Middle East Technical University
Civil Engineering Department
Geotechnical Engineering Division

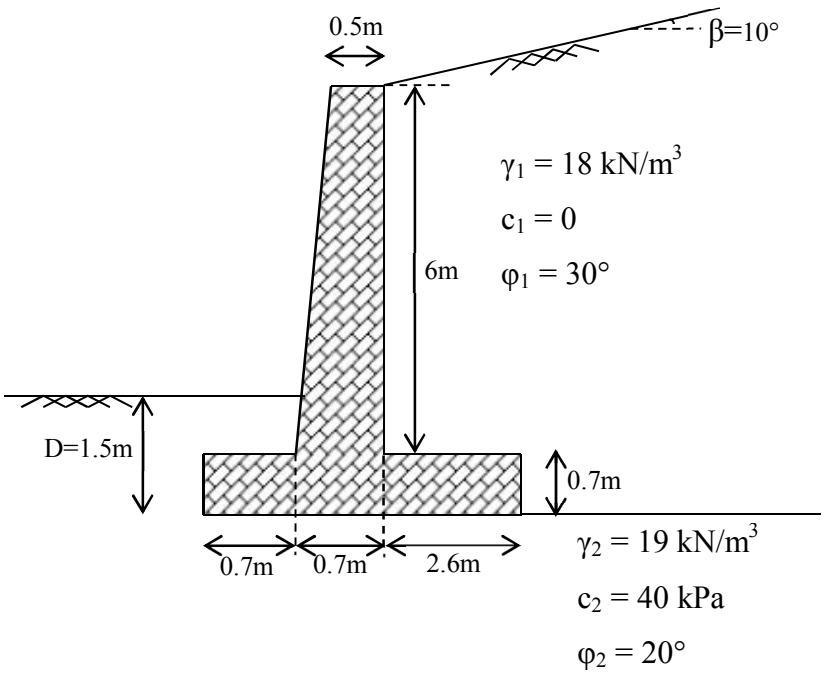
CE 366-FE1

(www.ce.metu.edu.tr/~ce366)
Spring' 2011-2012
Homework 3

Regulations:	
Due date:	*May 30, 2012, Wednesday at 17:00* (Do not subject to postpone)
Submission:	You will submit the homework to course assistants
Help:	You can ask your questions about the homework to the assistant **during their office hours** listed on the web.
Team:	The homework has to be done individually. Improper collaborations will get zero.
Solutions:	The solutions of homework questions will be uploaded to official web site.

Question 1

The cross section of a cantilever retaining wall is shown in Figure 1. Calculate the factors of safety with respect to overturning and sliding and bearing capacity.



NOTES:

(i) Depth of water table is at least 4 m below the base of the retaining wall.

(ii) Take $\gamma_{concrete} = 24$ kN/m^3.

(iii) Use reduced shear strength parameters by a factor of 2/3 when calculating the forces acting on soil-concrete interaction.

(iv) Do not consider passive resistance for factor of safety against overturning and bearing capacity. Consider passive resistance only for sliding and do not reduce the passive resistance (assume passive resistance can totally develop).

(v) Use Rankine's Lateral Earth Pressure Theory where K_A is:

$$K_A = \cos\beta \frac{\cos\beta - \sqrt{\cos^2\beta - cos^2\varphi}}{\cos\beta + \sqrt{\cos^2\beta - cos^2\varphi}}$$

and K_P is:

$$K_P = \frac{1 + \sin\varphi}{1 - \sin\varphi}$$

(vi) Use the general bearing capacity equation:

$$q_u = c_2 N_c d_c i_c + \gamma D N_q d_q i_q + \frac{1}{2}\gamma_2 B N_\gamma d_\gamma i_\gamma$$

$$d_c = 1 + 0.4\left(\frac{D}{B}\right)$$

$$d_q = 1 + 2\tan\varphi_2\,(1 - \sin\varphi_2)^2\left(\frac{D}{B}\right)$$

$$d_\gamma = 1$$

$$i_c = i_q = \left(1 - \frac{\psi}{90}\right)^2$$

$$i_\gamma = \left(1 - \frac{\psi}{\varphi}\right)^2$$

Where;

$$\tan\psi = \frac{\sum H}{\sum V}$$

Question 2

For the sheet pile wall presented in the figure given below, by using Rankine's earth pressure theory and free earth support method, answer the followings:

a) draw horizontal stress distribution along the sheet pile height until point O.

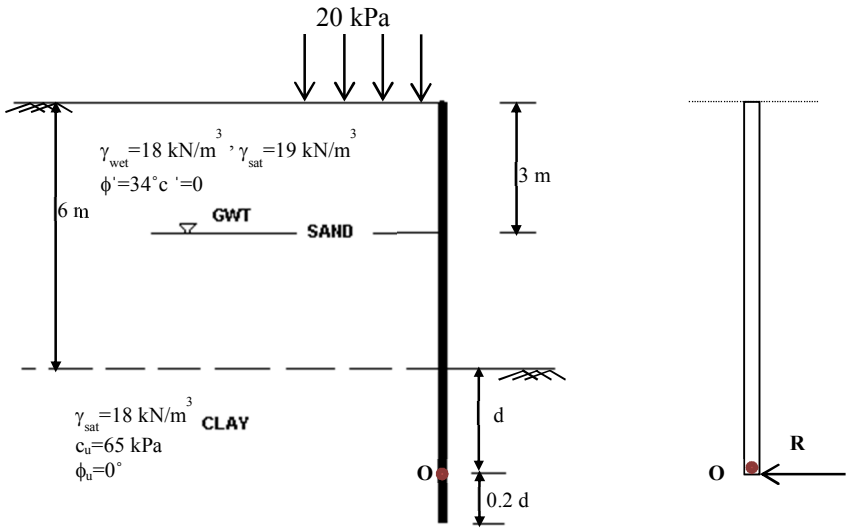
b) estimate the depth of penetration, d, of cantilever sheet pile wall,

c) estimate the maximum shear in the sheet pile.

d) check if net passive resistance below point "O" is greater than "R"

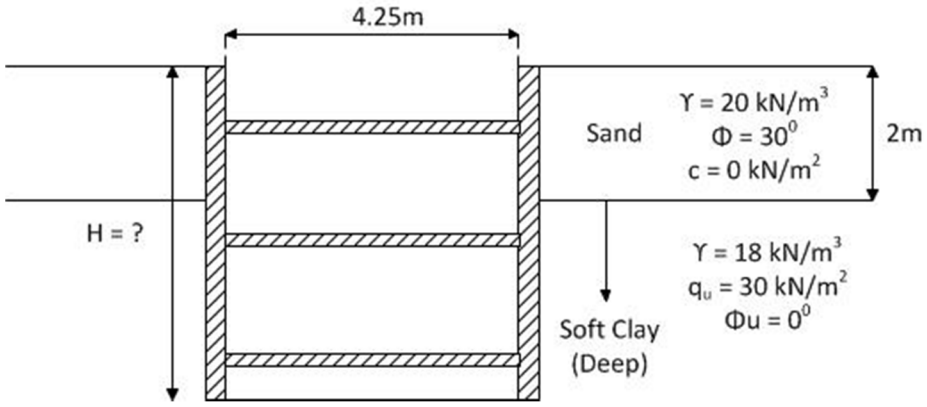
$$K_A = \frac{1-sin\phi}{1+sin\phi};\ p_A' = K_A\gamma' z - 2c'\sqrt{K_A}\ ;\ K_P = \frac{1+sin\phi}{1-sin\phi};\ p_P' = K_P\gamma' z + 2c'\sqrt{K_P}$$

Hint: Passive resistance is recommended to be penalized by a F.S. =1.5



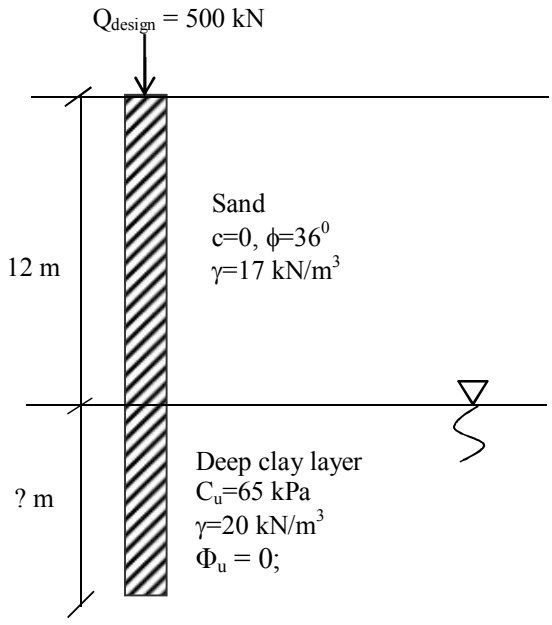
Question 3

A long braced system is to be constructed in a layered soil profile as shown in the figure below. Determine the critical depth "H" at which a bottom heave failure is to be expected.
$B_1 = 0.707xB$ and $K_a = \tan^2(45-\Phi/2)$



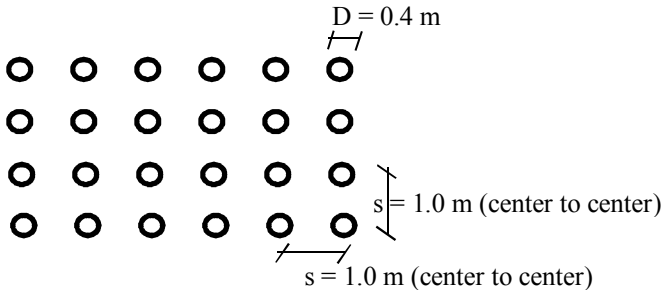
Question 4

A structure is to be supported by 0.6 m diameter bored piles. The required design load per pile is calculated as 500 kN. Determine the required pile length using a factor of safety of 2.5.
(Use $\delta = \frac{3}{4}\ \Phi$. $D_{cr} = 15D$, where δ is the angle of friction between sand and pile surface, D is the pile diameter).



Question 5

Consider the group of floating piles given in the figure below. The pile group is to be constructed in a deep layer of saturated clay of which the undrained cohesion and unit weight are 30 kPa and 21 kN/m^3, respectively. The piles are 7 m in length and 0.4m in diameter. Determine the allowable load per pile using Terzaghi-Peck block analysis and check whether it is necessary to consider group effect.



Question 6

Watch the video of an anchored retaining wall construction (about 6 minutes long video) and anwer the questions below:

http://www.youtube.com/watch?v=6BsYGd0lXUs

- What is the final depth of excavation?
- Anchors are inclined at . . . . . degree from horizontal.
- The fixed length (grouted length) of anchors are . . . . . m.
- What type of soil exists at the site? Assuming that there is no surcharge at the ground surface, calculate the lateral earth pressure distribution and the active thrust, you expect at the back of this pile wall system for the final depth of excavation (assume any missing data).
- Anchors are tensioned by a hydraulic jack to . . . . . tons.
- What is a waling beam?

Question 7

A harbour structure is resting on pile foundations as shown in the figure below. The loads acting on the foundation system includes a trapezoidally distributed vertical load and temporary skip impact load of 200 kN/m acting in horizontal direction. Determine the maximum and minimum axial loads on the piles.