manual, only the values for the dead and imposed load combination are required, which are 1.4 and 1.6 respectively. Thus the ultimate design load for the dead plus imposed combination would be as follows:

$$\text{Ultimate design load} = \gamma_f \times \text{dead load} + \gamma_f \times \text{imposed load}$$
$$= 1.4 \times \text{dead load} + 1.6 \times \text{imposed load}$$

5.7.4 Serviceability design load

For the purpose of checking the deflection SLS, the partial safety factor γ_f may be taken as unity. Furthermore, in accordance with BS 5950, the deflection of a beam need only be checked for the effect of imposed loading. Hence the serviceability design load for checking the deflection of a steel beam is simply the specified imposed load. This differs from the design of timber and concrete beams, for which the dead plus imposed load is used to check deflection. However, it is not unreasonable since we are only interested in controlling the deflection of steel beams to avoid damage to finishes, and the dead load deflection will already have taken place before these are applied. If for reasons of appearance it is considered necessary to counteract all or part of the dead load deflection, the beam could be pre-cambered.

5.8 Material properties

The ultimate design strength p_y for the most common types of structural steel are given in BS 5950 Table 6, from which those for grade 43 steel are shown here in Table 5.1. They incorporate the material partial safety factor γ_m in the specified values. Therefore the strength may be obtained directly from the table without further modification. For beam and column sections the material thickness referred to in the table should be taken as the flange thickness.

Table 5.1 Design strength p_y of grade 43 steel

Thickness less than or equal to (mm)	p_y for rolled sections, plates and hollow sections (N/mm^2)
16	275
40	265
63	255
100	245

The modulus of elasticity E, for deflection purposes, may be taken as $205\,kN/mm^2$ for all grades of steel.

5.9 Section properties

Dimensions and geometric properties for the hot rolled steel sections commonly available for use as beams and columns are tabulated in BS 4 Part 1. Similar tables expanded to include a number of useful design constants are also published by the Steel Construction Institute. These are contained in their *Steelwork Design Guide to BS 5950: Part 1*, Volume 1, *Section Properties, Member Capacities*. Tables 5.2 and 5.3 given here are typical examples from that publication, reproduced by kind permission of the director of the Steel Construction Institute. Complete copies of the guide can be obtained from the Institute at Silwood Park, Ascot, Berkshire, SL5 7QN.

Table 5.2 relates to universal beam (UB) sections, as illustrated in Figure 5.1, and Table 5.3 to universal column (UC) sections, as illustrated in Figure 5.2. The use of these tables in relation to the design of beams and columns will be explained in the appropriate sections of this chapter.

Whilst the UB sections are primarily intended for use as beams, they can if desired be used as columns; this is often the case in portal frame construction. Similarly the UC sections are intended for use as columns but can also be used as beams. However, because they have a stocky cross-section they do not lend themselves as readily to such an alternative use.

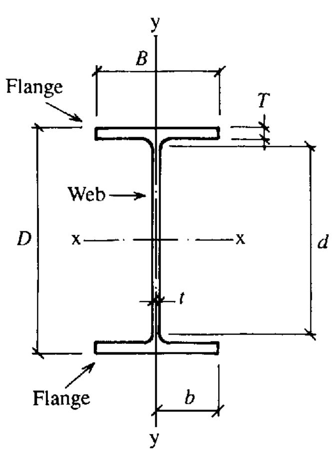

Figure 5.1 *Universal beam cross-section*

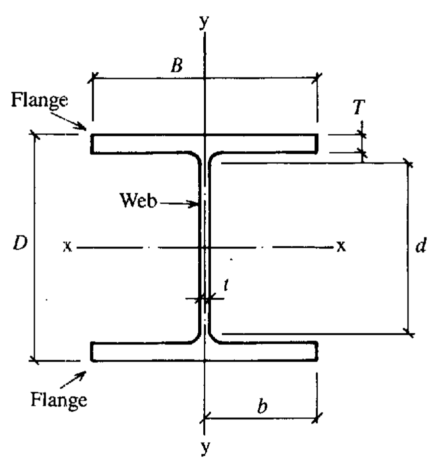

Figure 5.2 *Universal column cross-section*

5.10 Beams

The main structural design requirements for which steel beams should be examined as as follows:

(a) Bending ULS