Design of reinforced concrete structures I (61390)
Homework No. 1

Q1: Determine the service moment capacity for a rectangular beam section that has a width of 350mm and a depth of 500mm and reinforced with top bars of 5Φ25, using the allowable strength method. The concrete compressive strength, f'_c= 32MPa and the steel yield strength, f_y= 400 MPa.

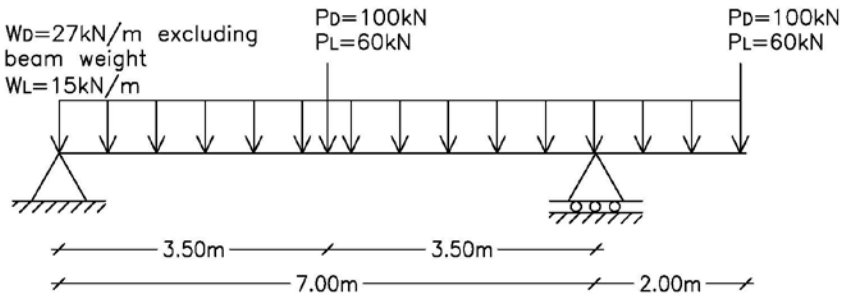
Q2: A rectangular beam section of 400mm width and 600mm depth (d= 540mm) and reinforced with bottom bars of 6Φ20 is to be converted to a beam of 400mm depth (d= 350mm). Determine the needed beam width and reinforcement using the same steel ratio. The concrete compressive strength, f'_c= 32MPa and the steel yield strength, f_y= 420 MPa.

Q3: A beam section of 350mm width is to be designed to resist a moment of 400kN.m. The concrete compressive strength, f'_c= 24MPa and the steel yield strength, f_y= 420 MPa. Determine the needed section depth and reinforcement using steel ratio varies from ρ= 0.003 to ρ= 0.015 considering steps of 0.001. Determine the concrete volume and the steel weight for each steel ratio considering one meter length of beam. If the concrete cost is 320 INS/m^3 and the steel cost is 3200 INS/ton, calculate the cost for the design for each steel ratio. Make comments.

Q4: A. Derive a formula for the maximum steel ratio allowed by the code (ACI 318-08) to have singly reinforced concrete rectangular beam section and calculate the corresponding steel reduction factor, Φ. (In ACI 318-08, the maximum allowed strain in tensile steel is 0.004). Determine the design moment capacity for a rectangular beam section of 450mm width and 600mm depth (d= 540mm) that have this steel ratio. The concrete compressive strength, f'_c= 28MPa and the steel yield strength, f_y= 420 MPa.

B. Derive a formula for the steel ratio to have failure in concrete and yielding of steel bars at the same time for a steel have yield strength, f_y for a rectangular singly reinforced beam section. (This steel ratio is called balanced steel ratio)

Q5: Design a rectangular beam section that has a width equal to half the thickness for the beam shown in the figure below. f'c= 24MPa and the steel yield strength, fy= 420MPa. Sketch the reinforcing layout of the beam. Assume maximum steel ratio, ρ=0.012



BEAM STRUCTURAL MODEL