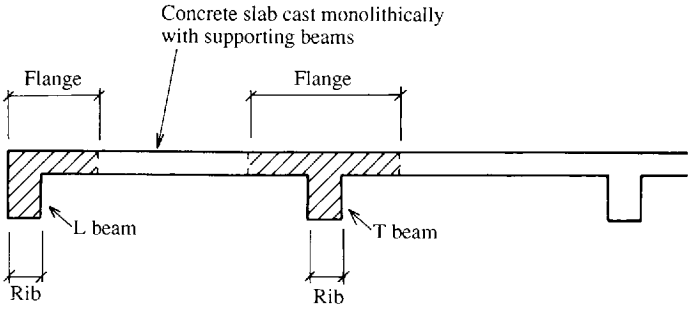

Figure 3.5 *Flanged beams*

3.9.8 Cracking SLS

Crack widths need to be controlled for appearance and to avoid corrosion of the reinforcement.

The cracking serviceability limit state will generally be satisfied by compliance with detailing rules given in BS 8110 Part 1. These relate to minimum reinforcement areas and bar spacing limits which for beams have already been stated in Sections 3.9.4 and 3.9.6. They ensure that crack widths will not exceed 0.3 mm.

Where it is necessary to limit crack widths to particular values less than 0.3 mm, perhaps for water tightness, then reference should be made to the guidance given in BS 8110 Part 2.

3.9.9 Deflection SLS

Reinforced concrete beams should be made sufficiently stiff that excessive deflections, which would impair the efficiency or appearance of the structure, will not occur. The degree of deflection allowed should be commensurate with the capacity of movement of any services, finishes, partitions, glazing, cladding and so on that the member may support or influence.

In all normal situations the deflection of beams will be satisfactory if the basic span to effective depth ratios given in BS 8110 Part 1 Table 3.10, reproduced here as Table 3.9, are not exceeded.

Table 3.9 Basic span to effective depth ratios for rectangular or flanged beams (BS 8110 Part 1 1985 Table 3.10)

Support conditions	Rectangular sections	Flanged beams with $b_w/b \leqslant 0.3$
Cantilever	7	5.6
Simply supported	20	16.0
Continuous	26	20.8

It should be understood that the span to depth ratios given in Table 3.9 are based on the following:

(a) The span does not exceed 10 m.

(b) The total deflection is not greater than span/250, and the deflection after application of finishes and erection of partitions (that is, due to imposed loads) is limited to 20 mm or span/500.

(c) The loading pattern is uniformly distributed.

If for any reason it is necessary to change any of these parameters, the span to depth ratio must be adjusted accordingly:

(a) If the span exceeds 10 m,

$$\text{Revised ratio} = \text{basic ratio} \times 10/\text{span}$$

(b) If the total deflection must not exceed span/β,

$$\text{Revised ratio} = \text{basic ratio} \times 250/\beta$$

If deflection after the application of finishes must be less than the 20 mm limit,

$$\text{Revised ratio} = \text{basic ratio} \times \alpha/20$$

where α is the revised limit.

(c) The basic ratios have been derived with a uniformly distributed loading pattern coefficient of 0.104 included. Therefore for other loading patterns the basic ratios would have to be adjusted in proportion to the coefficient values. Reference should be made to BS 8110 Part 2 Table 3.1 for the coefficients for other loading patterns.

Deflection of beams is also influenced by the amount of tension steel present in the beam. This is expressed in terms of the design service stress in the steel and the ratio M/bd^2. To allow for this the basic span to effective depth ratio is modified by a factor from BS 8110 Part 1 Table 3.11, reproduced here as Table 3.10.

To determine the design service stress in the steel the following expression, from the second footnote to Table 3.10, is used:

$$f_s = \frac{5}{8} f_y \frac{A_{s,req}}{A_{s,prov}} \times \frac{1}{\beta_b}$$

where

$A_{s,prov}$ area of tension reinforcement provided at mid-span or at the support of a cantilever

$A_{s,req}$ area of tension reinforcement required

f_s estimated design service stress in the tension reinforcement

f_y characteristic strength of steel

β_b ratio to take account of any bending moment redistribution that has taken place