Interaction Diagrams for Circular Columns

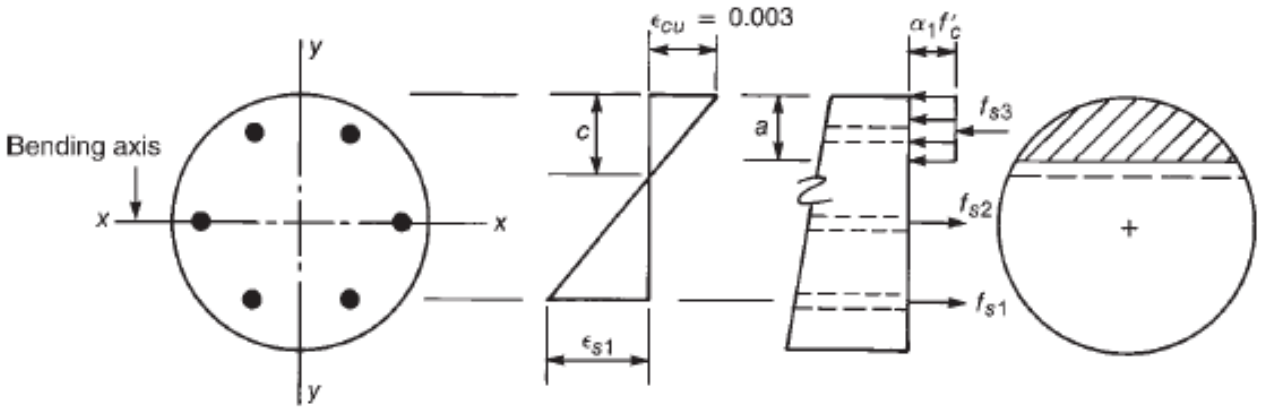
The strain-compatibility solution described in the preceding section can also be used to calculate the points on an interaction diagram for a circular column. As shown in Fig. 11-19b, the depth to the neutral axis, c, is calculated from the assumed strain diagram by using similar triangles (or from Eq. (11-9)). The depth of the equivalent rectangular stress block, a, is again $\beta_1 c$.

The resulting compression zone is a segment of a circle having depth a, as shown in Fig. 11-19d. To compute the compressive force and its moment about the centroid of the column, it is necessary to be able to compute the area and centroid of the segment. These terms can be expressed as a function of the angle θ shown in Fig. 11-20. The area of the segment is

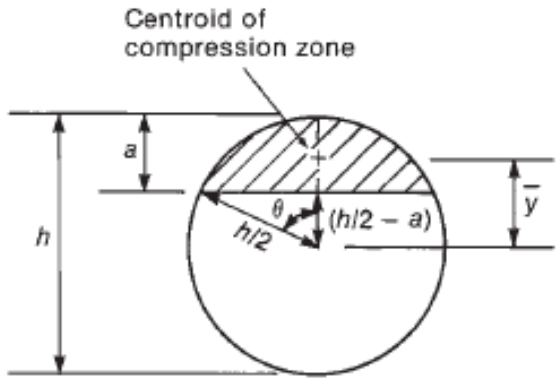
$$A = h^2\left(\frac{\theta - \sin\theta\cos\theta}{4}\right) \tag{11-17}$$

where θ is expressed in radians (1 radian $= 180°/\pi$). The moment of this area about the center of the column is

$$A\bar{y} = h^3\left(\frac{\sin^3\theta}{12}\right) \tag{11-18}$$

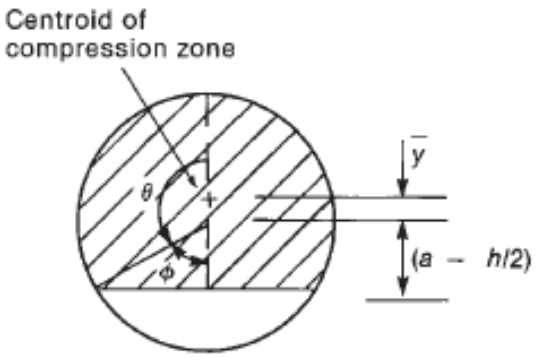


(a) Section. (b) Strains. (c) Stresses. (d) Compression zone.



(a) Case 1: $a \le h/2, \theta < 90°$

$$\theta = \cos^{-1}\left[\frac{h/2 - a}{h/2}\right]$$



(b) Case 2: $a > h/2, \theta > 90°$

$$\theta = 180° - \phi$$

$$\phi = \cos^{-1}\left[\frac{a - h/2}{h/2}\right]$$