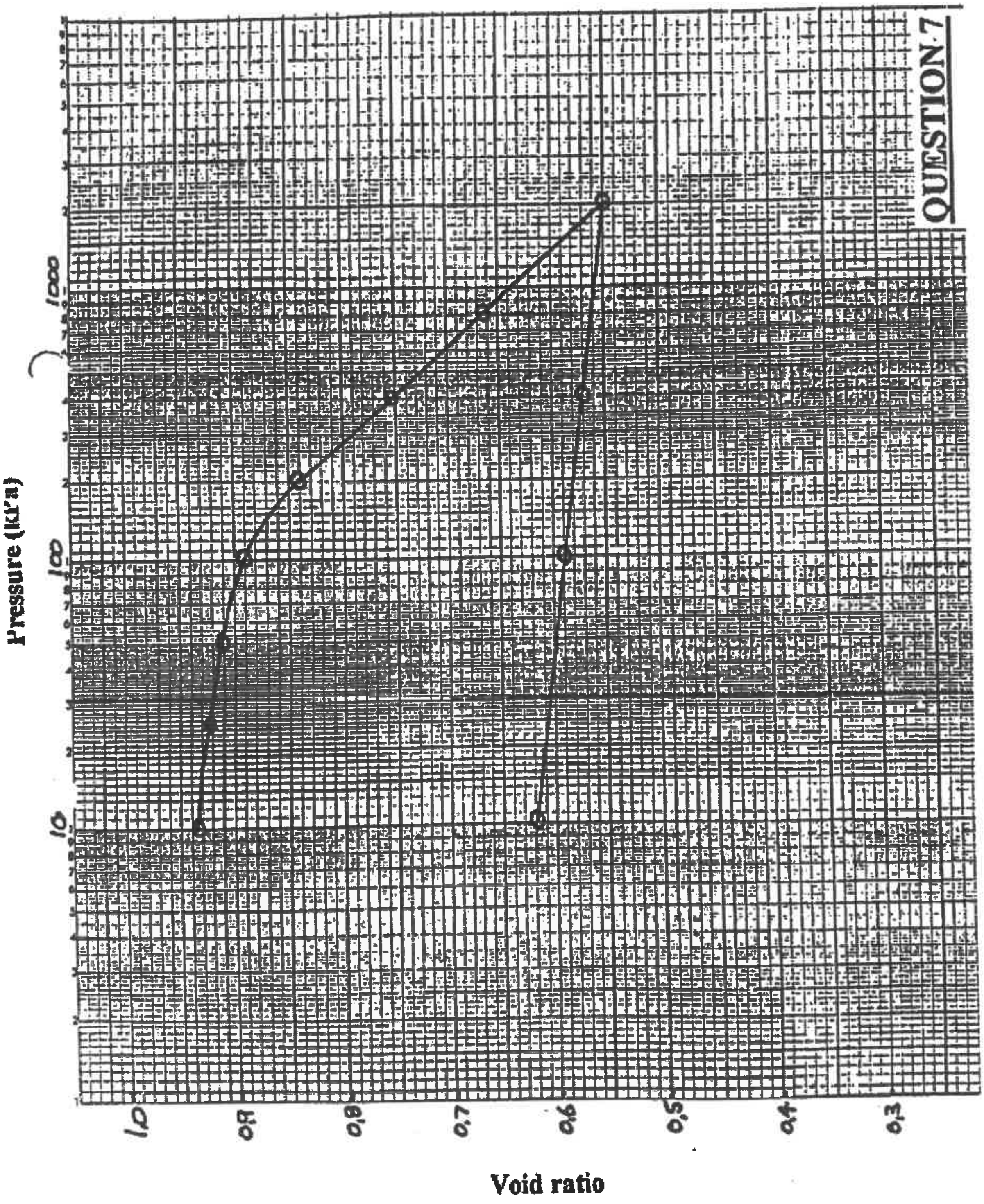
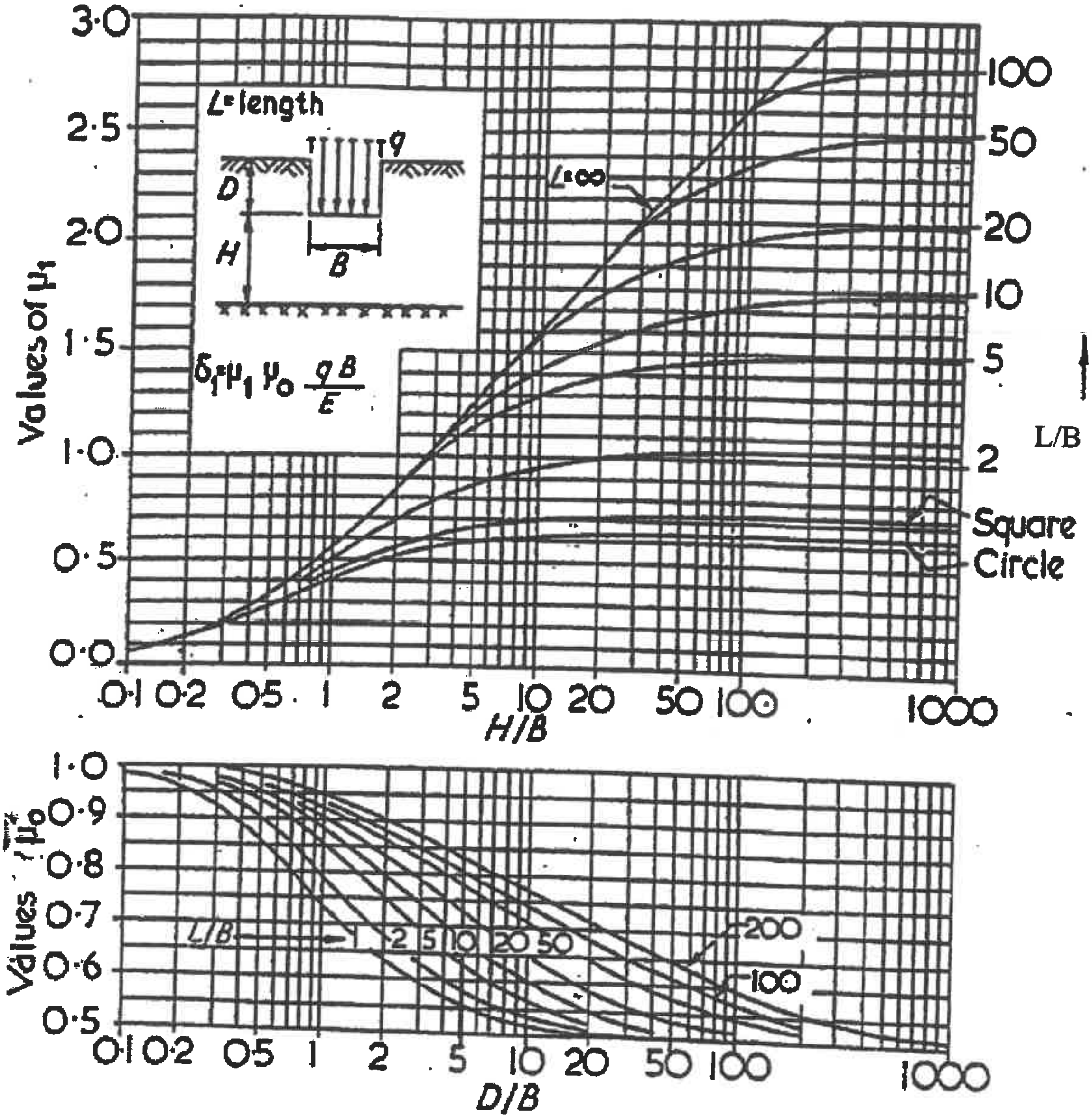


HAND IN THIS FIGURE WITH YOUR SCRIPT



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)