

Reinforced Concrete II - BCE  
 Fourth Year

June 5, 2011  
 Final Exam-First Attempt

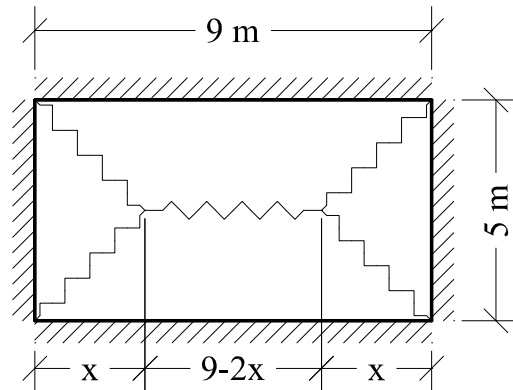
Time: Three Hours  
**Open Book & Notes**

**Note: Answer 4 (four) Questions**

Dr. Bassman R. Muhammad

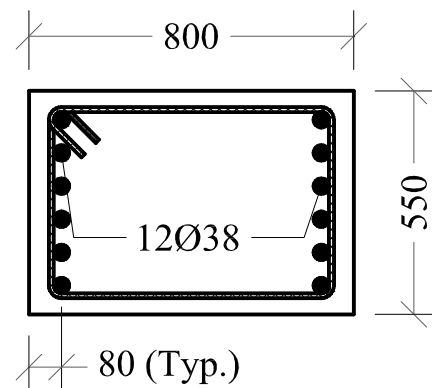
**Apply the latest ACI 318 M Code Specifications**

**Q1:** (25%) The uniformly loaded isotropically reinforced concrete slab is simply supported at its four – edges, as shown in the figure. The NOMINAL resistance (Isotropic) moment  $m_n = 32 \text{ kN.m/m}$ . Using yield line analysis (virtual work ITERATION) calculate the uniform load values  $w_n$  &  $w_u$  (in  $\text{kN/m}^2$ ).

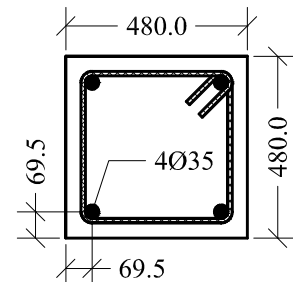


Note: (use one digit for x values)

**Q2:** (25%) The tied column ( $800 \times 550 \text{ mm}$ ) has  $A_{st} = 13610 \text{ mm}^2$  (longitudinal steel reinforcement);  $f'_c = 28 \text{ N/mm}^2$ ;  $f_y = 400 \text{ N/mm}^2$ ;  $P_u = 5150 \text{ kN}$ ;  $\psi_t = \psi_b = 3$ ; storey stability index ( $Q$ ) = 0.25. Equal factored moments (about major axis) at the top and bottom (causing single curvature) are  $M_{ns} = 210 \text{ kN.m}$  and  $M_s = 850 \text{ kN.m}$ .  $\ell_u = 3.5 \text{ m}$ . Assume that  $\beta_{dns} = 0.4$  for the nonsway part and  $\beta_{ds} = 0$  for the sway part. Also assuming that all storey columns have the same  $P_u$  and  $P_c$  values. Is the column safe per ACI 318M-08 code?

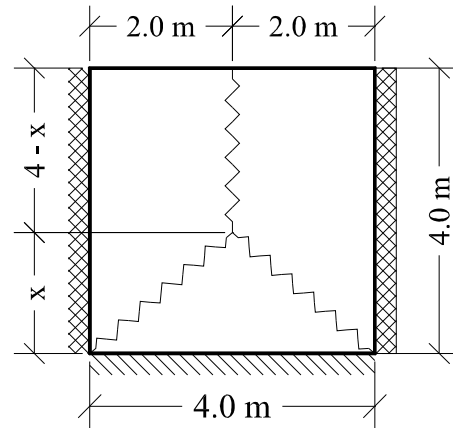


**Q3:** (25%) The short tied  $480 \times 480 \text{ mm}$  column has four 35 mm longitudinal bars;  $f'_c = 26 \text{ N/mm}^2$ ;  $f_y = 400 \text{ N/mm}^2$ ;  $P_u = 2275 \text{ kN}$ ;  $M_{ux} = 195 \text{ kN.m}$ . Using the Bresler Reciprocal Method, calculate the allowable value of the factored bending moment  $M_{uy}$ .



**Q4:** A uniformly loaded isotropically reinforced slab is supported as shown in the figure. Using the principle of Virtual Work, find the collapse load ( $w_n$ ). Assume that the plastic moment of resistance per meter width of slab for positive and negative sections ( $m_n$ ) are 22 & 44 kN.m/m respectively.

**(25%)**

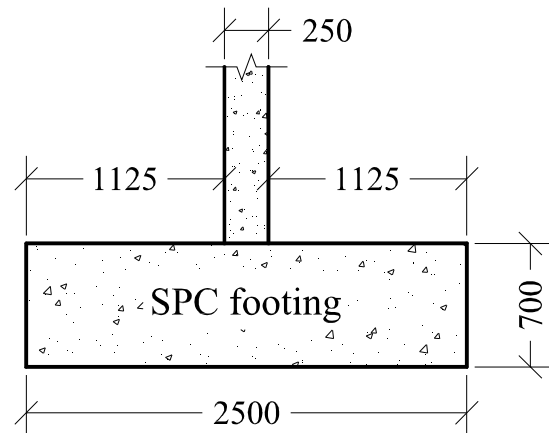


**Q5:** The 250 mm concrete wall is supported by structural plain concrete (SPC) footing: 700 mm deep and 2.5 m wide. The allowable soil bearing pressure = 145 kN/m<sup>2</sup>. Service loading consists of D = 200 kN/m and L = 100 kN/m.  $f'_c = 25$  N/mm<sup>2</sup>. Assuming no soil overburden, find if the SPC footing is safe per ACI 318M-08 code for:

**(25%)**

- I. Soil bearing;
- II. Concrete flexural stress; and
- III. Concrete Shear.

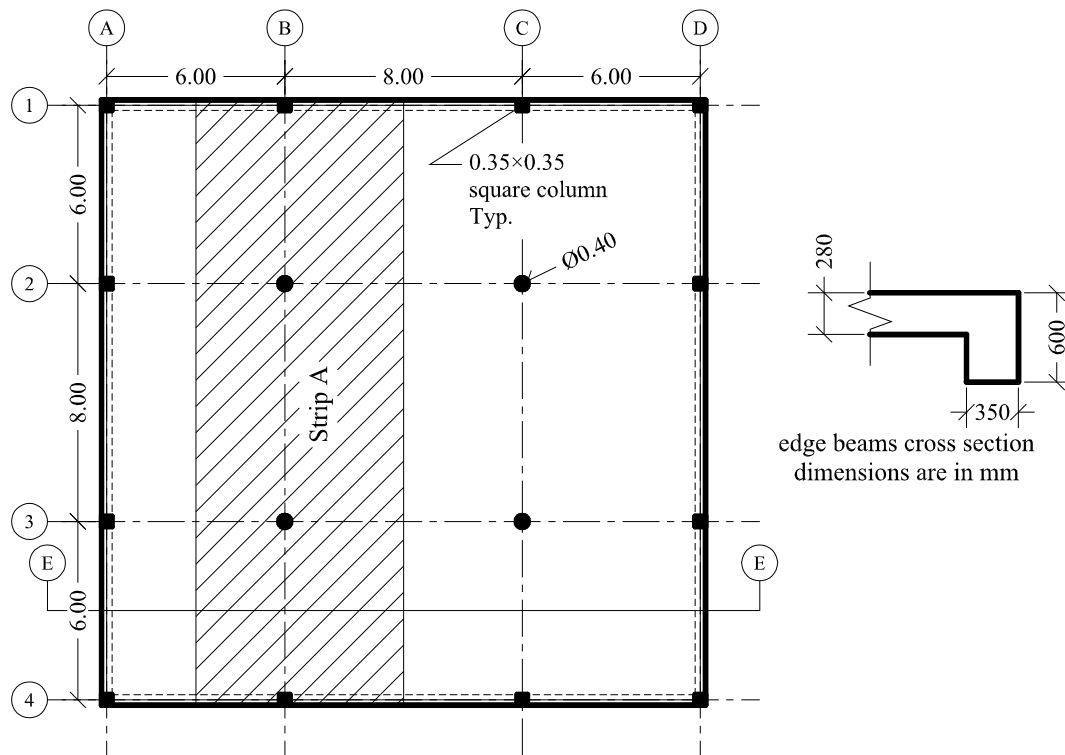
Discuss the adequacy of the design.



**Q6:**  
**(25%)**

The reinforced concrete flat plate shown in the figure is supported along its outer edges by reinforced concrete beams of 350 mm × 600 mm. The slab supports a service live load of  $2.8 \text{ kN/m}^2$  and a service total dead load of  $7.1 \text{ kN/m}^2$  (including the slab self weight). Slab thickness  $h_{\text{slab}}$  is 280 mm. Edge columns are square of  $350 \times 350$  mm; interior columns are circular of 400 mm in diameter. Use  $f'_c = 26.7 \text{ N/mm}^2$  and  $f_y = 276 \text{ N/mm}^2$ , using  $\text{Ø}12$  mm bars for the slab.

- using the ACI 318M-08 Direct Design Method, design and detail the column strip bottom bars required at section E-E of (**Strip A**) shown in the plan; and
- Check interior columns for two way shear.



*Good luck and best wishes*