University of Technology

Building and Construction Eng. Dept.

Final Exam / 2015

Subject : Soil Mechanics Class: 3rd Year

Branch : All Branches Time: 3 hrs.

Note: Answer Five Questions only including question one

ملاحظة : الاجابة عن خمسة اسئلة على ان يكون السؤال الاول من ضمنها

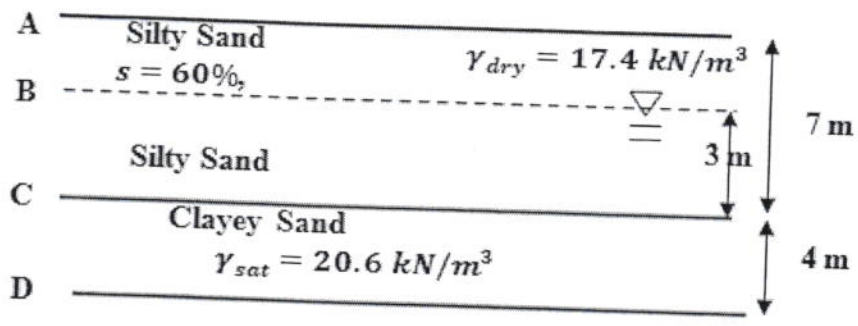
Q. No. 1:

Select the correct answer: **(20 marks)**

1. The ratio of the volume of voids to the total volume of soil is:
   a. Void ratio. b. Air content c. Degree of saturation. d. Porosity.
2. A soil sample has a specific gravity of 2.60 and a void ratio of 0.78. The water content required to fully saturate the soil at that void ratio will be:
   a. 20% b. 60 % c. 40% d. %30
3. The critical hydraulic gradient of a soil increases with :
   a. decrease in void ratio. b. increase in void ratio.
   c. decrease in specific gravity. d. none of the above.
4. Quick sand is:
   a. a type of soil.
   b. a condition in which a cohesive soil loses its strength.
   c. a condition in which a cohesionless soil loses its strength because of upward flow of water.
   d. none of the above.
5. A soil of 2000 kN is uniformly distributed over an area of 3 m x 2 m. The average vertical stress at a depth of 2 m using 2:1 method is:
   a. 100 kN/m^2 b. 160 kN/m^2 c. 48 kN/m^2 d. 37 kN/m^2
6. With an increase in the liquid limit, the compression index:
   a. decreases. b. increases. c. remains constant. d. may increase or decrease.
7. When consolidation of a saturated soil sample occurs, the degree of saturation:
   a. increases. b. decreases. c. remains constant. d. may increase or decrease.
8. For saturated normally consolidated soils, Skempton's pore pressure parameters can be represented as:
   a. $A < 1, B = 1.$ b. $A > 1, B > 1.$ c. $A > 1, B < 1.$ d. none of the above.
9. The rise of water due to capillary action:
   a. reduces the effective stress. b. increases the effective stress. c. does not alter the stresses. d. none of the above.
10. Under a load, the void ratio of a submerged saturated clay decreses from 1.0 to 0.92. The ultimate settlement of a layer 2 m thick will be:
    a. 2.0 cm b. 4.0 cm c. 8.0 cm d. 16.0 cm.

Q. No. 2:

A) Calculate and draw diagrams of distribution of the total stress, the effective stress and pore water pressure (at points A, B, C and D) if the capillary rises 1 m above the water table level. (*Note*: $G_s = 2.7$ *for both soils*). **(10 marks)**



B) A soil sample was compacted in the standard compaction apparatus. The results of the dry unit weight and moisture content are given below. If the sample had a dry mass of 452 gm when it was compacted at W opt., Gs = 2.7, determine γ_t, e, n and the total volume of the sample (after compaction) **(10 marks)**

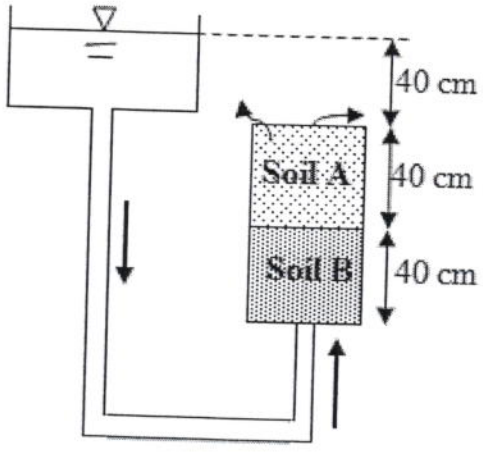
Moisture content (w%)	12.0	15.0	18.0	22.0	26.0	30.0	33.0
Dry unit weight (kN/m^3)	16.25	16.62	16.94	17.20	17.3	17.2	16.75

Q. No. 3:

A) For the setup shown, if 40% of the excess hydrostatic pressure is lost in flowing through soil B which has a coefficient of permeability of 0.05 cm/sec., determine:

a. The approach velocity and seepage velocity through each soil.

b. The hydraulic head at which instability (boiling) occurs.



Soil Type	e	G
A	0.5	2.65
B	0.6	2.67

(10 marks)

B) The following results were taken from a direct shear test conducted on a sample of soil.

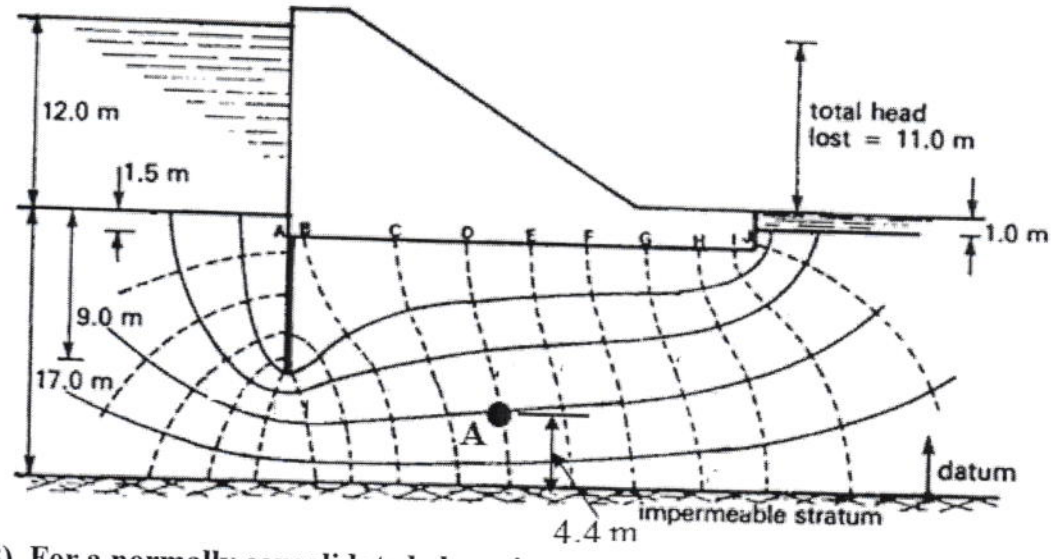
Test	Shear force (kg)	normal load (kg)
1	52.272	90
2	28.836	27

If the size of the shear box is 6 cm x 6 cm determine the shear strength parameters C and Ø for the soil. **(10 marks)**

Q. No. 4:

A)The cross-section of a dam founded on a permeable stratum, which is underlain by an impermeable stratum is shown in Fig. below. The coefficient of permeability k is 5.2 x 10^{-5} m/s. A row of sheet piles has been inserted near the upstream face of the dam in order to reduce thequantity of seepage: **(10 marks)**

a) **Determine the seepage quantity per meter.**
b) **Plot the distribution of uplift pressure acting on the base of the dam.**
c) **The piezometer reading at point (A).**



B) For a normally consolidated clay, given: **(10 marks)**

$Po' = 215\ kN/m^2$ at $eo = 1.22$

$Po' + \Delta P' = 430\ kN/m^2$ at $e = 0.98$

$k = 0.3 \times 10^{-8}$ m/sec. **Find:**

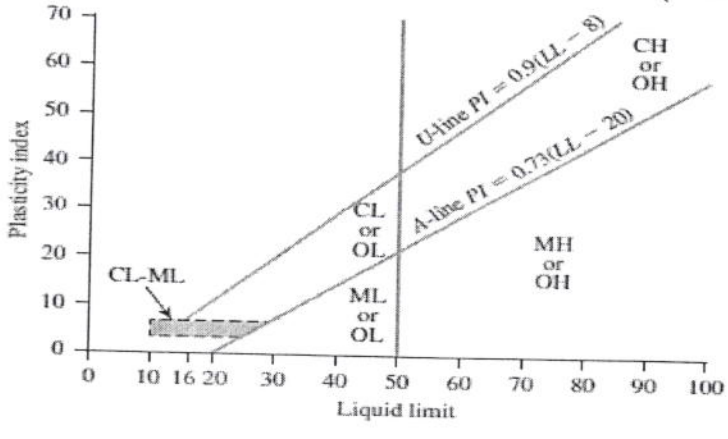
1. **How long (in days) will it take for a (3 m) thick layer of the same clay (drained on both sides) in the field to reach (50%) consolidation.**
2. **What is the settlement at (50%) consolidation.**

Q. No. 5:

A) **(6 marks)**

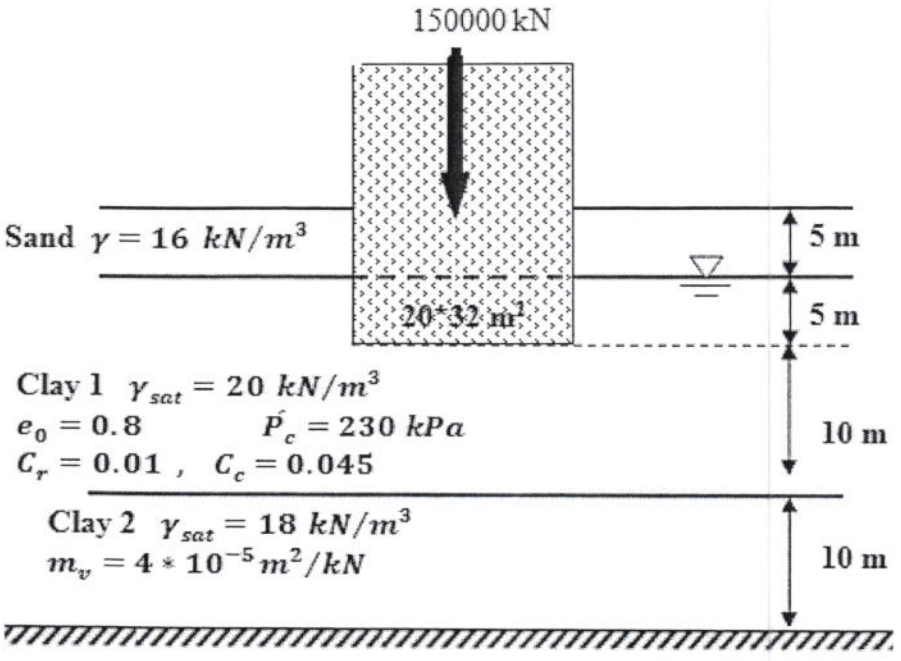
The following are the results of a sieve analysis:
Classify the soil according to unified Soil Classification System (USCS).

Sieve number	% Passing
40	100
80	97
170	92
200	90
L.L	67
P.L	35



B) A building is 20*32 m in plan. The total weight of the building is 150000 kN. It will be built on a 10 m deep raft foundation as shown in the figure: **(14 marks)**

1- **Calculate the net foundation pressure.**
2- **Calculate the final consolidation settlements of this building.**
3- **If the allowable settlement is 1 cm for clay2: calculate the net foundation pressure that would cause this settlement.**

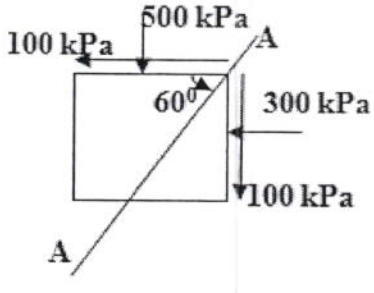


Q. No. 6:

A) A saturated specimen of cohesionless sand was tested under drained conditions in a triaxial compression test apparatus and the sample failed at a deviator stress of 482 kN/m^2 and the plane of failure made an angle of 60° with the horizontal. Find the magnitudes of the principal stresses. **(10 marks)**

B) For the given stress condition find:

1- **Principal stresses and their orientation.**
2- **The stresses on plane A-A.**



(10 marks)

Some useful information:

For N.C.C. $S_{cf} = \frac{Cc}{1+e} H log \frac{P_\circ + \Delta P}{P_\circ}$

For O.C.C. $if\ P_\circ + \Delta P \leq P_C\ then\ S_{cf} = \frac{Cr}{1+e} H log \frac{P_\circ + \Delta P}{P_\circ}$

$if\ P_\circ + \Delta P > P_C\ then$ use: $S_{cf} = \frac{Cr}{1+e} H log \frac{P_c}{P_\circ} + \frac{Cc}{1+e} H log \frac{P_\circ + \Delta P}{P_c}$

$O.C.R = \frac{P_c}{P_\circ}$

$T_v = 1.781 - 0.933 \log (100 - U_{av})$ for $U_{av} > 60\%$