Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	ADVANCED GEOTECHNICS
COURSE CODE	:	BFG40203
PROGRAMME	:	4BFF
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSIST OF **SEVEN (7)** PAGES

Q1 (a) With the aid of sketch, clearly explain the Mohr-Coulomb strength envelope of saturated and unsaturated soil.

(4 marks)

(b) Give an explanation of application area of unsaturated soil mechanics in

(i) Bearing capacity of shallow foundation and
(ii) Road and railroad structures.

(3 marks)

(c) Sketch the Soil Water Characteristic Curve (SWCC) of volumetric water content vs soil suction for :

(i) Clay
(ii) Silt
(iii) Sand

(3 marks)

(d) According to SWCC shown in the **Figure Q1(d)**, explain the condition of wetting and drying of unsaturated soil.

(3 marks)

(e) The following data were obtained from modified direct shear test for unsaturated residual soil specimen size of 50 mm x 50 mm.

Table 1

(u_a-u_w) (kN/m^2)	$(\sigma- u_a)$ (kN/m^2)	Shear stress, τ (kN/m^2)
0	0	10
93	50	44
159	100	68
225	150	92
288	200	115
354	250	139
420	300	163

(i) Plot the graph matric suction versus shear stress and net stress versus shear stress.

(4 marks)

(ii) Determine the shear strength of the soil if the applied matric suction and the net stress are 500 kN/m^2 and 550 kN/m^2 respectively.

(4 marks)

(iii)If the soil becomes saturated, what is the strength of the soil when the effective normal stress is 500 kN/m^2. Comment your answer.

(4 marks)

Q2 (a) (i) What are the differences between plane strain and axisymmetric conditions ?

(ii) In 3-Dimension modeling, is it necessary to transform real case into plane strain or axisymmetric conditions. Explain why ?

(5 marks)

(b) Explain the weaknesses of 1- gravity simulation compared to enhanced gravity of centrifuge modelling

(5 marks)

(c) Explain the three **(3)** essential features of the plasticity theory :

(i) yield function
(ii) plastic potential function
(iii) hardening or softening rules

(6 marks)

(d) There are three methods (isotropic compression, 1 d consolidation and deviatoric stress over axial strain in triaxial test) to detect yielding in soil. With the aids of sketch, indicate those **THREE (3)** yield conditions of soil.

(5 marks)

(e) Critically discuss the difficulties of adopting physical models in geotechnical engineering. Your answer must contain the dimensional analysis and scaling law.

(4 marks)

Q3 (a) (i) Sketch the stress- strain curve of soil under loading which shows elastic, plastic, hardening and softening condition.

(ii) Explain why the stiffness from oedometer test is higher than from triaxial test of similar soil

(5 marks)

(b) A cylindrical soil, 75 mm in diameter and 150 mm long, is axially compressed. The length decreases to 147 mm and the radius increases by 0.3 mm. Calculate:

(i) The axial and radial strains
(ii) The volumetric strains
(iii) Poisson's ratio

(5 mark)

(c) Sketch the graph of typical results of triaxial test result (CD, CU and UU) which depicts stress , strain, volume change and pore water pressure of the following soil :

(i) Loose sand
(ii) Highly Over Consolidated Ratio (OCR) clay

(5 marks)

(d) In a triaxial compression test on a sample of soil the pore pressure is zero. The radial stress is held constant at σ_r' = 200 kPa and the axial stress is changed from σa' = 350 kPa to 360 kPa. The strains for this increment were $\delta\varepsilon_a$ = 0.05% and $\delta\varepsilon_r$ = - 0.01% . Calculate the shear and bulk modulus if the soil is isotropic and elastic.

(5 marks)

(e) The result of oedometer test was shown in the Figure **Q3(e)**, if υ = 0.35 Calculate E_{oed} and E.

(5 marks)

Q4 (a) List down the critical state parameter measured from triaxial test and the parameters of normal consolidation line from oedometer test.

(3 marks)

(b) Sketch in p,q and υ surface
(i) Roscoe surface
(ii) Hvorslev surface

(4 marks)

(c) The undrained strength properties of c and φ moves to critical state condition becomes c_u and φ_{cs} . What the philosophy behind this critical state condition.

(4 marks)

(d) The following data were obtained from a consolidation phase of a standard triaxial CU test on a clay soil. Determine the λ and κ.

Table 2

p'(kPa)	25	50	200	400	800	1600	800	400	200
e	1.65	1.64	1.62	1.57	1.51	1.44	1.45	1.46	1.47

(5 marks)

(e) The water content of a saturated soil sample at mean effective stress of 50 kN/m^2 is 80%.

The sample was isotropically consolidated with a mean effective stress of 200 kN/m^2. The water content was 40% at the end of consolidation. Then, the sample was Isotropically unloaded to a mean effective stress of 150 kN/m^2, and the water content increased by 5%.

(i) Draw the NCL and URL in (p',e) and (lnp',e) spaces.
(ii) Calculate λ and κ
(iii) Draw the initial yield surface and the CSL in (p', q), (p',e) and (lnp',e) spaces if $\phi'_{cs} = 25^o$

(9 marks)

END OF QUESTION

FINAL EXAMINATION

SEMESTER / SESSION : I / 2013/2014
COURSE : ADVANCED GEOTECHNICS

PROGRAMME : 4 BFF
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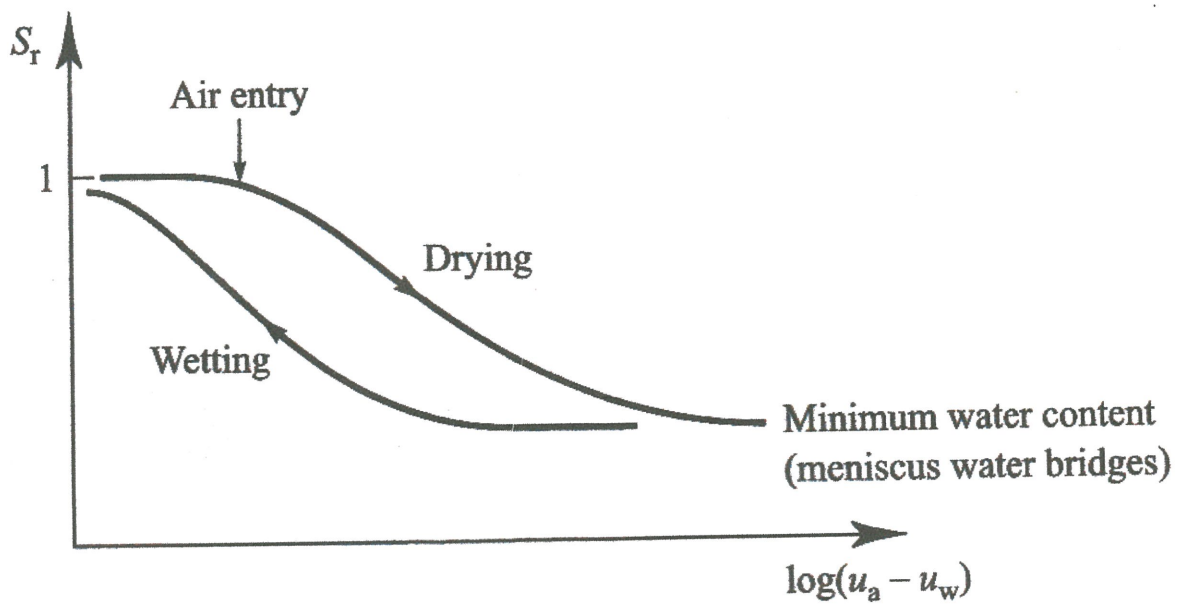

Figure Q1(d) : SWCC of saturation vs soil suction

FINAL EXAMINATION

SEMESTER / SESSION : I / 2013/2014 PROGRAMME : 4 BFF
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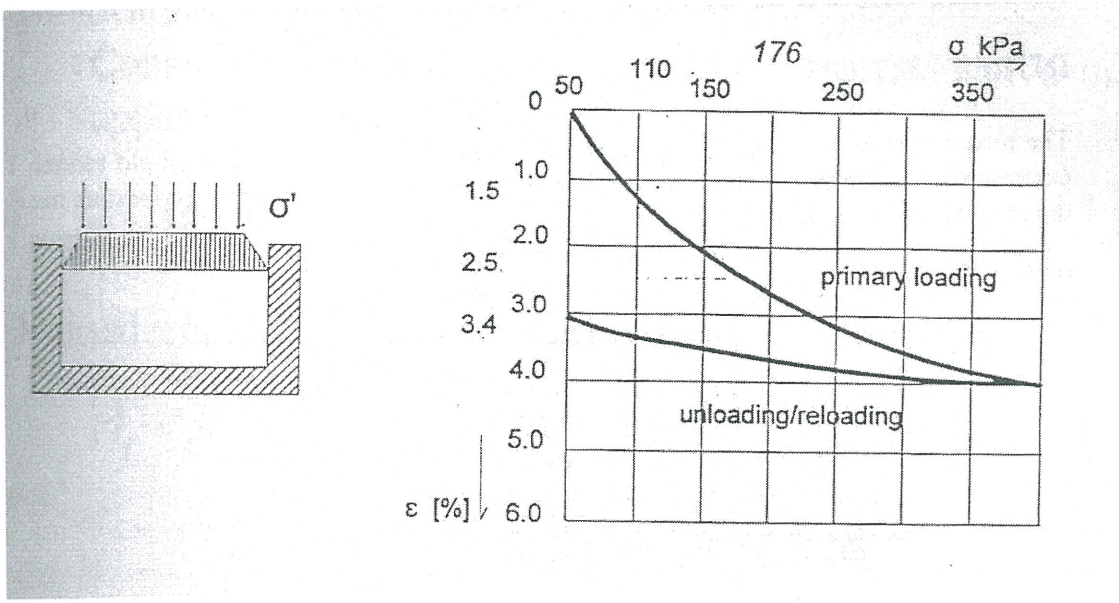

Figure Q3(e) : Result from Oedometer