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 of short Rectangular columns

Design the reinforcement in a column of size 450 mm × 600 mm, subject to an axial load of 2000 kN under service dead and live loads. The column has an unsupported length of 3.0m and its ends are held in position but not in direction. Use M_{20} concrete and Fe $_{415}$ steel.

Given:

l_{eff}= 3000 mm

b = 450 mm

D = 600 mm

P =2000kN

M_{20}, Fe_{415}

Ends are fixed. $l_{ex} = l_{ey} = l = 3000$ mm

$$\frac{l_{ex}}{D} = \frac{3000}{600} < 12$$

$$\frac{l_{ex}}{b} = \frac{3000}{450} < 12$$

Short Column

Minimum eccentricity

$$e_{\min} = \frac{l_{eff}}{500} + \frac{D}{30}$$

In the longer direction

$$e_{\min} = \frac{3000}{500} + \frac{600}{30} = 26\,mm\,or\;\;20\,mm$$

$e_{\min} < 0.05D = 0.05 \times 600 = 30mm$

In the Shorter direction

$e_{\min} = \frac{3000}{500} + \frac{450}{30} = 21mm\ or\ \ 20\,mm$

$e_{\min} < 0.05D = 0.05 \times 450 = 22.5mm$

Minimum eccentricities are within the limits and hence code formula for axially loaded short columns can be used.

P = service load × partial load factor

= 2000 × 1.5 = 3000 kN

Design of Longitudinal Reinforcement (39.3-71)

$Pu = 0.4\ f_{ck}\ A_c + 0.67\ f_y\ A_{sc}$

or

$Pu = 0.4\ f_{ck}\ A_c + (0.67\ f_y - 0.4 f_{ck})\ A_{sc}$

$3000 \text{ X } 10^3 = 0.4 \times 20 \times (450 \times 600) + (0.67 \times 415 – 0.4 \times 20) Asc$

A_{SC}=3111mm^2

In view of the column dimensions (450 mm, 600 mm), it is necessary to place intermediate bars, in addition to the 4 corner bars:

Provide 4–25φ at corners

4 × 491 = 1964 mm^2 and 4–20φ

additional ie, 4 × 314 = 1256 mm^2

Asc = 3220 mm^2 > 3111 mm^2

p = (100×3220) / (450×600)

= 1.192 > 0.8 (minimum steel), OK.

Design of transverse steel

Diameter of tie = ¼ diameter of main steel

= 25/4 =6.25 mm or 6 mm

Spacing:

i) 300 mm

ii) 16 x 20 = 320 mm

iii) LLD = 450mm.

Provide ties 8mm @ 300 mm c/c