FINAL

CIVE 431
Soil Mechanics and Laboratory

SPRING 2006
Professor: Salah Sadek

CLOSED BOOK/NOTES, 2 ½ HOURS

Programmable calculators are not allowed. Question sheets *must* be returned with the answer booklet.

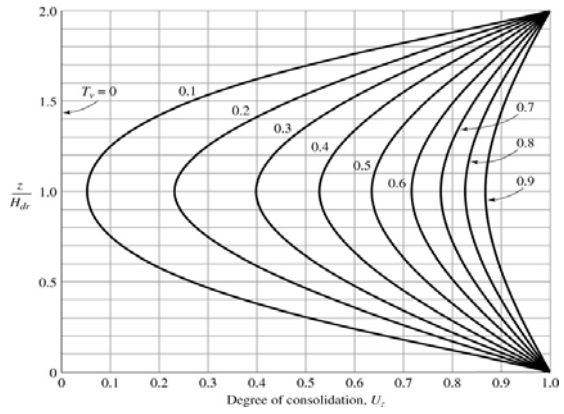
Name : _____ **ID #:** _____

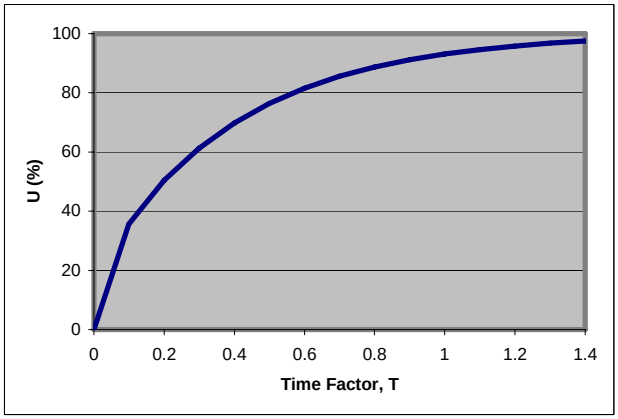
Manage your time carefully (quickly read through all the problems before starting the exam, & do not spend an hour on one problem!).

Good Luck!

NOTE:
The following might be of help:
Unit weight of water, γ_w = 9.81 kN/m^3 = 62.4 lb/ft^3
Seepage Force/Volume = i . γ_w
$\gamma_{sat} = (G_s+e).\gamma_w/(1+e)$

Consolidation:
Time factor $T=c_v.t/H^2$
Relation between Time Factor and U (% consolidation)





PROBLEM -1 (10 Points)

A soil sample is taken from the field and brought to the laboratory for testing. In the lab, the "natural" dry density of the sample is determined to be 15.0 kN/m^3.

Further tests allow the determination of the maximum and minimum possible dry densities. The obtained values are 17.0 kN/m^3 and 13.0 kN/m^3, respectively. G_s is measured at 2.65.

(a) What is the relative density, D_R, of the sample as obtained from the field?

(b) Assuming the sample was disturbed while being transported from the site to the lab, and that its volume decreased by ~ 4% during transport. What is the error in D_R calculated in (a) as a result of the sample disturbance

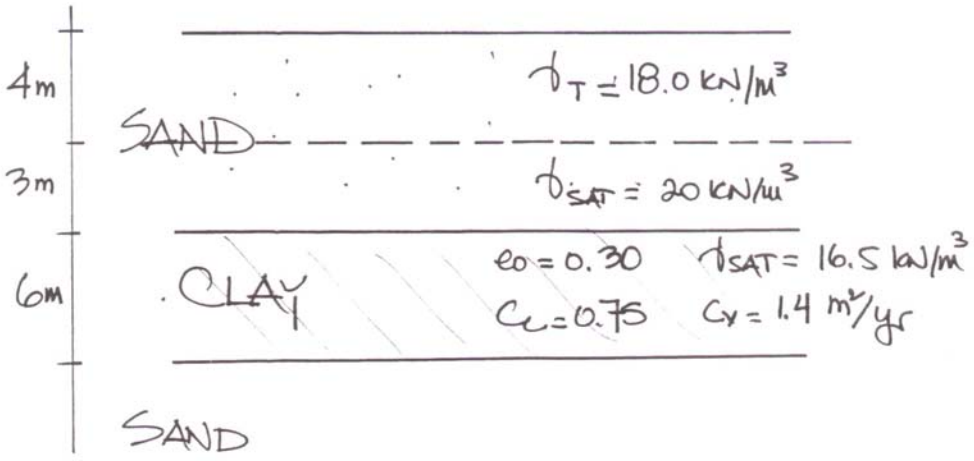
Problem #2: (25 Points)

A proposed fill (surcharge) is to be constructed at a site having the subsurface conditions shown in the figure below. The fill would impose a net pressure increase of Δp=75kN/m^2.

(a) Assuming that the clay layer is *normally consolidated*, estimate the ultimate consolidation settlement due to the fill surcharge.

(b) Estimate how long it would take for 85% of the ultimate settlement calculated in (a) to occur.

(c) It is suggested that the surcharge be temporarily increased in order to shorten the time required to reach the amount of settlement calculated in (a). Estimate the surcharge magnitude required to cause a consolidation settlement equal to 95% of that calculated in part (a) within an 8 months period.

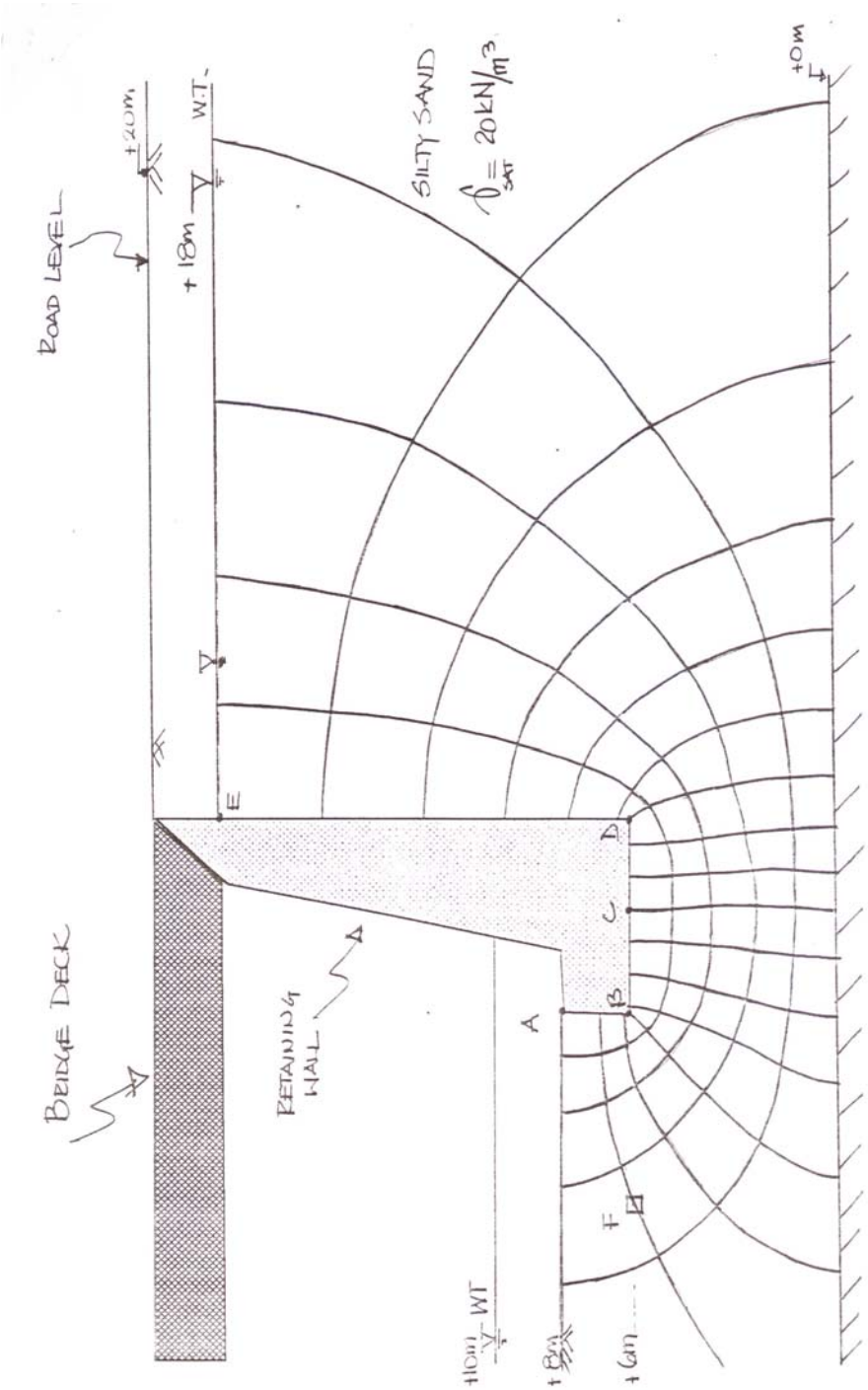


Problem #3: (15 Points)

A section of a Bridge abutment is shown in the attached Figure. Given the water levels as shown on either side of the retaining wall answer the following questions:

Note: Dimensions and levels are indicated on the Figure. ***Heights and lengths can be scaled from the figure***.

Calculate the vertical effective stress at point F (shown on the figure).



Problem #4: (20 Points)

A compacted soil specimen is 75mm in diameter and 150mm long. It is to be prepared from oven dry soil (G_s = 2.67), and water. The specimen is to have a water content of 15% and air content of 17%.

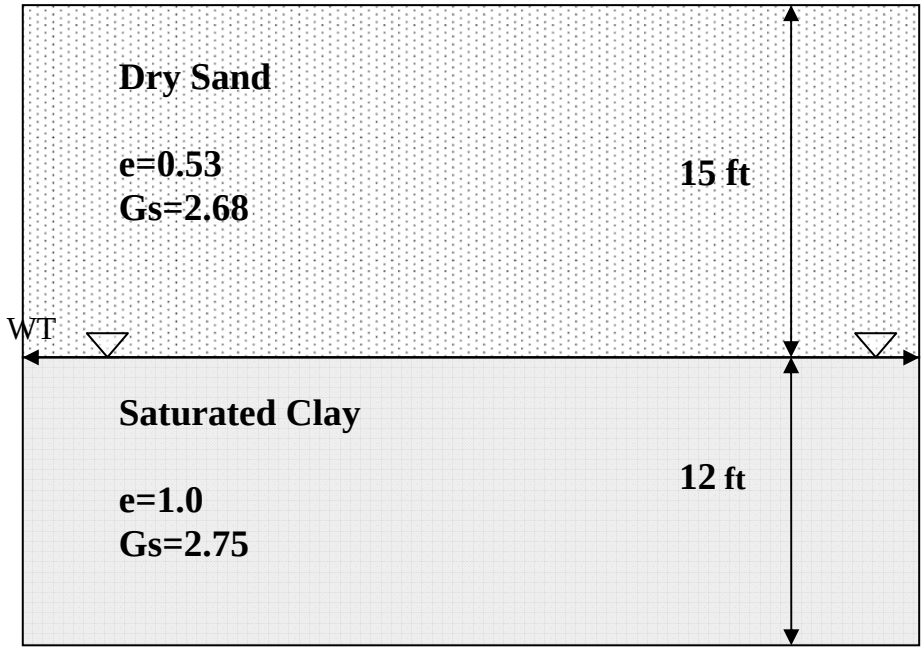
(Note: air content = volume of air x100% / total volume).

Calculate:
(a) The *mass of soils* **and** *volume of water* required for the preparation of the specimen.

(b) The bulk unit weight γ_T, the dry unit weight γ_d, the void ratio **e**, the degree of saturation **S** and the porosity **n**, of the compacted specimen.

Problem #5: (15 Points)

Refer to the soil profile shown below:



(a) Calculate and plot the variation of **total stress, pore water pressure and effective stress** with depth.

(b) If the water rises to the top of the ground surface what is the change in the effective stress at the bottom of the clay layer?

(c) How many feet must the groundwater table rise to decrease the effective stress by 250 lb/ft^2 at the bottom of the clay layer?

Problem #6: (15 Points)

The total consolidation settlement for a compressible layer 7m thick is estimated to be about 30cms. After about 6 months (180 days), a point 2m below the top of the ***singly drained*** layer (point A), had a degree of consolidation of 60%

(a) – Compute the coefficient of consolidation of the clay c_v, in m^2/day.

(b) – Compute the settlement of the clay layer at 180 days.