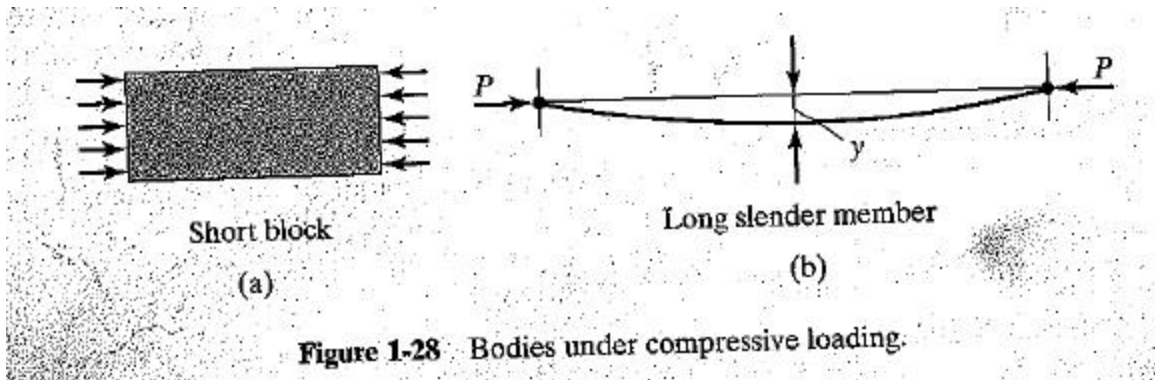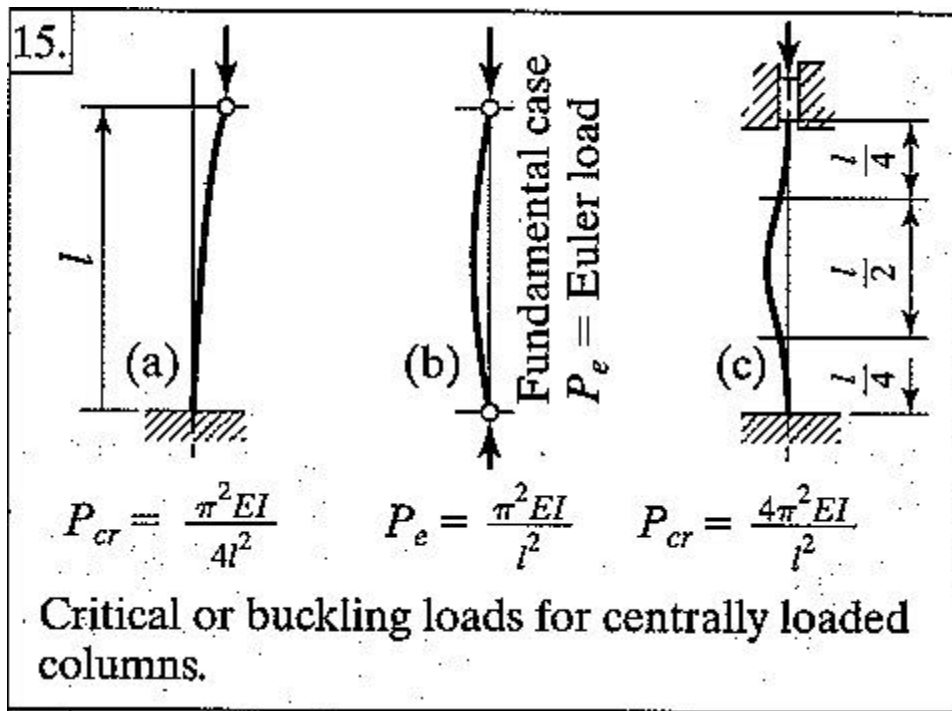# 1-18 SLENDER COMPRESSION MEMBERS OR COLUMNS

Figure 1-28 Bodies under compressive loading.

For the straight column with hinged ends loaded by centrally applied forces, it can be shown that the critical buckling load is given by

$$P_e = \frac{\pi^2 EI}{l^2} \tag{31}$$

This is commonly known as the Euler equation. See No. 15 of Fig. 1-15. Moment of inertia I should be about the axis of rotation of the cross section.

$$P_{cr} = \frac{\pi^2 EI}{4l^2} \qquad P_e = \frac{\pi^2 EI}{l^2} \qquad P_{cr} = \frac{4\pi^2 EI}{l^2}$$

Critical or buckling loads for centrally loaded columns.

For different end conditions of column

Sometimes a column may not be perfectly straight, but has some initial crookedness a, as shown in Fig. 1-29. The bending moment then will be larger, and the carrying capacity will be reduced. It can be shown[8] that the working load P for such a column with factor of safety F_s is given by

$$P^2 - \left[\sigma_{yp}A + \left(1 + \frac{ac}{i^2}\right)P_e\right]\frac{P}{F_s} + \frac{\sigma_{yp}AP_e}{(F_s)^2} = 0 \tag{32}$$

where

σ_{yp} = yield point stress for the material

$\quad$ = area of cross section
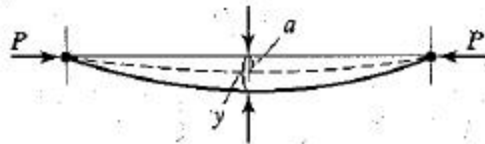
c = distance from neutral axis to edge of cross section

$i = \sqrt{I/A}$ $\tag{33}$

Figure 1-29 Column with initial crookedness a.