

# Lecture-03A/04 · Final-Term

Page-01

Date: 04-06-2020

## Design of Circular Spiral Column:

Design Problem: Design a circular spiral column to support an axial D.L of 500 kips and L.L of 230 kips. Using  $f'_c = 4$  ksi and  $f_y = 60$  ksi and steel ratio of about 3%. Also design the necessary spiral.

Sol:

Step-01:  $P_u = 1.2 * D.L + 1.6 * L.L$   
 $= 1.2 * 500 + 1.6 * 230 = 968$  kips

Step-02:  $A_{st} = 3\% \text{ of } A_g = 0.03 * A_g$   
where:  $A_g = \text{Total Gross Cross-sectional Area}$

Step-03:  $P_u = \phi * 0.85 * [0.85 * 4 * (A_g - A_{st}) + A_{st} * f_y]$   
 $968 = 0.70 * 0.85 * [0.85 * 4 * (A_g - 0.03 * A_g) + 0.03 * A_g * 60]$   
 $A_g = 319.12 \text{ in}^2$

Step-04:  $A_g = \frac{\pi}{4} * D^2 = 319.12 \text{ in}^2$

$D^2 = \frac{319.12 * 4}{\pi} \Rightarrow D = 20.16'' \approx 20''$   
Actual  $A_g = \frac{\pi}{4} * 20^2 = 314.16 \text{ in}^2$

Step-05:  
 $968 = 0.70 * 0.85 * [0.85 * 4 * (314.16 - A_{st}) + A_{st} * 60]$   
 $A_{st} = 9.87 \text{ in}^2$



Page-02:

Step-06: Selection of Bars

Use #10 Bars;

$$\text{No. of bars} = \frac{A_{st}}{A_b} = \frac{9.87}{1.27} = 7.7 \approx 8 \#10 \text{ Bars}$$

Step-07: Design of Spiral

$$D_c = \text{Dia. of Core} = 20 - 2 \cdot 1.5 = 17''$$

$$\text{Area of Core} = A_c = \frac{\pi}{4} \cdot D_c^2 = \frac{3.14}{4} \cdot (17)^2$$

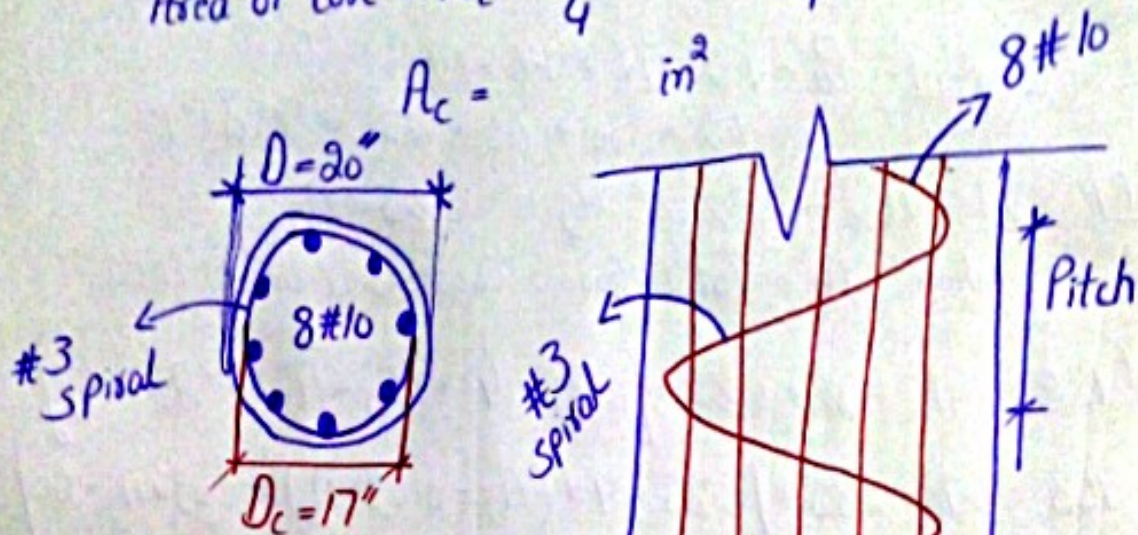


Fig: X-Section of Circular Column

Fig: Long Section of Column

Step-08: Minimum Reinforcement Ratio of Spiral.

$$\text{Min. } \rho_s = 0.45 \cdot \left( \frac{A_g}{A_c} - 1 \right) \cdot \frac{f_c'}{f_y}$$

$$\text{Min. } \rho_s = 0.45 \cdot \left[ \frac{\frac{\pi}{4} \cdot (20)^2}{\frac{\pi}{4} \cdot (17)^2} - 1 \right] \cdot \frac{4}{60} = 0.01152$$



## Page-03:

Step-09: Pitch

Using #3 Spiral,  $A_{\text{spiral}} = 0.11 \text{ in}^2$ ,  $d_s = 0.375''$ .

$$f_s = \frac{4 \cdot A_s \cdot (D_c - d_s)}{S + D_c^2}$$

$$0.01152 = \frac{4 \cdot 0.11 \cdot (17 - 0.375)}{S + (17)^2}$$

$$\Rightarrow S = 2.2'' \Rightarrow \text{Use \#3 spiral @ } 2'' \text{ c/c}$$

Since  $1'' < S < 3''$  OK

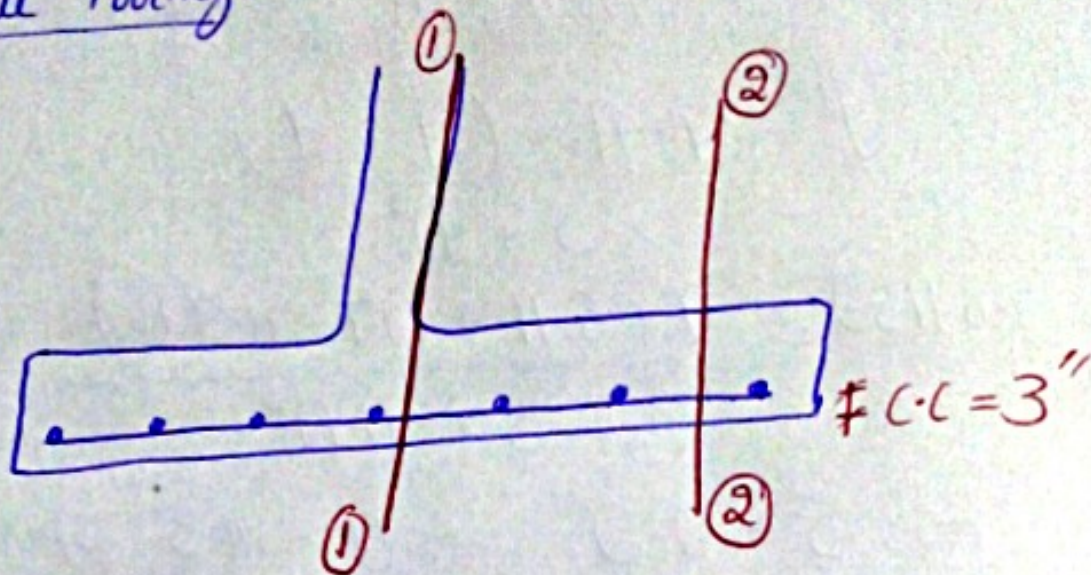
### Footings / Foundation:

Reinforced concrete footings are structural members used to support columns and walls and to transmit and distribute their loads to the soil safely. There are two essential requirements in the design of footing. Total Settlement of the structure shall be limited to a tolerably small amount and the differential settlement of various parts of the structure shall be eliminated as nearly as possible.



Page-04;

Wall Footing:



①-① → Critical Section for moment

②-② → Critical Section for Beam Shear  
OR, One Way Shear.

\* Minimum Clear Cover = 3''  
(Because of wetting, drying etc)