

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2013
Program: B.Sc. Engineering (Civil)

Course Title: Design of Concrete Structures II
 Time: 3hrs

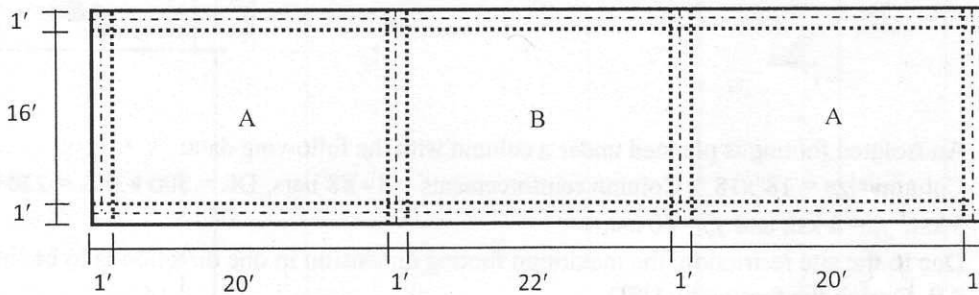
Course Code: CE 317
 Full Marks: 15x10=150

There are two parts of this question. (Part A and Part B)

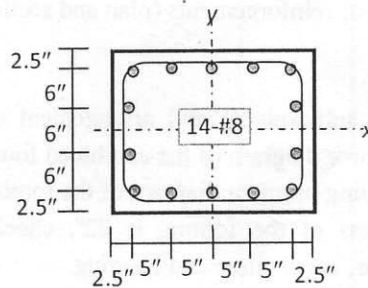
PART A

[There are 10 (ten) questions. Answer any 7 (seven)]

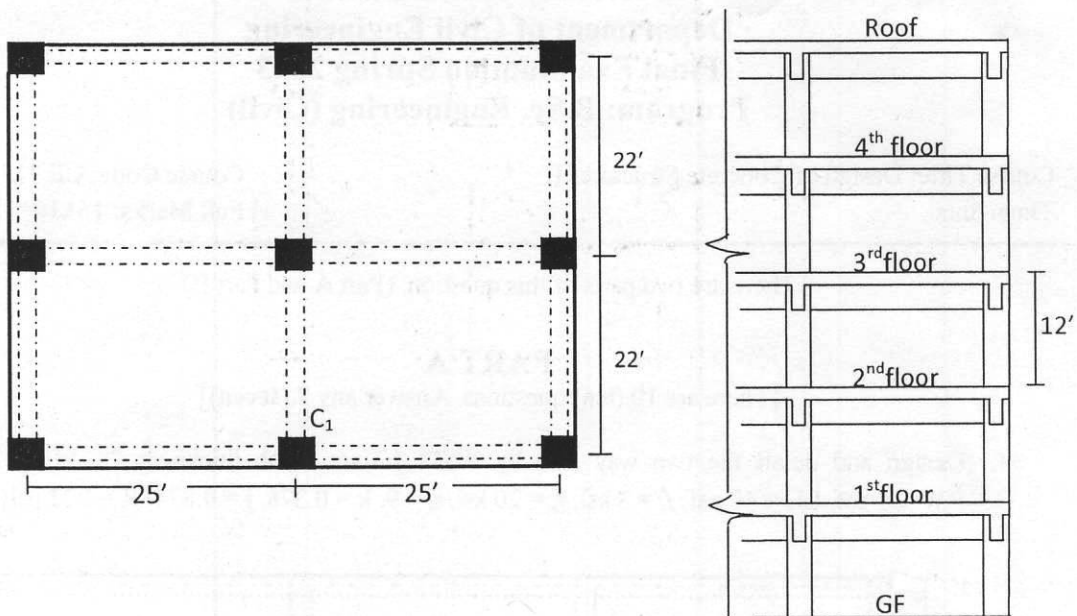
1. Design and detail the two way slab by WSD. [Given, Slab thickness 7", FF = 25 psf, RW=25 psf, LL = 40 psf, $f'_c = 3$ ksi, $f_s = 20$ ksi, $n = 9$, $k = 0.378$, $j = 0.874$, $R = 223$ psi]



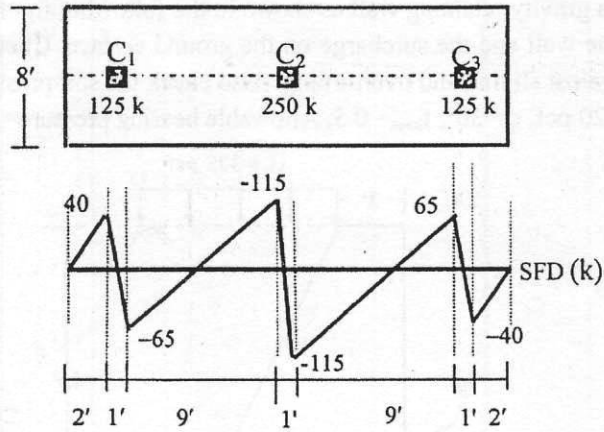
2. For the tied column section shown below [with $f'_c = 3$ ksi, $f_y = 60$ ksi], use the WSD to
- Draw the interaction diagram about x-axis
 - Calculate the allowable moment of the section if it is subjected to axial force
 - $P = 200$ k and
 - $P = 600$ k
 - Using Bresler's equation, verify if the section is allowed to take $P = 350$ k along with bending moments $M_x = 900$ k-in and $M_y = 1200$ k-in.



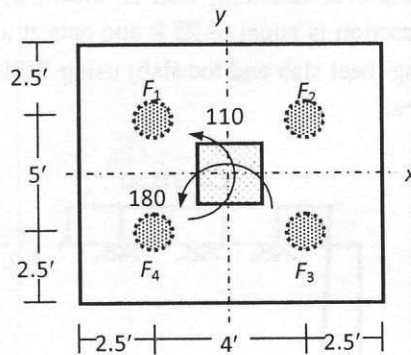
3. Refer to the following figure. Design the column C1 at ground level using USD. Design data: Slab thickness 8", Proposed column size 24"x24", LL on floor slab= 40 psf, LL on roof slab= 20 psf, Random wall= 25 psf, Lime Concrete on roof= 20 psf, Floor Finish= 25 psf, Beam size 12"x24" (including slab), $f'_c = 4$ ksi, and $f_y = 60$ ksi.



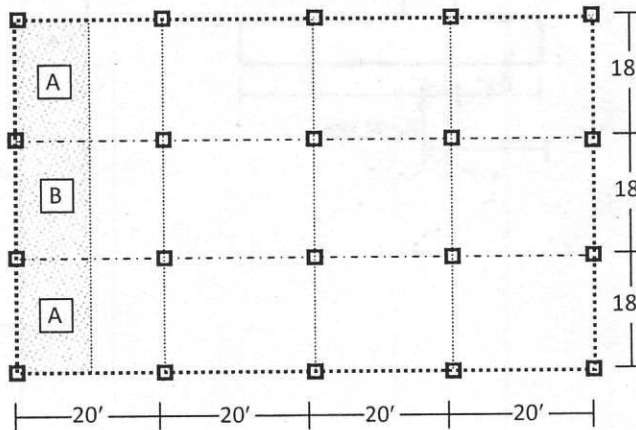
4. An isolated footing is planned under a column with the following data:
 Column size = 18"x18" , Column reinforcements = 8 - #8 bars, DL = 300 k, LL = 220 k, $q_{all.} = 5$ ksf, $f'_c = 4$ ksi, and $f_y = 60$ ksi.
 Due to the site restriction, the maximum footing dimension in one direction is to be limited at 8 ft. Design the footing by USD.
 Follow the steps mentioned below:
- i. Calculation for bearing area (i.e. size of the footing)
 - ii. Check for punching shear
 - iii. Check for beam shear
 - iv. Calculation for design moment and check for footing thickness
 - v. Calculation for reinforcements
 - vi. Check for flexural bond stress
 - vii. Design for dowels
 - viii. Neat sketches of reinforcements (plan and sections)
5. The loads (including self-weight) and arrangement of columns of size 12"x12" and the corresponding shear force diagram of the combined footing are shown below. Use WSD to
- i. Draw the bending moment diagram of the footing.
 - ii. If the thickness of the footing is 22", check the adequacy of the thickness for punching shear, beam shear and bending.
 - iii. Calculate longitudinal reinforcements and show them in neat sketch.



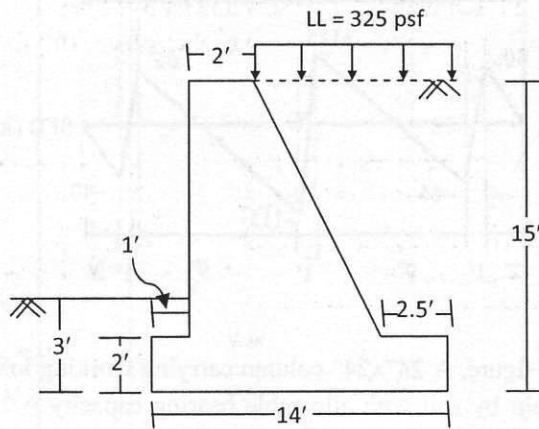
6. Refer to the following figure. A 24"×24" column carrying working loads of $DL = 225$ k, and $LL = 175$ k is underlain by soil with allowable bearing capacity = 2 ksf. The column also carries biaxial moments (due to LL) of $M_x = 110$ k-ft and $M_y = 180$ k-ft. Design the pile foundation by USD. [Given: $f'_c = 3$ ksi, $f_y = 50$ ksi].



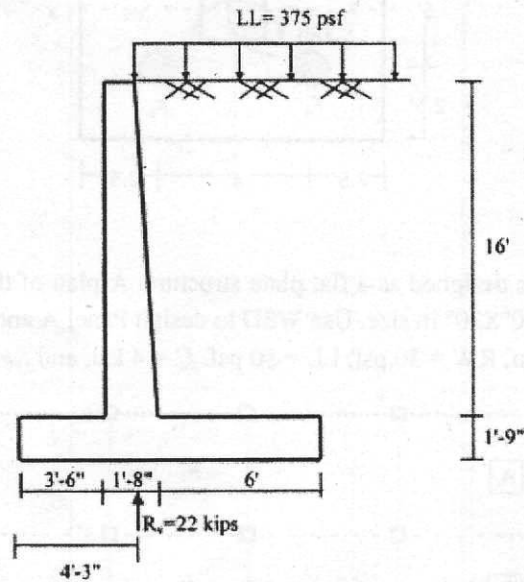
7. A building is to be designed as a flat plate structure. A plan of the building is shown below. The columns are 20"×20" in size. Use WSD to design Panel A and Panel B. [Given, $FF = 25$ psf, $RW = 30$ psf, $LL = 50$ psf, $f'_c = 4$ ksi, and $f_y = 60$ ksi]



8. A section of a gravity retaining wall as shown in the following figure was made to support the soil behind the wall and the surcharge on the ground surface. Check the external stability of the section against sliding and overturning. Also check the soil pressure under the base. [Given, $\gamma_s = 120$ pcf, $\phi = 30^\circ$, $f_{base} = 0.5$, Allowable bearing pressure = 4 tsf.]



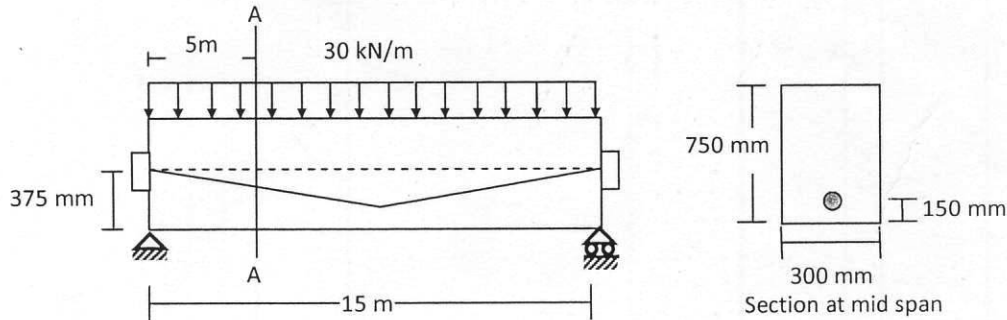
9. A cross section of a cantilever retaining wall is shown in the following figure. If R_v , the vertical component of reaction is equal to 22 k and acts at a distance 4.25 ft from the toe as shown, design the footing (heel slab and toe slab) using WSD. [Given, $\gamma_s = 120$ pcf, $f'_c = 3$ ksi, $f_s = 24$ ksi, $n=9$, $R=223$ psi]



10. A post-tensioned bonded concrete beam has a prestress of 1600 kN in the steel immediately after prestressing, which eventually reduces to 1400 kN due to losses. The beam carries live load of 30 kN/m in addition to its own weight of 5.76 kN/m.

Compute the extreme fiber stress at the section A-A shown in figure below.

- At the initial condition with full prestress and no live load
- At the final condition, after the losses have taken place with full live load



PART B

[There are 4 (four) questions. Answer any 3 (three)]

- What are corner reinforcements in two-way slab? Write down the ACI provision for corner reinforcements.
 - What is flat slab? Write down the advantages and disadvantages of flat slabs.
 - Mention the conditions necessary for using the Direct Design Method of flat slab analysis.
- Explain why punching shear is considered in the design of column footings but not for wall footings.
 - Define the band-width in placing reinforcements for rectangular footings and explain why it is used.
 - What is Transverse Beam in combined footings?
- "The application of compressive load may increase or decrease the moment capacity of columns." – Explain briefly.
 - Why is it not advisable to use single piles under columns?
 - What is retaining wall? Name different types of retaining walls and explain their relative advantages.
- What is pre-stressed concrete? Write down the advantages and limitations of prestressing.
 - Define: i. External Prestressing and Internal Prestressing, ii. Full, Limited and Partial Prestressing.
 - What is loss of prestress? Mention different types of loss of prestress.

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2013
Program: B. Sc. Engineering (Civil)

Course Title: Design of Concrete Structures II
 Time: 3 hours

Credit Hours: 3.0

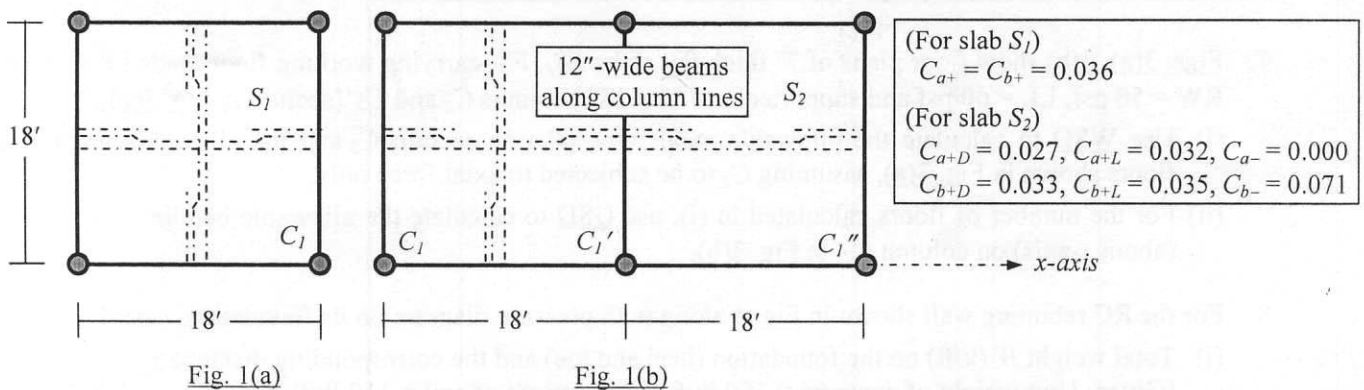
Course Code: CE 317
 Full Marks: 100 (= 10 × 10)

PART A

[Answer any 7 (seven) of the following 10 questions]

[Given: $f_c' = 4$ ksi, $f_y = 60$ ksi for all questions except Question No. 10]

- Fig. 1(a) shows the 5" thick RC slab S_1 supported on 12"-wide beams, to be designed (by WSD) for floor loads including FF = 30 psf, RW = 50 psf and LL = 60 psf. Calculate the
 - Required slab reinforcements,
 - Design LL if same reinforcements are used for S_2 in Fig. 1(b).



- Figs. 1(a), 1(b) show floor plans consisting of 5" thick slabs S_1, S_2 (supported on 12" × 18" beams) with floor loads FF = 30 psf, RW = 50 psf, as well as 5" thick brick walls along column lines.
 - Use WSD to design two sections of circular column C_1 (with steel ratios 1% and 4%) in Fig. 1(a), assuming it to be subjected to axial force only from a 6-storied structure, with slab LL = 60 psf.
 - Use both sections obtained in (i) for column C_1' to calculate allowable LL on slab S_2 (using USD) [Fig. 1(b)].
- For floor plans (of 6-storied structures) shown in Fig. 1(a), 1(b) and loaded as described in Question 2 (with slab LL = 60 psf), determine the size and thickness (using WSD for punching shear only) of
 - Square footing (F_1) supporting circular column C_1 (of 12"-dia) in Fig. 1(a),
 - Rectangular footing (of same width as calculated in (i) for F_1) supporting 16"-dia circular column C_1' in Fig. 1(b)

[Given: Allowable bearing capacity of the soil = 3 ksf].

- For the floor plan of a 6-storied structure shown in Fig. 1(b) and loaded as described in Question 2,
 - Determine the size and thickness (using USD for punching shear only) of a combined footing supporting circular columns C_1 (12"-dia), C_1' (16"-dia) and C_1'' (12"-dia), if the footing length (in the x-direction) is limited to 40 ft
 - Design the transverse beam below column C_1' (using USD)

[Given: Allowable bearing capacity of the soil = 3 ksf].

- Fig. 2 shows a pile-group supporting 16"-dia circular column C_1' of the 6-storied structure shown in Fig. 1(b) and loaded as described in Question 2. If each pile in the group is 40'-long and has a diameter of 12", use WSD to calculate the
 - Axial force capacity of each pile
 - Allowable bending moment M_x (about x-axis) for the pile group

[Given: Allowable bearing capacity of the soil = 1 ksf].

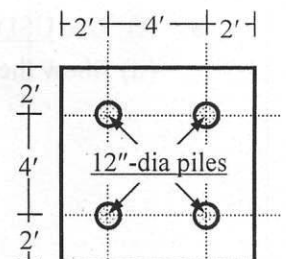


Fig. 2

6. Fig. 3(a) shows 7" thick flat slab FS_1 supported on 15" \times 15" columns and designed (by USD) for floor loads including FF = 30 psf, RW = 50 psf and LL = 60 psf. Calculate the
- Required reinforcements in slab column strip,
 - Design LL if same reinforcements are used for FS_2 in Fig. 2(b).

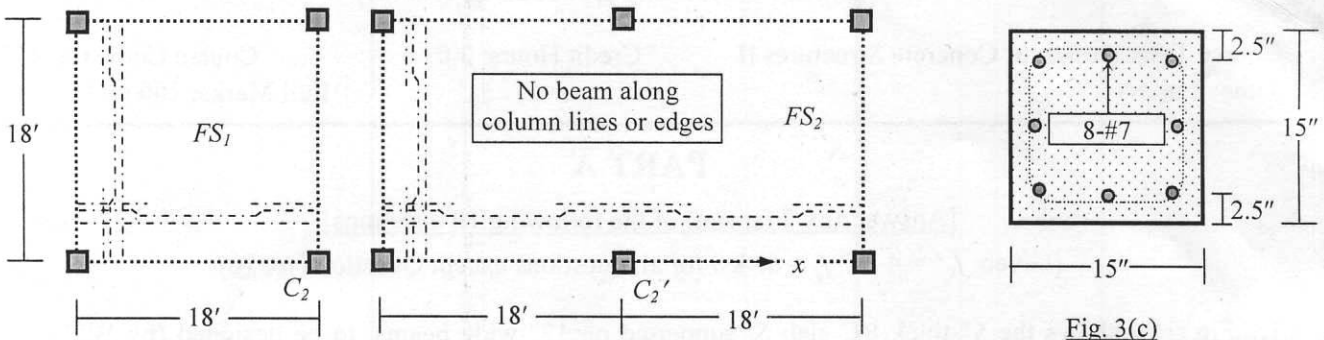


Fig. 3(a)

Fig. 3(b)

Fig. 3(c)

Column section C_2, C_2'

(Distribution factors for M_0 in FS_1)
 $C_{Ext-} = 0.26, C_{Mid+} = 0.74$

(Distribution factors for M_0 in FS_2)
 $C_{Ext-} = 0.26, C_{Mid+} = 0.52, C_{Int-} = 0.70$

7. Figs. 3(a), 3(b) show floor plans of 7" thick flat slabs FS_1, FS_2 carrying working floor loads FF = 30 psf, RW = 50 psf, LL = 60 psf and supported on 15" \times 15" columns C_2 and C_2' [section in Fig. 3(c)].
- Use WSD to calculate the allowable axial force (P_a) on section C_2 and the allowable number of floors shown in Fig. 3(a), assuming C_2 to be subjected to axial force only.
 - For the number of floors calculated in (i), use USD to calculate the allowable bending moment M_x (about x -axis) on column C_2' in Fig. 3(b).
8. For the RC retaining wall shown in Fig. 4 along with pressure diagram on its foundation, calculate the
- Total weight W (k/ft) on the foundation (heel and toe) and the corresponding distance x [Given: Unit weight of concrete = 150 lb/ft³, Unit weight of soil = 110 lb/ft³]
 - Surcharge pressure w (ksf) and horizontal force H (k/ft) resulting in the pressure diagram shown
 - Factor of safety against sliding and overturning.

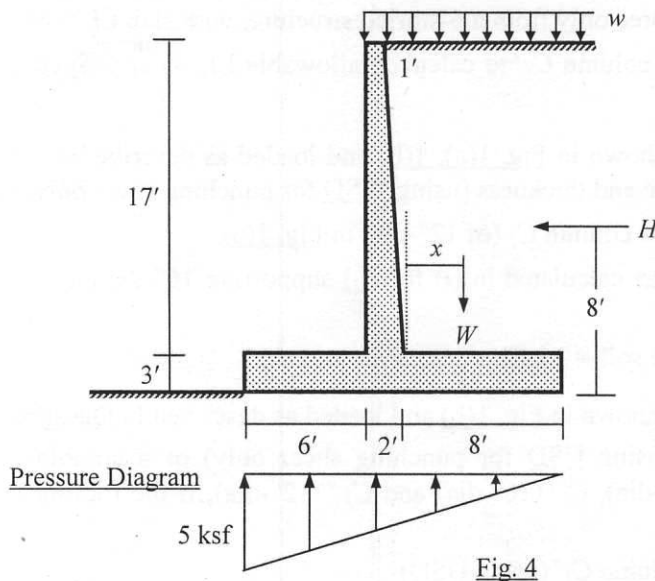
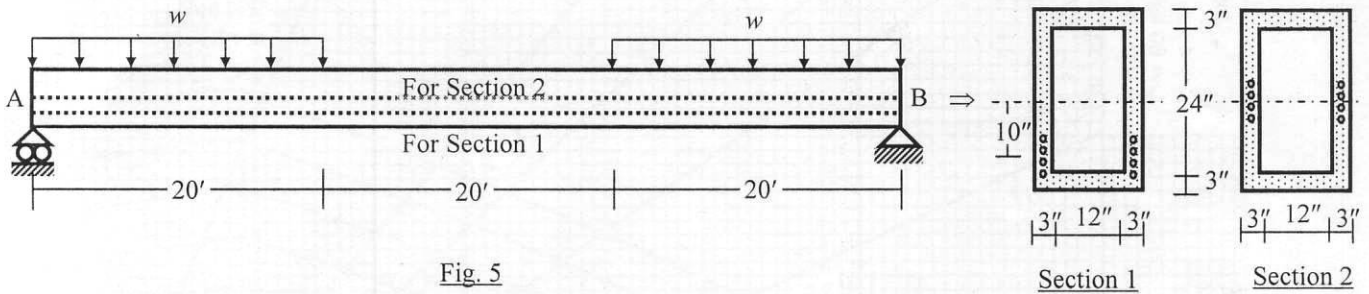


Fig. 4

- Use USD to design the heel and toe of the retaining wall in Fig. 4, using the pressure diagram,
- Show the reinforcements calculated in (i) with neat sketches.

10. Fig. 5 shows a simply-supported concrete beam AB subjected to pre-stressing force of 250 kips that reduces to 200 kips after losses.

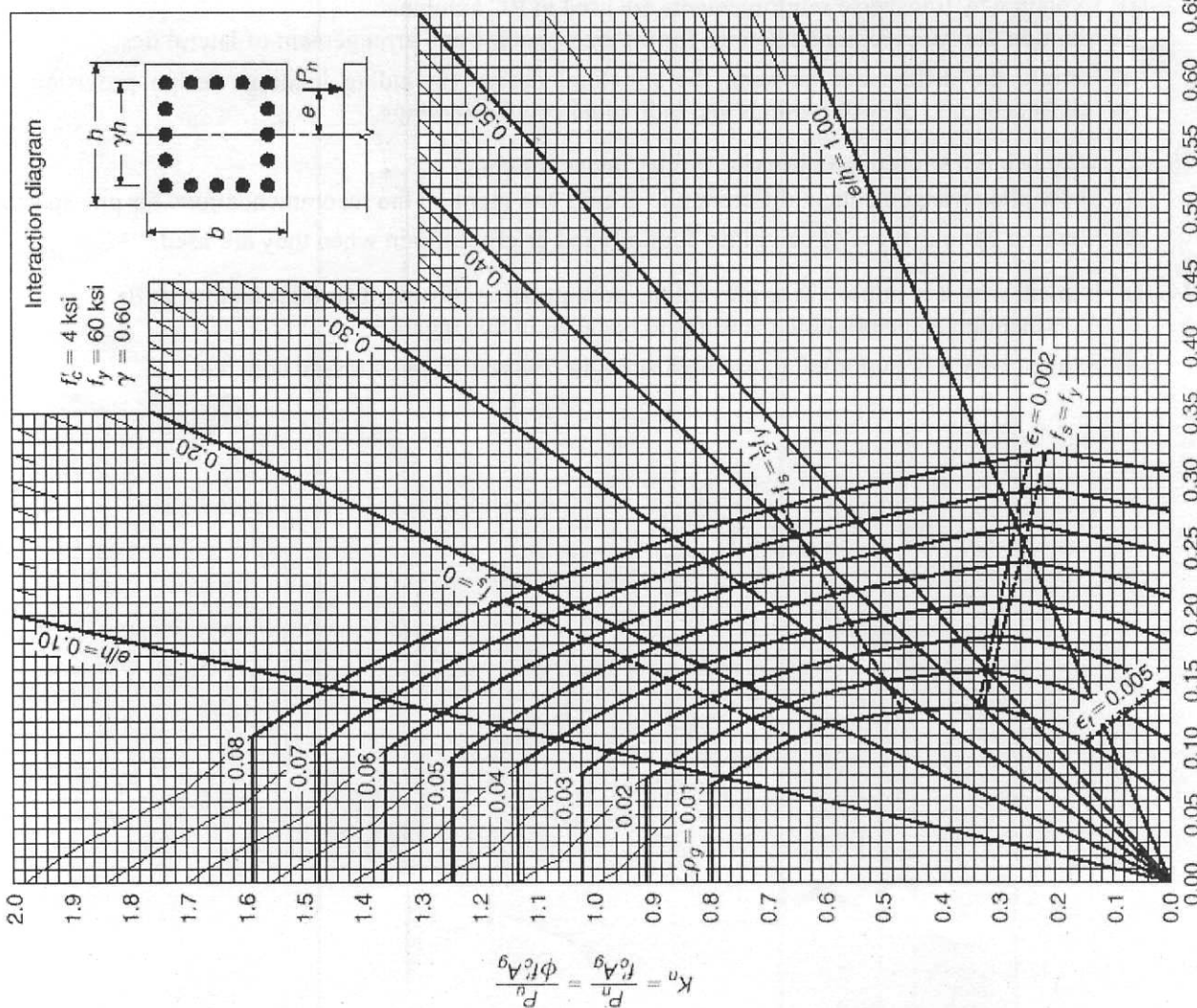
- (i) For both sections of the beam (i.e., Section 1 and Section 2), calculate the
 - (a) Extreme fiber stresses at support A and midspan of the beam at working condition (i.e., with effective prestress and beam self-weight)
 - (b) Cracking moment and corresponding distributed load w on the beam
[Given: $f_c' = 6$ ksi, $f_{ct} = 4.5$ ksi]
- (ii) Comment on the suitability of the sections based on the results obtained in (i).



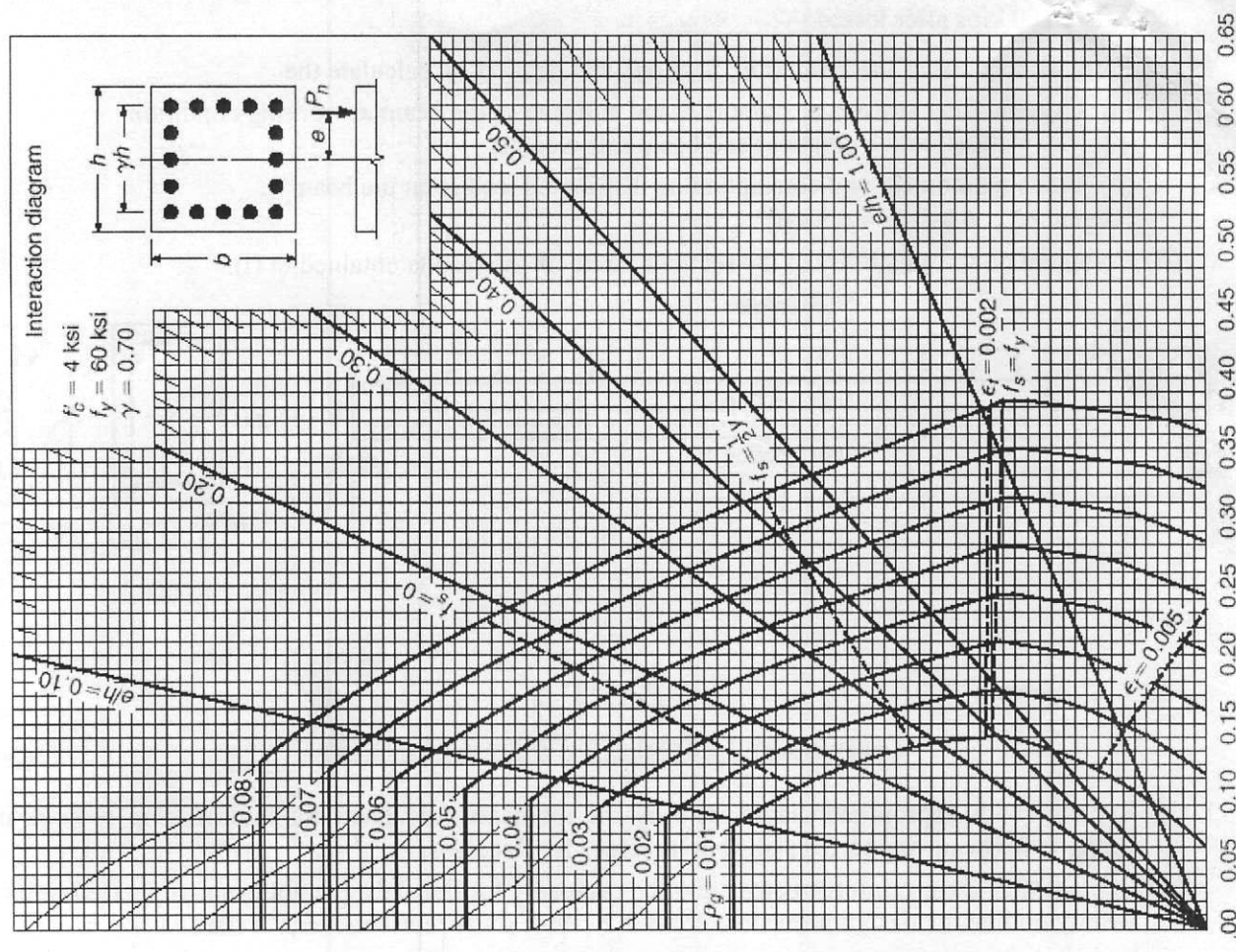
PART B

[Answer any 3 (three) of the following 4 questions]

11. (i) Explain (with appropriate diagrams) why the moments calculated for middle strip reduces near supports for beam-supported slabs but increases for flat slabs.
- (ii) Explain why shear reinforcements are often necessary for flat slabs but not beam-supported slabs. Briefly outline the design provisions for two types of shear reinforcement in flat slabs.
12. (i) Explain why transverse reinforcements are used in RC columns. Mention the ACI recommendations for the size, spacing and arrangement of lateral ties.
- (ii) Narrate the differences between the structural design (including loading, design provisions and reinforcements) of wall footings and individual column footings.
13. (i) Why is it not advisable to use single piles under columns? Show pile arrangements in different pile groups and mention the recommendations for pile spacing.
- (ii) Mention various types of combined footings and briefly explain when they are used.
14. (i) Explain why it is important to prevent the accumulation of water behind retaining walls. Also mention some possible measures to be taken in this regard.
- (ii) Explain why it is important to use high strength concrete in pre-stressed concrete.



$$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_n e}{\phi f'_c A_g h}$$



$$R_n = \frac{P_n e}{f'_c A_g h} = \frac{P_n e}{\phi f'_c A_g h}$$