

- (c) Short braced columns supporting vertical loads and subjected to either uniaxial or biaxial bending.

Each of these categories will be discussed in turn.

Short braced axially loaded columns

When a short braced column supports a concentric compressive load or where the eccentricity of the compressive load is nominal, it may be considered to be axially loaded. Nominal eccentricity in this context is defined as being not greater than 0.05 times the overall column dimension in the plane of bending or 20 mm. Thus for a lateral column dimension not greater than 400 mm the value 0.05 times the dimension would apply, and over 400 mm the 20 mm limit would apply. These load conditions are illustrated in Figure 3.41.

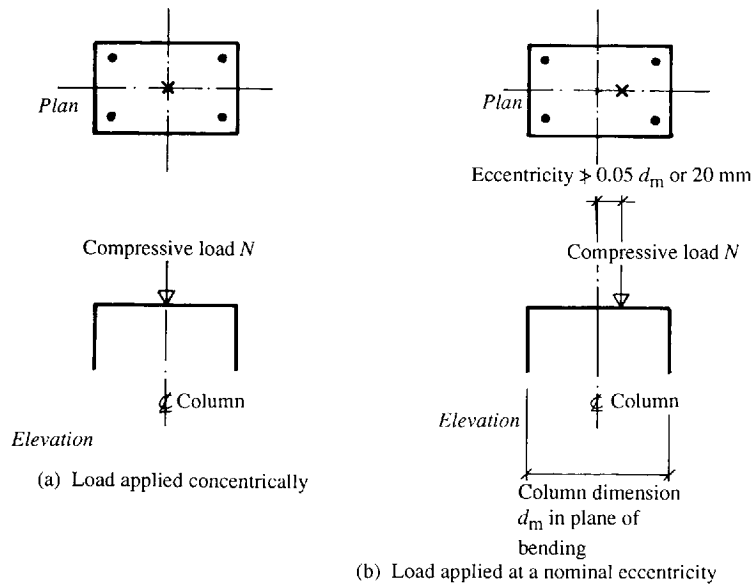


Figure 3.41 *Axially loaded columns*

The ultimate compressive load for columns in such instances is obtained from the following expression, which includes an allowance for the material partial safety factory γ_m :

$$\text{BS 8110 equation 38: } N = 0.4f_{cu}A_c + 0.75A_{sc}f_y$$

where

A_c net cross-sectional area of concrete in a column (excluding area of reinforcement)

- A_{sc} area of vertical reinforcement
 f_{cu} characteristic strength of concrete
 f_y characteristic strength of reinforcement
 N design ultimate axial load on column

Now $A_c = A_g - A_{sc}$, where A_g is the gross cross-sectional area of the column. Hence by substituting this value in the BS 8110 expression 38 it becomes:

$$\text{Equation 38(a): } N = 0.4f_{cu}(A_g - A_{sc}) + 0.75A_{sc}f_y$$

It should be appreciated that the two parts of this expression represent the load sustained by each of the column's two composite materials, concrete and steel. That is,

$$\begin{aligned} &\text{Ultimate load supported by the concrete} \\ &= \text{ultimate concrete design stress} \times \text{net concrete area} \\ &= 0.4f_{cu}A_c = 0.4f_{cu}(A_g - A_{sc}) \end{aligned}$$

$$\begin{aligned} &\text{Ultimate load supported by the steel} \\ &= \text{ultimate steel design stress} \times \text{steel area} \\ &= 0.75f_yA_{sc} \end{aligned}$$

Short braced columns supporting an approximately symmetrical arrangement of beams

For columns within this category, either the columns must support symmetrical beam arrangements (Figure 3.42), or the span of the beams on adjacent sides of the column must not differ by more than 15 per cent of the longer span (Figure 3.43). Furthermore the column must only support beams carrying uniformly distributed loads.

Provided that these conditions are met, a column may be designed as axially loaded using the following modified expression, which again includes an allowance for the material partial safety factor γ_m :

$$\text{BS 8110 equation 39: } N = 0.35f_{cu}A_{sc} + 0.67A_{sc}f_y$$

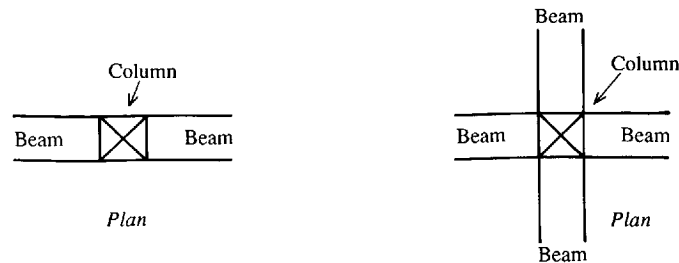


Figure 3.42 Columns supporting symmetrical beam arrangements