

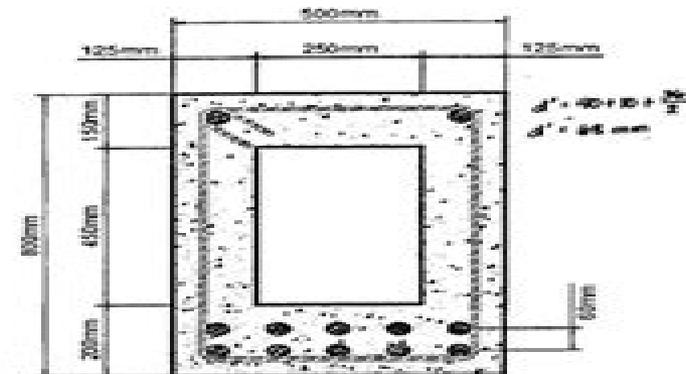


MIDTERM EXAM: ANALYSIS OF IRREGULAR REINFORCED CONCRETE BEAM

PROBLEM 1:

A hollow rectangular concrete beam shown in the figure is reinforced by 36mmØ main bars and 10mmØ stirrups. Concrete strength $f'_c = 34.2$ MPa, Steel Yield Strength $f_y = 415$ MPa. Minimum concrete cover was applied on the section.

- Determine the total compressive force of concrete.
- Determine the total tensile force of the steel.
- Compute the ultimate strength design of the section.



$$b = 0.85 = \frac{0.85}{1} (34.2 - 25)$$

$$b = 0.8087$$

$$f'_c = \frac{0.85(34.2)(0.8087)}{415} \left(\frac{400}{800 + 725} \right)$$

$$f'_c = 0.09836$$

$$f'_{max} = 0.35f'_c = 0.35(0.09836)$$

$$f'_{max} = 0.03442$$

$$d = 800 - 10 - 10 - \frac{36}{2} - \frac{36}{2}$$

$$d = 702 \text{ mm}$$

$$\rho = \frac{\frac{4}{3} (36)^2 (10)}{(800)(702) - (250)(450)}$$

$$\rho = 0.04284$$

$$\rho > f'_{max} \therefore \text{Doubly Reinforced Beam}$$

Depth of Compressive Block (a):

$$\text{Let } a: 0 \leq a \leq 150$$

$$eT_c = 0; (f'_c + f_y)$$

$$C = T$$

$$0.85(34.2)(a)(800) + 415 \left(\frac{4}{3} (36)^2 (10) \right) = 415 \left(\frac{4}{3} (36)^2 (10) \right)$$

$$a = 232.4873 \text{ mm}$$

$$\text{Let } a: 150 \leq a \leq 800$$

$$eT_c = 0; (f'_c + f_y)$$

$$C = T$$

$$0.85(34.2)(a)(800) - 0.85(34.2)(a - 250)(250) + 415 \left(\frac{4}{3} (36)^2 (10) \right) = 415 \left(\frac{4}{3} (36)^2 (10) \right)$$

$$a = 319.9946 \text{ mm}$$

$$f'_c = 800 \left(\frac{a - d'}{a} \right)$$

$$f'_c = 435.69 \text{ MPa} \therefore \text{Yield}$$

$$a) \quad C_c = 0.85(34.2)(319.9946)(800) - 0.85(34.2)(319.9946)(250)$$

$$C_c = 3,373,246.960 \text{ N}$$

$$C_c = 3,373.25 \text{ kN}$$

Concrete Engineering Questions

JG Myers



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