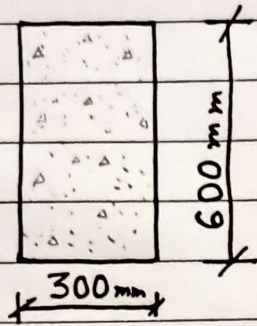


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Q-1



Given \rightarrow Depth, $(D) = 600 \text{ mm}$
 Width, $(b) = 300 \text{ mm}$
 $f_{ck} = 25 \text{ MPa}$

To find \rightarrow Cracking Moment

Since it does not contain any reinforcement,
 \therefore From Annex C, C-2.1 of IS 456:2000

$$M_{cr} = \frac{I_{gr} f_{cr}}{y_t}$$

Where, f_{cr} = Modulus of Rupture
 I_{gr} = Moment of Inertia (Gross Section)
 y_t = distance of extreme fiber from centroid.

$$I_{gr} = \frac{b D^3}{12} = \frac{300 \times (600)^3}{12} = 5.4 \times 10^9 \text{ mm}^4$$

$$f_{cr} = 0.7 \sqrt{f_{ck}} = 0.7 \sqrt{25} = 3.5 \text{ MPa (Cl 6.2.2.1)}$$

$$y_t = \frac{D}{2} = \frac{600}{2} = 300 \text{ mm}$$

Hence, Cracking Moment =

$$M_{cr} = \frac{3.5 \times 5.4 \times 10^9}{300} =$$

$$M_{cr} = 63 \times 10^6 \text{ MPa}$$

2. Moment at Service level

$$M_{service} = S.F. \times M_{cr} \quad (\text{Given Safety factor} = 0.67)$$
$$= 0.67 \times 63 \times 10^6$$

$$M_{service} = 42.21 \times 10^6 \text{ MPa}$$

3. Bending Stresses (σ_b) for any assumed bending moment less than the cracking moment

$$\sigma_b = \frac{M \times 10^6}{Z} \quad (M = 0.8 \text{ of } M_{cr})$$

$$Z = \frac{bd^2}{6} = \frac{300 \times (600)^2}{6}$$

$$\sigma_b = \frac{33.768 \times 10^6 \times 10^6}{Z}$$

$$\sigma_b = 18.76 \times 10^6 \text{ MPa}$$

4. Maximum Factored Moment for Singly Reinforced Section.

$$M_u = 0.36 \times f_{ck} \times b \times d^2 \times 0.67$$

$$= 0.36 \times 25 \times 300 \times 550^2 \times 0.67$$

$$\boxed{M_u = 43.105 \times 10^5 \text{ kNmm}} \text{ (Factored)}$$

5. Maximum factored Moment for doubly reinforced section

$$M_u = 0.36 f_{ck} \times b \times d^2 + f_y' \times A_{st}' \times (d - x')$$

$$A_{st}' = 804.25 \text{ mm}^2 \text{ and } x' = 542 \text{ mm}$$

$$M_u = 9,660,312,500 \text{ Nmm} \times 0.67$$

$$\boxed{M_u = 6,474,205,875 \text{ Nmm}} \text{ (Factored)}$$