Department of Civil Engineering
Katihar Engineering College, Katihar

Subject: Design of Concrete Structure-I

Topic: Column

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Lecture: 02

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Design of Lateral Ties :

① Diameter

Max^m value
- ⓐ $\frac{\phi_{main}}{4}$ [ϕ_{main} = Dia of main reinf^n (larger dia)]
- ⓑ 6 mm

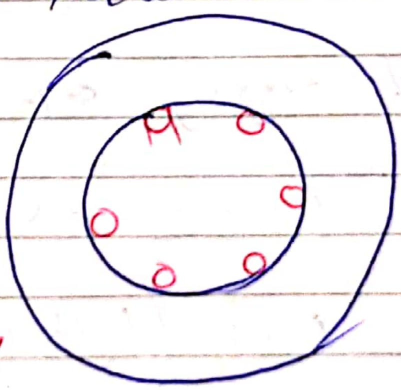
② Spacing

Min^m value
- (i) Least lateral dimension (say B)
- (ii) 16 ϕ_{main} [ϕ_{main} = smaller dia of main reinforcement]
- (iii) 300 mm

Design of circular column :

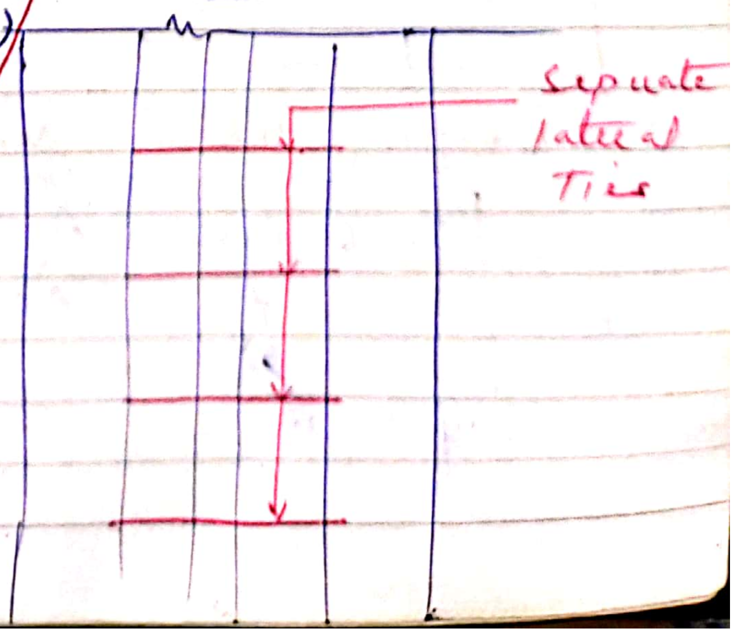
① Circular column with separate lateral ties

ⓐ For a long column load carrying capacity



$$P = C_r \cdot (\sigma_{sc} \cdot A_{sc} + \sigma_{cc} \cdot A_c)$$

$$P = \left(1.25 - \frac{L_{eff}}{48D}\right)(\sigma_{sc} \cdot A_{sc} + \sigma_{cc} \cdot A_c)$$



ⓑ Design of lateral Ties

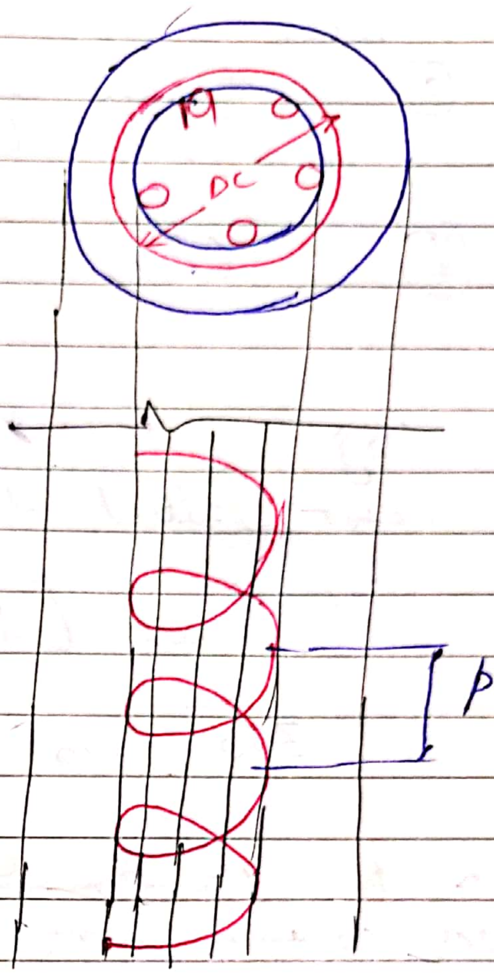
① Dia
- ⓐ $\frac{\phi_{main}}{4}$
- ⓑ 6 mm

Max^m

② spacing
- ⓐ LLD
- ⓑ 16 ϕ
- ⓒ 300 mm

② ~~Column~~ : Circular column with helical reinforcement

→ Load carrying capacity is increased by 5%.



→ load carrying capacity of a long column.

$$P = 1.05 \times C_r (\sigma_{sc} \cdot A_{sc} + \sigma_{cc} \cdot A_c)$$

$$P = 1.05 \times \left(1.25 - \frac{l_{eff}}{48\,D_c}\right) (\sigma_{sc} \cdot A_{sc} + \sigma_{cc} \cdot A_c)$$

→ Design of helical reinforcement

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

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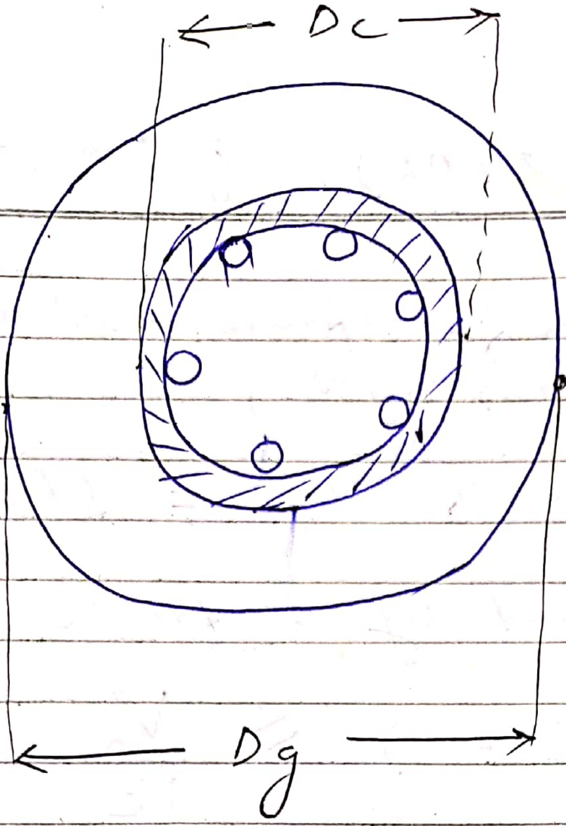

① A_g

$D_g = D =$ Gross diameter

$A_g = \frac{\pi}{4} \times (D_g)^2$

② D_c (Core diameter)
Outside to outside of helical reinforcement

$D_c = D_g - 2 \times$ clear cover

$D_c = (D_g - 2 \times 40)$

$A_c = \frac{\pi}{4} \times D_c^2$

V_c = Volume of Core for Unit length of column (1m = 1000 mm)

$V_c = A_c \times 1000$ mm^3

③ $V_h \rightarrow$ volume of helical reinforcement for unit length of column.

$= \begin{pmatrix} \text{No of} \\ \text{turns} \end{pmatrix} \times \begin{pmatrix} \text{Length in} \\ \text{one turn} \end{pmatrix} \times \left(\text{c/s area} \right)$

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$$V_h = \left(\frac{1000}{p}\right) \times (\pi \times D_h) \times \frac{\pi}{4}(\phi_h)^2$$

Where $\pi D_h \rightarrow$ length of reinforcement in one turn (approx length)

$D_h \rightarrow$ Dia of helix $= (D_c - \phi_h)$

pitch can be found by the formula

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

pitch (p)

①	$p \ngtr 75$ mm	As per 26.5.3.2(d) (P-49)
②	$p \ngtr \left(\frac{D_c}{6}\right)$	
③	$p \nless 25$ mm	
④	$p \nless 3\phi_h$	

Pr 25.1.2 A compression member may be considered short if both $\left(\frac{L_{ex}}{D}\right)$ or $\left(\frac{L_{ey}}{B}\right) < 12$

Pr 25.2 Effective length of column.
Refer Table 28 / Annexure 'E'

Pr 25.3 Slenderness Limit

Unsupported length $\ngtr$ 60 × least lateral dimension
$60B$ or $\left(\frac{100B^2}{D}\right)$

<Happy Learning>

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