Birzeit University
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Department of Civil and Environmental Engineering

ENCE 436 Reinforced Concrete Design II

Quiz 1 & Exam Thursday, April 29, 2021

For all questions, fc' = 35 MPa, β_1 = 0.80, fy = 420 MPa, $\gamma_{concrete}$ = 24 kN/m^3 (2.4 t/m^3)

Q1. Design a short, circular, spirally reinforced column to support the ultimate loads applied for each case. Use ρ_g of approximately 2%, Φ 28 longitudinal bars and assume a Φ 10 spiral for parts a, b, and c.

a. (5 points) An interior concentrically loaded column with Pu = 650 t.
b. (10 points) An exterior eccentrically loaded column with Pu = 650 t and Mu = 65 t.m.
c. (10 points) A corner column with Pu = 650 t, Mux = 35 t.m, and Muy = 65 t.m.
d. (10 points) If the column has a diameter of 65 cm, and is reinforced with 14 Φ 30 bars, design the spiral, and check the longitudinal bar spacing.

Q2. In an intermediate floor in a braced building, all columns are square with b = h = 45 cm, while all beams are rectangular with b = 45 and h = 60 cm. Column reinforcement consists of 4 Φ 32 bars with Φ 10 ties. The center-to-center beam span = 9 m, and the column center-to-center height = 8 m. For an interior column, the service loads and moments are:
P_{dead} = 120 t, P_{live} = 80 t
M_2-D = 8 t.m, M_2-L = 22 t.m
M_1-D = 8 t.m, M_1-L = 22 t.m

a. (10 points) Determine K using the ACI nomograph.
b. (5 points) Is this column slender?
c. (20 points) Assuming this column is slender, determine the magnified eccentricity for which this column should be checked.

Q3. A two-way slab on beams consists of (9 m x 11 m) panels, four in each direction, measured center-to-center of columns (i.e., 36 m x 44 m overall dimensions). All beams have a width b = 50 cm. The slab is solid with a thickness of 27 cm (d = 23 cm). The service DL = 1.3 t/m^2 (including self-weight), and the service LL = 0.6 t/m^2 (Wu = 2.52 t/m^2). Assuming α_{fm} for all panels exceeds 2.0:

a. (10 points) Check the adequacy of the slab thickness for shear. Provide an appropriate shear diagram.
b. (15 points) For a corner panel, determine the moments at all critical locations for a 1-m wide column strip and a 1-m wide middle strip in the long direction.
c. (5 points) Present your answers on a sketch of the panel.