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

Determine the reinforcement to be provided in a circular column with the following data:

Diameter of column 500 mm
Grade of concrete M20
Factored moment 125 kN.m
Characteristic strength 250 N/mm^2
Factored load 1600 kN

Lateral reinforcement:
(a)Hoop reinforcement
(b) Helical reinforcement
(Assume moment due to minimum eccentricity to be less than the actual moment).
Assuming 25 mm bars with 40 mm cover,

$d^1 = 40 + 12.5 = 52.5$ mm
d^1/D - 52.5/50 = 0.105
Charts for $d'/D = 0.10$ will be used.
Let b=D

(a) Column *with hoop reinforcement*

$$\frac{P_u}{f_{ck}\,D^2} = \frac{1600\times10^3}{20\times500^2} = 0.32$$

$$\frac{M_u}{f_{ck}\,D^3} = \frac{125\times10^6}{20\times500^3} = 0.05$$

Referring to *Chart 52,* for f_y = 250 N/mm^2

$$\frac{P}{f_{ck}} = 0.87$$

Percentage of reinforcement, p = 0.87 x 20 = 1.74 %

$$A_s = \frac{1.74}{100}\times\frac{\Pi\times500^2}{4} = 3416\,mm^2$$

(b) ***Column with Helical Reinforcement***

According to 38.4 of the Code, the strength of a compression member with helical reinforcement is 1.05 times the strength of a similar member with lateral ties. Therefore, the, given load and moment should be divided by 1.05 before referring to the chart.

$$\frac{P_u}{f_{ck}\,D^2} = \frac{1600\times10^3}{1.05\times20\times500^2} = 0.31$$

$$\frac{M_u}{f_{ck}\,D^3} = \frac{125\times10^6}{1.05\times20\times500^3} = 0.048$$

Hence, From Chart 52, for f_y = 250 N/mm^2,

$$\frac{P}{f_{ck}} = 0.078$$

p = 0.078 x 20 = 1.56 %

$$A_s = \frac{1.56}{100}\times\frac{\Pi\times500^2}{4} = 3063\ mm^2$$

According to 38.4.1 of the Code the ratio of the volume of helical reinforcement to the volume of the core shall not be less than

$$0.36\left(\frac{A_g}{A_c}-1\right)\times\frac{f_{ck}}{f_y}$$

where A_g is the gross area of the section and A_c is the area of the core measured to the outside diameter of the helix. Assuming 8 mm dia bars for the helix

Core diameter = 500 - 2 (40 - 8) = 436 mm

$$\frac{A_g}{A_c} = \frac{500}{436} = 1.315$$

$$0.36\left(\frac{A_g}{A_c}-1\right)\times\frac{f_{ck}}{f_y} = 0.36\left(\frac{500}{436}-1\right)\times\frac{20}{250} = 0.0091$$

Volume of helical reinforcement / Volume of core

$$A_{sh}\ \Pi \times 428 / \left(\Pi / 4 \times 436^2\right) s_h$$

$$\Rightarrow 0.9 \frac{A_{sh}}{S_h}$$

where, A_{sh} is the area of the bar forming the helix and s_h is the pitch of the helix. In order to satisfy the coda1 requirement,

0.09 Ash / s_h = 0.0091
For 8 mm dia bar,
s_h = 0.09 x 50 / 0.0091 = 49.7 mm.
Thus provide 48 mm pitch