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B. Sc. Engg. (CEE)/6th Semester

08 May 2023 (Group-B)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

Semester Final Examination
Course Number: CEE 4611
Course Title: Design of Concrete Structures II

Summer Semester: 2021–2022
Full Marks: 150
Time: 3.0 Hours

There are 6 (six) questions. Answer all of them. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in the brackets. Assume reasonable value for any missing data.

1. A residential building is to be designed using a flat plat floor system. The interior columns are 24" × 24" and they are spaced 22 ft c/c in one direction and 24 ft c/c in other direction. Design the interior panel (22' × 24') and show the reinforcements in long direction only with neat sketch. Assume slab thickness 8". Specified live load = 40 psf; Floor finish and partition wall load = 60 psf in addition to the self weight of floor slab. Given: $f'_c = 3,500$ psi and $f_y = 60,000$ psi. CO2, PO3: [25]

OR

Two interior columns of a high rise building are spaced 15 ft apart and each carries DL = 400 kip and LL = 300 kip. The columns are 21" × 21" in cross-section. The columns will be supported on a rectangular combined footing with a long-side dimension twice that of the short side. The allowable soil bearing pressure is 5000 psf. The bottom of the footing will be 6 ft below grade. Design the footing and show the reinforcement with neat sketch. Given: $f'_c = 3$ ksi and $f_y = 60$ ksi. CO2, PO3: [25]

2. (a) A ground floor column of a multistoried building is to be designed for the following load combinations (axial force and uniaxial bending)- CO2, PO3: [18]
- Gravity load condition; $P_u = 700$ kip, $M_u = 80$ kip-ft
- Lateral load condition; $P_u = 600$ kip, $M_u = 500$ kip-ft
- Architectural considerations require that a rectangular column with $b = 16$ in. and $h = 25$ in. is to be used. Material strengths are $f'_c = 4$ ksi and $f_y = 60$ ksi. Find the required column reinforcement and show in a neat sketch. Use supplied

design charts, BNBC load combinations and assume that the reinforcement are distributed along the perimeter.

Basic Load combinations of BNBC 2020.

1. $1.4D$
2. $1.2D + 1.6(L + H) + 0.5(L_r \text{ or } R)$
3. $1.2D + 1.6(L_r \text{ or } R) + (L \text{ or } 0.8W)$
4. $1.2D + 1.6W + L + 0.5(L_r \text{ or } R)$
5. $1.2D + 1.0E + 1.0L$
6. $0.9D + 1.6W + 1.6H$
7. $0.9D + 1.0E + 1.6H$

- (b) Design tie for the above column considering seismic provisions of an IMRF system. Clear height of the column is 10 ft. Show arrangements in cross and long-sections. CO2, PO3: [7]
3. The section of RC cantilever retaining wall supporting granular soil is shown in Fig. 1. Assuming that there are adequate factors of safety against overturning, bearing, and sliding, design the thickness and flexural reinforcement for the arm at the bottom. Also, find other reinforcements required in the arm. Show all reinforcement in a sketch. Given: $f'_c = 3$ ksi and $f_y = 60$ ksi, unit weight of soil = 120 lb/ft³, $\phi = 30^\circ$, surcharge = 400 psf. (Hint: Calculate the missing dimension using basic proportioning of cantilever retaining wall). CO2, PO3: [25]

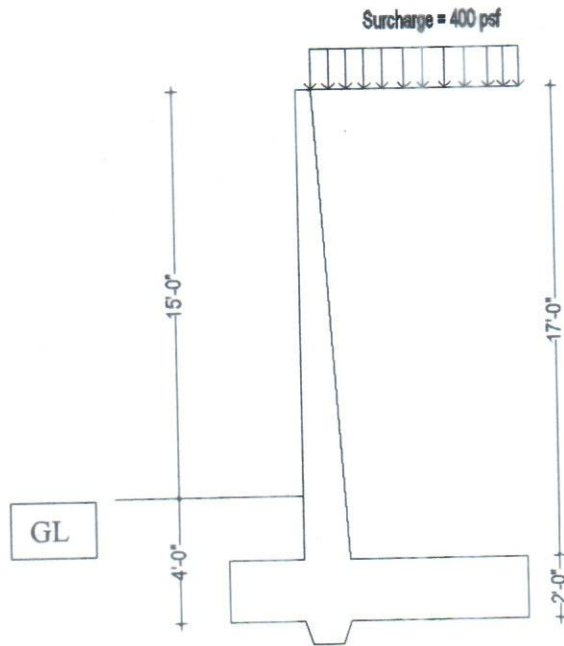


Fig. 1 for Question No. 3

or

The plan of a pile cap with 12 nos. 20" dia cast-in-situ piles is shown in Fig. 2. The piles are provided for a RC column 30" x 30" in section carrying DL = 950 kip and LL = 550 kip. Assume that the individual pile capacity is adequate. Design the pile cap showing all the reinforcements with necessary details. Given: $f'_c = 4$ ksi and $f_y = 60$ ksi.

CO2, PO3: [25]

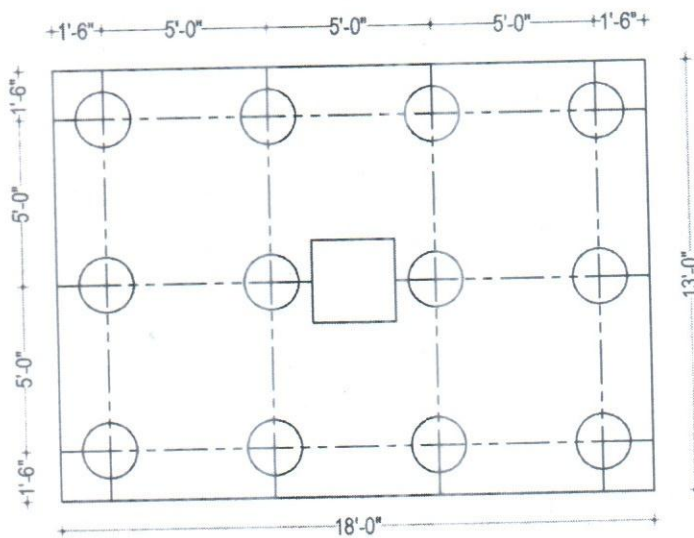


Fig. 2 for Question No. 3

4. (a) A 25 inch \times 25 inch column is reinforced with sixteen No. 8 bars arranged around the column perimeter. Material strengths are $f'_c = 4$ ksi and $f_y = 60$ ksi. Check the adequacy of the short column using Reciprocal Load Method for $P_u = 400$ kip, $M_{ux} = 300$ kip-ft, $M_{uy} = 300$ kip-ft. Use the supplied design chart. CO2, PO3: [17.5]
- (b) A flat plate floor has thickness $h = 7.5$ " and is supported by 18 in square columns spaced 20 ft on centers each way. The floor will carry a DL = 160 psf including its self weight and a live load of 90 psf. Check the adequacy of the slab in resisting punching shear and provide shear reinforcement, if needed using bent bars. Consider, $d = 6$ ", $f'_c = 4$ ksi and $f_y = 60$ ksi. CO2, PO3: [17.5]
5. (a) What are the limitations of Direct Design Method for the analysis of two-way slab? CO1, PO1: [7.5]
- (b) What are the common types of shear reinforcement used for flat plates? Show with neat sketches. CO1, PO1: [7.5]
- (c) What is ACI spiral? Explain the failure behaviour of ACI spirally reinforcement column. CO1, PO1: [7.5]
- (d) Explain different modes of failure of a high-rise shear wall. CO1, PO1: [7.5]
6. A shear wall of a 15-storey building is subjected to following factored loads: CO2, PO3: [17.5]
- $P_u = 400$ kip
 $V_u = 600$ kip
 $M_u = 5000$ kip-ft
- The wall is 18 ft long, 150 ft high and 14 inches thick. Design the shear wall with $f'_c = 4$ ksi and $f_y = 60$ ksi.

