Yonsei University
Dept. of Civil and Environmental Engineering

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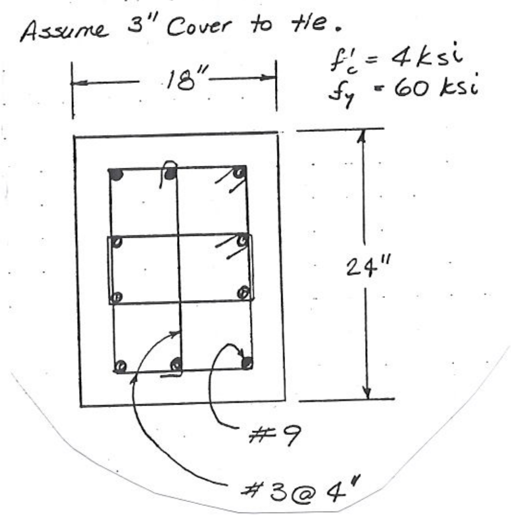
Advanced Concrete Member Behavior
CEE6301-01

Problem 1 : [Total 50 points]

(A) For the column cross section shown below, calculate the peak stress capacity of the confined core. Cylinder strength test of 4000 psi achieved. [25 points]

(B) Describe expected post-spalling behavior under axial load of a ten foot long column with the cross-section shown below. [25 points]

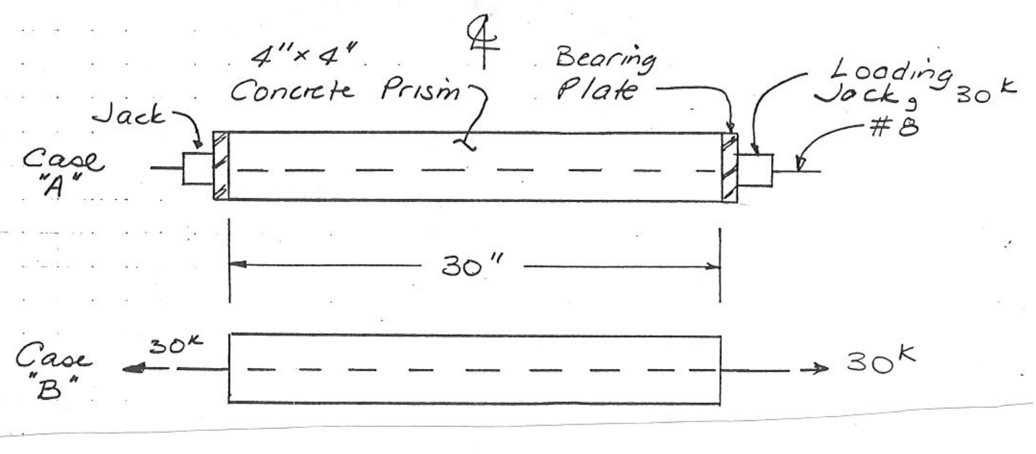


Problem 2 : [Total 50 points]

Shown below are two concrete prism with embedded #8 longitudinal bar bonded to the concrete. f'_c=4000 psi and f_y=60,000 psi.

(A) Two jacks pull the #8 bar, reacting against bearing plates that are expoxied to the prism. Calculate the bar slip from concrete at one end when tension of 30 kips is applied. Case "A" [25 points]

(B) The bars are pulled with same 30 kip force with no reaction on concrete. Calculate the slip from concrete at one end. Case "B" [25 points]



Good Luck!

$$\tau_a = \frac{f_t A_c}{\pi d_o L} \times 1.5$$

$$K_{tr} = \frac{A_{tr} f_y}{1500 s}$$

$$f_c = 2 \frac{\epsilon}{\epsilon_o}\left(1 - \frac{1}{2}\frac{\epsilon}{\epsilon_o}\right) f'_c$$

$$\rho_s \geq 0.12\, f'_c / f_y$$

$$\sigma_a = (\sigma_1 + \sigma_2 + \sigma_3)/3$$

$$\sigma = \left[\frac{\Sigma x_i^2 - (\Sigma x_i)^2/n}{(n-1)}\right]^{1/2}$$

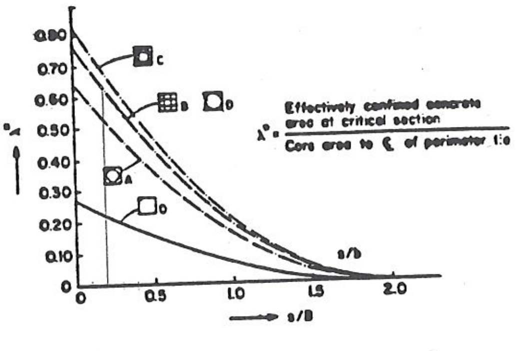


FIG. 7.—Effectively Confined Concrete Area as a Function of Tie Spacing and Core Size for Various Square Steel Configurations

$$l_s = \frac{1860}{\sqrt{f'_c}} d_b \geq 20 d_b$$

$$f_r = \frac{\pi^2 E}{(kl/r)^2}$$

$$A_{sh} = 0.3\left(\frac{A_g}{A_c} - 1\right)\frac{f'_c}{f_y} s h$$

$$r = d_o/4$$

$$f_{cmax} = f'_c + 4.1 f_r$$

$$\rho_o = 0.85 \beta_1 \frac{f'_c}{f_y} \frac{87000}{87000 + f_y}$$

$$f_c = f_{cmax}\left[1 - Z(\epsilon_c - \epsilon_o k)\right]$$

$$\tau_a = \frac{1}{\sqrt{15}}\left[(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2\right]^{1/2} \quad ; \quad k = K_{tr} + c$$

$$f_{cr} = f'_c + t\sigma$$

$$\rho_s = 0.45\left(\frac{A_g}{A_c} - 1\right)\frac{f'_c}{f_y}$$

$$A_{sh} \geq 0.09\, s h\, f'_c / f_y$$

$$Z = \frac{0.5}{\frac{3 + 0.002 f'_c}{f'_c - 1000} + \frac{3}{4}\rho_s \sqrt{\frac{b}{s}} - 0.002}$$

$$l_d = \frac{5500 A_b}{\phi k \sqrt{f'_c}}$$

bar#	d_b (in)	A_b (in²)
3	3/8	0.11
4	4/8	0.20
5	5/8	0.31
6	6/8	0.44
7	7/8	0.60
8	1	0.79
9	1.12	1.00
11	1.44	1.56