447.328 Theory of Reinforced Concrete and Lab. II
Fall 2007

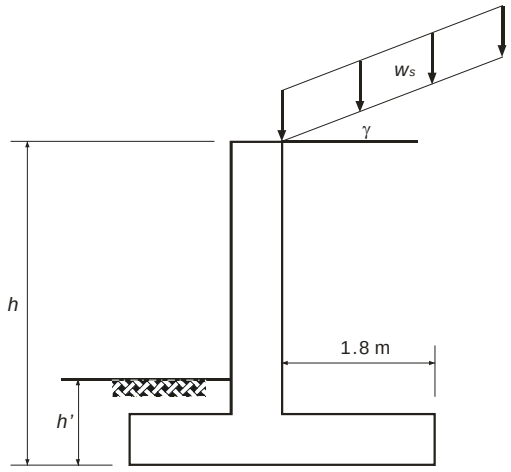
Final Exam **December 17, 2007**
(Closed Textbook & Note) **Instructor: JAE-YEOL CHO**

Problem 1. (**15 pts.**) A reinforced concrete footing supports 350mm × 350mm column reaction P = 1780 kN at the frost line (900 mm below grade). The load acts at an eccentricity e_1 = 120 mm, e_2 = 400 mm, e_3 = 670 mm. Select the necessary area of footing assuming that it is rigid and has a thickness h = 760 mm. Soil test indicates that the bearing area is composed of layers of shale and clay to a considerable depth below the foundation. Use a unit weight γ = 22 kN/m^3. (Assuming an allowable bearing capacity is q_a = 620 kN/m^2 at the footing base level.)

Problem 2. (**15 pts.**) Service dead load is 1,800 kN and service live load is 1,100 kN. Soil density is 19 kN/m^3. Allowable soil pressure is 290 kN/m^2. Column cross section is 750 mm × 300 mm. f_{ck} = 21 MPa and f_y = 410 MPa. Select the elevation of the top of the footing so that there is 150 mm of soil and 150 mm slab on the grade above the footing.

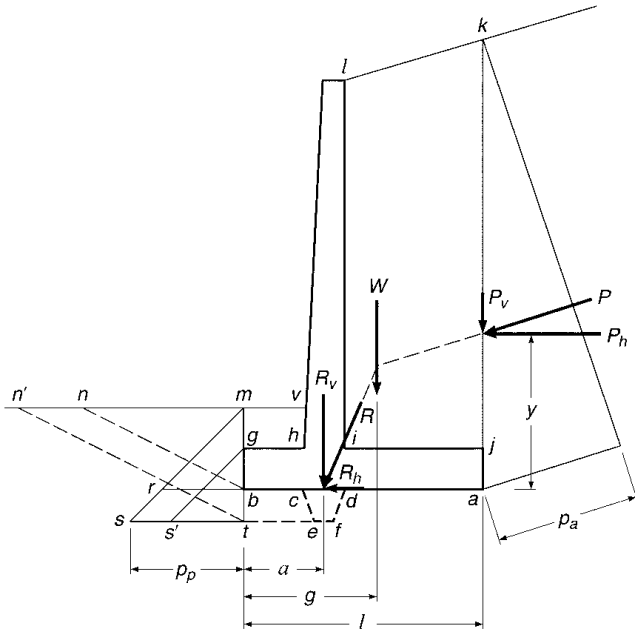
Problem 3. (**10 pts.**) Compute the active earth pressure horizontal forces on the wall shown for the following conditions. Use w = 16 kN/m^3.

(1) $\phi = 30^\circ$, $\gamma = 0^\circ$, w_s = 10 kN/m^2, h = 6.0 m
(2) $\phi = 33^\circ$, $\gamma = 20^\circ$, w_s = 0 kN/m^2, h = 7.6 m



Hint) $C_a = \cos\delta \dfrac{\cos\delta - \sqrt{\cos^2\delta - \cos^2\phi}}{\cos\delta + \sqrt{\cos^2\delta - \cos^2\phi}}$

Problem 4. (**15 pts.**) Explain the *external stability* of retaining wall using the following figure and simple equations.



Problem 5. (**10 pts.**) The magnitude of the prestress force is not constant. List up the prestress losses (both instantaneous losses and long-term losses) and explain them.

Problem 6. (**10 pts.**) Illustrate the critical section for flexure and shears of footings using figures.

Problem 7. (**10 pts.**) Discuss the difference of behaviors of two-way edge supported slabs and column supported slab.

Problem 8. (**15 pts.**) It has been found experimentally that the increase in compressive strength of the core concrete in a column provided through the confining effect of spiral steel is closely represented by the equation

$$f_c^* - 0.85 f_{ck} = 4.0 f_2^{'}$$

(1) Explain each parameter in the above equation.
(2) Derive f_2' and express it with spiral reinforcement ratio ρ_s and f_y.