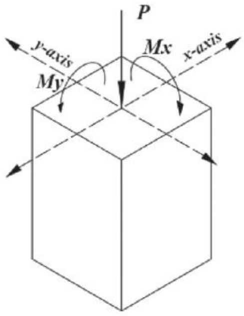
UNIT IV DESIGN OF COLUMNS

Types of columns –Axially Loaded columns – Design of short Rectangular Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves

Design for Biaxial bending using Column Curves



$b = 400$ mm

$D = 400$ mm

$P_u = 1500$ kN

$M_{ux} = M_{uy} = 50$ kN·m

$f_{ck} = 20$ N/mm^2

$f_y = 415$ N/mm^2

Equivalent moment

The reinforcement in section is designed for the axial compressive load P_u and the equivalent moment

$$M_u = 1.15\sqrt{M_{ux}^2 + M_{uy}^2}$$

$$= 1.15\sqrt{50^2 + 50^2}$$

$$= 81.3 \text{ kN}\cdot\text{m}$$

Nondimensional parameters

$$\left(\frac{P_u}{f_{ck}bD}\right) = \left(\frac{1500 \times 10^3}{20 \times 400 \times 400}\right) = 0.468$$

Assume $d' = 40$ mm

$(d'/D) = 0.10$

$$\left(\frac{M_u}{f_{ck}bD^2}\right) = \left(\frac{81.3 \times 10^6}{20 \times 400 \times 400^2}\right) = 0.063$$

Refer to Chart 44, SP:16

$$(p/f_{ck}) = 0.06$$

$$p = (20 \times 0.06) = 1.2$$

$$A_{st} = \left(\frac{pbD}{100}\right)$$

$$= \left(\frac{1.2 \times 400 \times 400}{100}\right)$$

$$= 1920 \text{ mm}^2$$

Provide 4 bars of 20 mm diameter and 4 bars of 16 mm diameter ($A_{sc} = 2060$ mm^2) distributed equally on all faces with 3 bars on each face.

$$p = (100 \times 2000)/(400 \times 400) = 1.28$$

$$(p/f_{ck}) = (1.28/20) = 0.064$$

Refer to Chart 44, SP:16 and readout $(M_{ux1}/f_{ck}bD^2)$ corresponding to the values of $(P_u/f_{ck}bD) = 0.468$ and $(p/f_{ck}) = 0.064$.

$$\left(\frac{M_{ux1}}{f_{ck}bD^2}\right) = 0.068$$

$$M_{ux1} = (0.068 \times 20 \times 400 \times 400^2)\ 10^{-6}$$

$$= 87\ \text{kN·m}$$

Due to symmetry $M_{ux1} = M_{uy1} = 87\ \text{kN·m}$

$$P_{uz} = [0.45 f_{ck}\ A_c + 0.75 f_y\ A_s]$$

$$= (0.45 \times 20)\ [(400 \times 400) - 2060] + 0.75 \times 415 \times 2060$$

$$= 2062 \times 10^3\ \text{m}$$

$$= 2062\ \text{kN}$$

$$\left(\frac{P_u}{P_{uz}}\right) = \left(\frac{1500}{2062}\right) = 0.72$$

$$\alpha_n = 1.8$$

Check for safety under biaxial bending

$$\left[\left(\frac{M_{ux}}{M_{ux1}}\right)^{\alpha_n} + \left(\frac{M_{uy}}{M_{uy1}}\right)^{\alpha_n}\right] \leq 1$$

$$\left[\left(\frac{50}{87}\right)^{1.8} + \left(\frac{50}{87}\right)^{1.8}\right] = 0.736 < 1$$

Hence the section is safe against bending