where

- F applied axial load
- A_g gross sectional area, from section tables
- p_c compressive strength
- m has value 1 when only nominal moments are applied
- M_x applied moment about the major axis
- M_b buckling resistance capacity about the major axis
- M_y applied moment about the minor axis
- p_y design strength of the steel
- Z_y elastic section modulus about the minor axis, from section tables

It should be noted that when $m = 1$ the overall buckling check will always control the design. Therefore for columns supporting only nominal moments it is not necessary to carry out the local capacity check discussed in the previous section.

The buckling resistance capacity M_b of the section about the major axis is obtained from the following expression:

$$M_b = p_b S_x$$

where p_b is the bending strength and S_x is the plastic modulus of the section about the major axis, obtained from section tables. The bending strength for columns is obtained from BS 5950 Table 11, reproduced earlier as Table 5.5. It depends on the steel design strength p_y and the equivalent slenderness λ_{LT}, which for columns supporting only nominal moments may be taken as

$$\lambda_{LT} = 0.5 \frac{L}{r_y}$$

where L is the distance between levels at which both axes are restrained, and r_y is the radius of gyration of the section about its minor axis, from section tables.

5.12.4 Design summary for axially loaded steel columns with nominal moments

The procedure for the design of axially loaded columns with nominal moments, using grade 43 UC sections, may be summarized as follows:

(a) Calculate the ultimate axial load F applied to the column.

(b) Select a trial section.

(c) Calculate the nominal moments M_x and M_y about the respective axes of the column.

(d) Determine the overall effective length L_E from the guidance given in Table 5.10

(e) Calculate the slenderness λ from L_E/r and ensure that it is not greater than 180.

(f) Using the slenderness λ and the steel design strength p_y, obtain the compression strength p_c from Table 27a–d of BS 5950.

(g) Obtain the bending strength p_b from Table 5.5 using the steel design strength p_y and the equivalent slenderness λ_{LT}, which may be taken as $0.5L/r_y$ for columns subject to nominal moments.

(h) Calculate M_b from the expression $M_b = p_b S_x$.

(i) Ensure that the following relationship is satisfied:

$$\frac{F}{A_g p_c} + \frac{mM_x}{M_b} + \frac{mM_y}{p_y Z_y} \leqslant 1$$

Example 5.13

Design a suitable grade 43 UC column to support the ultimate loads shown in Figure 5.38. The column is effectively held in position at both ends and restrained in direction at the base but not at the cap.

Ultimate axial load $F = 125 + 125 + 285 + 5 = 540\,\text{kN} = 540 \times 10^3\,\text{N}$

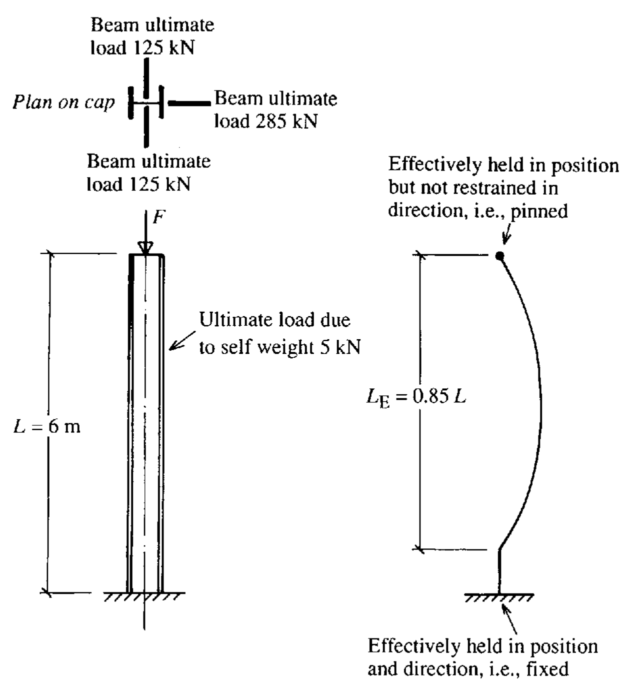

Figure 5.38 *Column loads and effective length*