axes. It may also be subject to horizontal bending induced by lateral wind loading. However, the effect of wind loading on individual structural elements is not being considered in this manual.

Guidance for the design of axially loaded columns and axially loaded columns with moments is given in BS 5950 Part 1. The procedure for dealing with columns subject to axial load alone is first explained. This is then extended to include the interaction between compression and bending. Separate guidance is also given for the design of concrete cased columns and baseplates for columns.

The design of steel columns in this manual will therefore be considered under the following headings:

(a) Axially loaded columns
(b) Axially loaded columns with moments
(c) Cased columns
(d) Column base plates.

5.12.1 Axially loaded columns

A column supporting an axial load is subjected to direct compression. The compression resistance P_c of a column is given by the following expression:

$$P_c = A_g p_c$$

where A_g is the gross sectional area and p_c is the compressive strength. To ensure that a particular steel column is adequate, its compression resistance must be equal to or greater than the ultimate axial load F:

$$P_c \geqslant F$$

A steel column, because of its slender nature, will tend to buckle laterally under the influence of the applied compression. Therefore the compressive strength p_c is reduced to take account of the slenderness of the column. The slenderness λ of an axially loaded column is given by the following expression:

$$\lambda = \frac{L_E}{r}$$

where L_E is the effective length of the column and r is the radius of gyration of the section about the relevant axis, found from section tables.

The maximum slenderness of steel columns carrying dead and imposed loads is limited to 180. Values greater than this limit indicate that a larger section size is required.

Guidance on the nominal effective lengths to be adopted, taking end restraint into consideration, is given in BS 5950 Table 24. Additional guid-

ance in relation to columns in certain single storey buildings and those forming part of a rigid frame are given in Appendices D and E respectively of the standard. The main effective length requirements for single storey steel sections are summarized here in Table 5.10.

Table 5.10 Effective length of steel columns

End condition	Effective length L_E
Restrained at both ends in position and direction	$0.7L$
Restrained at both ends in position and one end in direction	$0.85L$
Restrained at both ends in position but not in direction	$1.0L$
Restrained at one end in position and in direction and at the other end in direction but not in position	$1.5L$
Restrained at one end in position and in direction and free at the other end	$2.0L$

The compressive strength p_c depends on the slenderness λ and the design strength of the steel p_y, or on a reduced design strength if the section is classified as slender. It was mentioned previously with respect to beams that the web and flanges of steel sections are comparatively slender in relation to their depth and breadth. Consequently the compressive force acting on a column could also cause local buckling of the web or flange before the full plastic stress is developed. This situation is avoided by reducing the stress capacity of the columns in relation to its section classification.

The column designs contained in this manual will be related to the use of UC sections, which are defined as H-sections in BS 5950. Since it can be shown that all UC sections are classified as at least semi-compact when used as axially loaded columns, no reduction in the design strength p_y because of local buckling will be necessary.

The value of the compressive strength p_c in relation to the slenderness λ and the design strength p_y is obtained from strut tables given in BS 5950 as Table 27a–d. The specific table to use is indicated in Table 25 of the standard relative to the type of section employed. With respect to UC sections, the particular strut table to use is given here as Table 5.11.

Table 5.11 Selection of BS 5950 strut table

Section type	Thickness	Buckling axis	
		x–x	y–y
Rolled H-section	Up to 40 mm	Table 27b	Table 27c
	Over 40 mm	Table 27c	Table 27d