ELIZADE UNIVERSITY, ILARA-MOKIN
FACULTY OF ENGINEERING
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
FIRST SEMESTER 2019/2020 EXAMINATIONS

CVE 409: Elements of Foundation Engineering **Units: 3** **Time Allowed: 3Hrs**

INSTRUCTION: Answer ANY FOUR Questions

Question 1 (25 marks)

(a) A cutting 10m deep with sides sloping at 8:5, shown in Figure 1 is to be made in a clay soil having a mean undrained strength of 19.0 kN/m^3. Determine factor of safety, F under immediate (undrained) conditions against slope failure shown

(i) If lower 6m of the backfill is submerged

(ii) If there is no external water pressure on the bank face

Assume $Z_c = 1.33\ \gamma/H$, for the tension cracking. **(14 marks)**

(b) What are the differences between gravity and cantilever retaining walls? **(5 marks)**

(c) Globally, there are two methods of analysing slope stability via stress system approach. Write short note on the two methods. **(6 marks)**

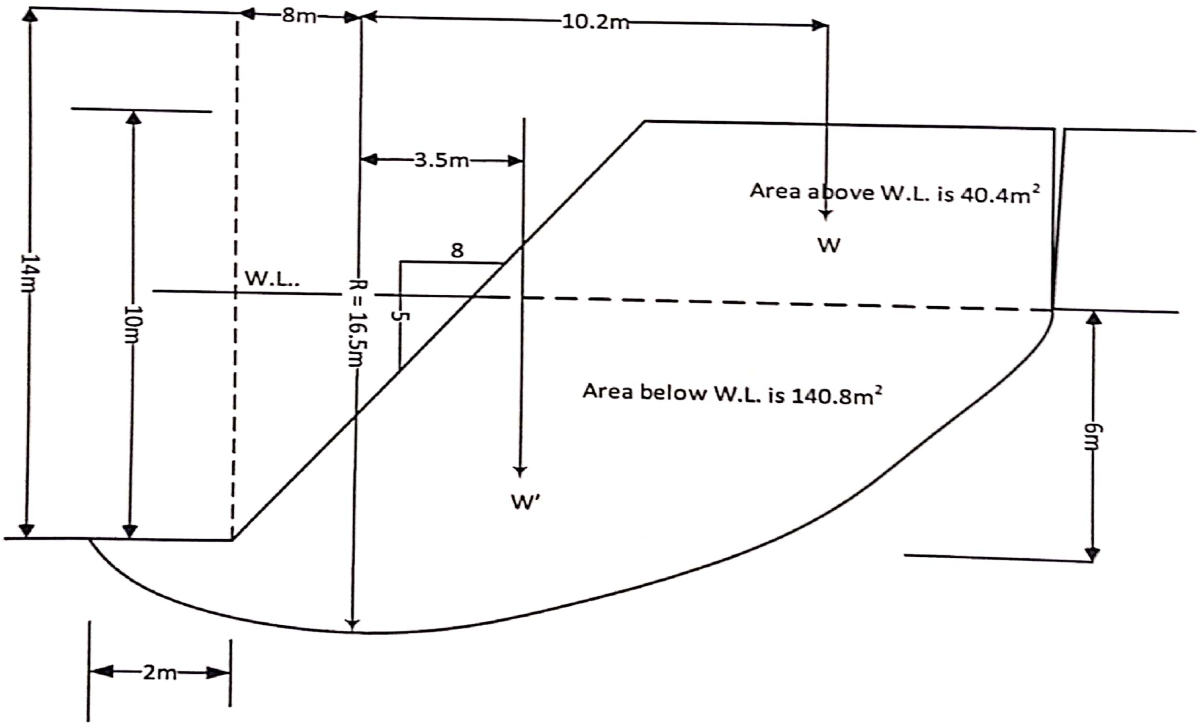

Figure 1: Cutting with Side Slope

Question 2 (25 marks)

(a) The foundation for a rectangular tower block 40m x 20m in plan is to be constructed at a depth of 6m with one storey basement as shown in Figure 1 resting on the top of a layer of dense silty sand.

The soil profile comprises 6.0m of clay (C_u = 70kN/m^2, γ_{sat} = 18kN/m^3, $\Phi_u = 0^o$) underlain by fine sand (c = 10kN/m^2, γ_{sat} = 20kN/m^3, $\Phi = 26^o$). The groundwater level is at a depth of 3.0m. If the total allowable bearing capacity of the sand is given by:

$$q_{a=\frac{1}{f}}\{1.2cN_c + P_o'(N_q - 1) + 0.4\gamma BN_\gamma\} + P_o$$

Calculate the maximum allowable load intensisty the building can carry for a factor of safety f = 2.5 considering the weight of the clay removed during excavation for the basement and the foundation weight is 40kN/m^2. Also note that when $\phi = 0^o$, N_c = 5.7, N_q = 1, N_γ = 0; but when ϕ = 26°, N_c = 16.53, N_q = 6.05, N_γ = 2.59.
(15 marks)

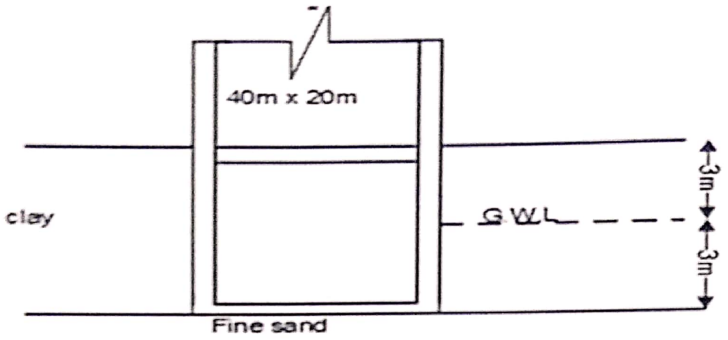

Figure 2: Foundation for a Rectangular Tower Block

(b) With the aid of cleared labeled diagram and all assumptions stated, derive Bishop's Simplified method of analyzing slip surface stability problems. **(10 marks)**

Question 3 (25 marks)

(a) A concentrated load of 1000kN is applied at the ground surface. Compute the vertical pressure i) at a depth of 4m below the load ii) at distances of 3m, 4m and 6m but at the same depth. Use the Boussinesq's equation supplied. Draw inference from the results obtained. **(10 marks)**

$$\sigma_z = \frac{Q}{z^2} I_B, \text{ where } I_B = \frac{3/2\pi}{\left[1 + (r/z)^2\right]^{5/2}}$$

(b) Write short note on local shear failure associated with shallow foundation. **(10 marks)**

(c) State three assumptions made during the derivation of Boussineq's formula for estimating stresses distribution in soil layers. **(5 marks)**

Question 4 (25 marks)

(a) A foundation 2m square is installed 1.2m below the surface of a uniform sandy soil having bulk density γ = 20kN/m^3 above the water table and a submerged density of 10.2kN/m^3. The effective strength parameters are c' = 0, $\Phi = 30^o$. Calculate q_f when i) water table is far below the footing, ii) water table is not at footing level, iii) water table is at ground surface, d) use the answers obtained to draw an inference on the effect of rising in water level on soil bearing capacity. When $\Phi = 30^o$ N_q = 18.4 and N_γ = 18.1. Also, $q_f = 1.3cN_c + q'N_q + 0.4B\gamma N_\gamma$. **(15 marks)**