UNIVERSITY OF JOHANNESBURG

PROGRAM	:	BACCALAUREUS INGENERIAE *CIVIL ENGINEERING*
SUBJECT	:	**GEOTECHNICAL ENGINEERING 3B**
CODE	:	**GTG3B21**
DATE	:	EXAMINATION NOV 2014
DURATION	:	08:30 - 11:30
WEIGHT	:	50:50
TOTAL MARKS	:	100

EXAMINER	:	DR FN OKONTA
MODERATOR	:	DR HA QUAINOO
NUMBER OF PAGES	:	3 PAGES AND 2 ANNEXURES

INSTRUCTIONS	:	QUESTION PAPERS MUST BE HANDED IN.

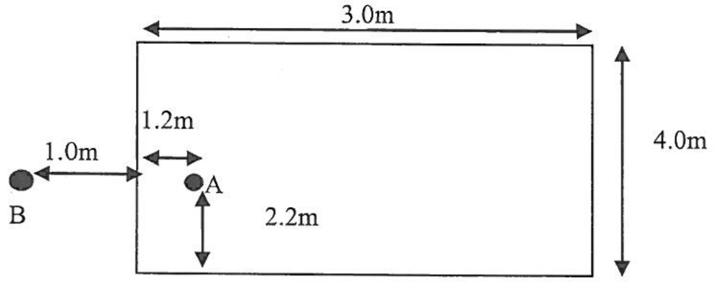
INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.
PLEASE NUMBER ALL QUESTIONS EXACTLY AS QUESTION PAPER.

QUESTION 1 (20 MARKS)

1.1) Discuss the differences in computing induced stresses in soil profiles using Analytical solutions and approximate methods. (8)

1.2). Foundation geometry is shown in figure 1, a) compute the induced vertical stress at point A 6 m into the ground, b) discuss how you would compute the induced stress at point B by the foundation . Discuss the relative magnitudes of the two values.



(12)

QUESTION 2 (20 MARKS)

2.1) Discuss the insitu states, inducing conditions and mechanism of a soil layer exhibiting consolidation settlement (5)

2.2) Compute the preconsolidation stress from a clayey sample in the laboratory of data shown in table 1, the water content of the sample was 49% insitu and it Gs = 2.66 and effective initial vertical stress at the same depth was 40kPa. (10)

2.3) The insitu unit weight of a sample taken from the centre of 10m soil profile is $15kN/m^3$. The water table is 2m from the surface. Estimate the average strain induced by a 10m water filled square tank, if table 1 represent the stress – strain behavior of the profile for (2V:1H) stress spread. (5)

Table 1: Consolidation data

σ'_z (kPa)	8	16	32	64	128	256	512	1024	16
ε_z	0.032	0.041	0.051	0.069	0.109	0.173	0.240	0.301	0.22

QUESTION 3 (20 MARKS)

3.1) A consolidation test has been performed on a sample obtained from a saturated clay at a point 6.5m below the ground surface. The groundwater table is at the ground surface and the unit weight of the clay is 18.5kN/m^3. The measured preconsolidation stress was 260kPa. a) Determine whether the soil was normally consolidated , b) compute the overconsolidation margin and the overconsolidation ratio, c) compute the preconsolidation stress at a depth 12m in the same soil. (13)

3.2) Explain the term overconsolidation margin and the overconsolidation ratio. (7)

QUESTION 4 (20 MARKS)

4.1) Provide the boundary conditions applicable when deriving the solution of the One-Dimensional Consolidation (5)

4.2) In an effort to accelerate the consolidation settlement of a 5m normally consolidated clayey layer, a fill was placed. The clay layer is fully saturated and the fill was placed directly on the clayey layer, a double drainage scenario prevailed and table 2 detailed the soil properties. Determine the required height of the fill to achieve significant settlement in 2524days before construction begins. (15)

Table 2: Proposed fill and clayey layer data

Strata	Properties
Proposed fill	γ = 17.5kN/m^3
Clayey layer	γ_{sat} = 16.0kN/m^3 sample depth = 2.5m Cc = 0.4 e = 1.10 $\delta_{c,ult}$ = 200mm c_v = 0.0021m^2/day

QUESTION 5 (20 MARKS)

5.1) Explain to the technician running a direct shear test on a fine soil, a) what is meant by undrained shear strength, and b) how to determine undrained parameters from direct shear test. (10)

5.2) Equation 1 is the failure envelope of a sandy SILT obtained 4.1m into the ground and the ground water table was located 1.1m above the sample location point A. a) Determine the vertical and horizontal shear stresses at point A if the unit weight and saturated unit weight are 17 and 17.5kN/m^3 respectively and K = 0.54. b) Determine the angle between the plane of failure and the horizontal plane. (10)

$$\tau = 10 + \sigma_z' \tan 28 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1.1)$$

YOU MAY USE ANY OF THE FOLLOWING EQUATIONS AND TABLES

$e = (1 - \varepsilon_z)(1 + e_0) - 1$ $\quad U = \left[1 - 10^{-\left(\frac{0.085 + T_v}{0.933}\right)}\right] x100\%$ $\quad U = \sqrt{\frac{4T_v}{\pi}} x100\%$

$\sigma'_{zo} = \sum \gamma H - u$ $\quad \delta_{c,ult} = \sum \left(\frac{Cc}{1 + e_0}\right) H \log\left(\frac{\sigma'_{zf}}{\sigma'_{zo}}\right)$ $\quad \rho_d = \frac{M_s}{V}$

$S = \frac{wG_s}{e} x\ 100\%$ $\quad G_s = \frac{M_s}{V_s \rho_w}$ $\quad e = \frac{G_s \gamma_w}{\gamma_d} - 1$

$\gamma_d =$

$\sigma'_m = \sigma'_c - \sigma'_{z0}$ $\quad OCR = \frac{\sigma'_c}{\sigma'_{z0}}$

$\gamma_{sat} = \frac{G_s + e}{1 + e} \gamma_w$ $\quad \delta_{c,ult} = \sum \left(\frac{Cr}{1 + e_0}\right) H \log\left(\frac{\sigma'_{zf}}{\sigma'_c}\right) + \left(\frac{Cc}{1 + e_0}\right) H \log\left(\frac{\sigma'_c}{\sigma'_{zo}}\right)$

$T_v = \frac{c_v t}{H_{dr}^2}$ $\quad \sigma'_h = K\sigma'_v$

$$\frac{u_e}{\Delta\sigma_z} = \sum_{N=0}^{\infty} \left(\frac{4}{(2N+1)\pi} \sin\left[\frac{(2N+1)\pi}{2}\left(\frac{z_{dr}}{H_{dr}}\right)\right] e^{-\left[\frac{(2N+1)^2\pi^2}{4} T_v\right]}\right)$$

$$\delta_{c,ult} = \sum \left(\frac{Cc}{1 + e_0}\right) H \log\left(\frac{\sigma'_{z0} + \gamma_{fill} H_{fill}}{\sigma'_{zo}}\right)$$

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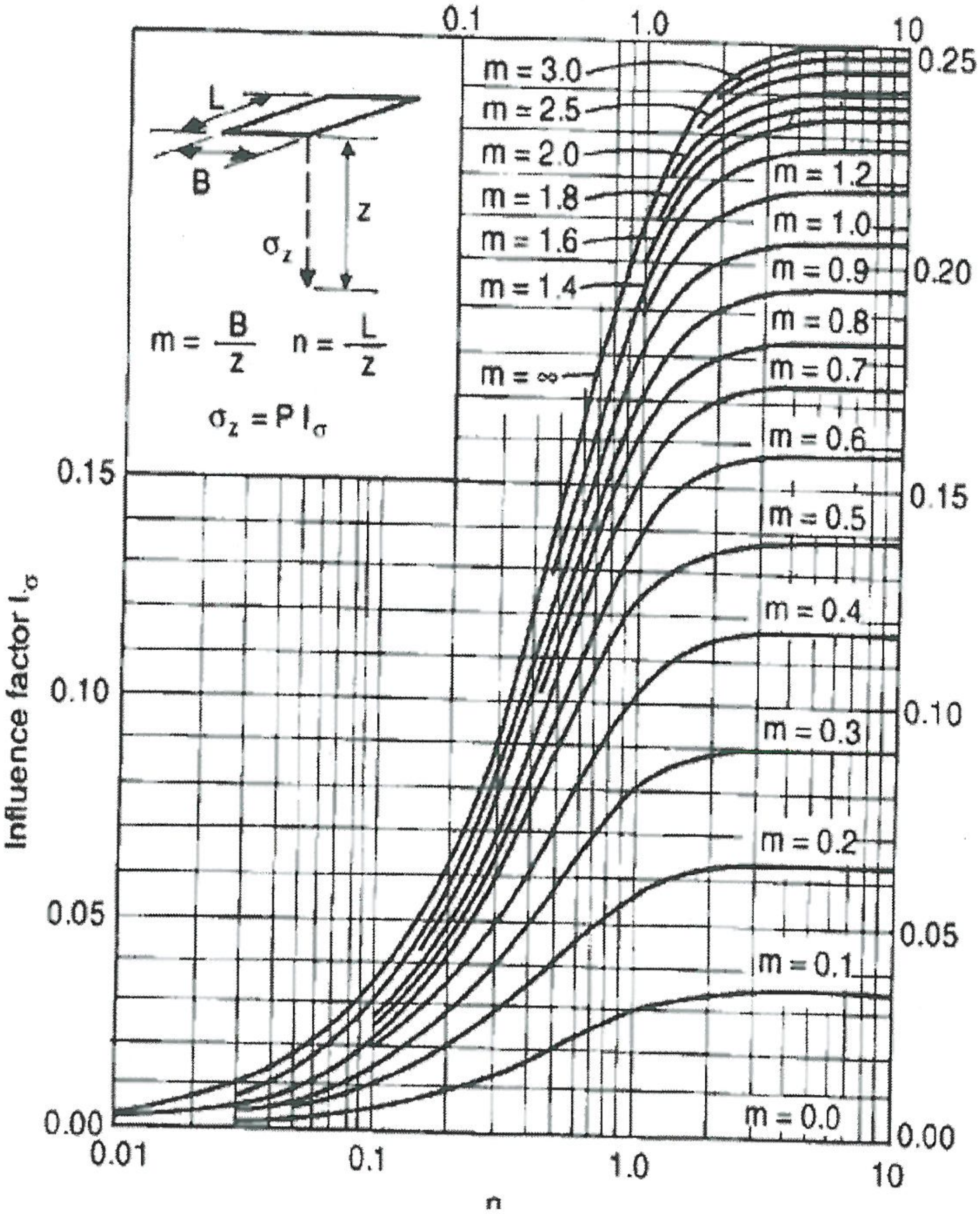

0.1
1.0
10
L
B
z
σ_z
$m = \frac{B}{z}$ $n = \frac{L}{z}$
$\sigma_z = P\,I_\sigma$
m = 3.0
m = 2.5
m = 2.0
m = 1.8
m = 1.6
m = 1.4
m = ∞
m = 1.2
m = 1.0
m = 0.9
m = 0.8
m = 0.7
m = 0.6
m = 0.5
m = 0.4
m = 0.3
m = 0.2
m = 0.1
m = 0.0
0.25
0.20
0.15
0.10
0.05
0.00
Influence factor I_σ
0.01
n

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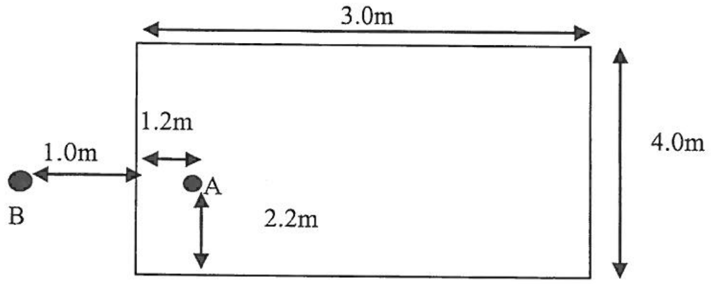

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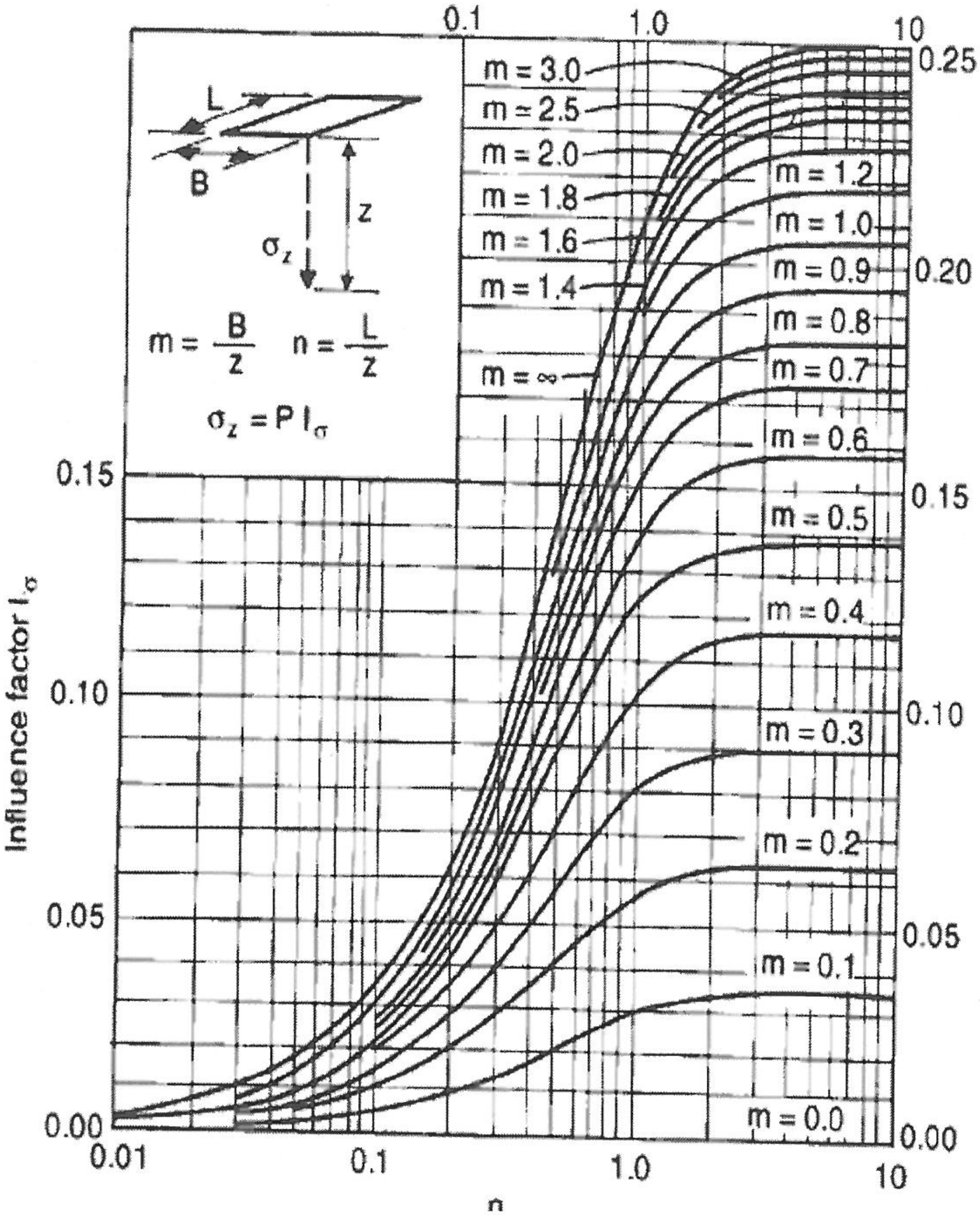
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m = 0.8
m = 0.7
m = 0.6
m = 0.5
m = 0.4
m = 0.3
m = 0.2
m = 0.1
m = 0.0
Influence factor I_σ
0.00
0.05
0.10
0.15
0.20
0.25
0.01
0.1
1.0
10
n