

DEFLECTION COEFFICIENTS

Clause 15 to BS 449 includes the requirement that the maximum deflection due to loads other than the weight of the structural floors or roof, steelwork and casing, if any, shall not exceed 1/360th of the span. For a simply supported beam, the uniformly distributed load W_D in kN to produce this deflection is:

$$W_D = \frac{384EI}{5 \times 360L^2} = \frac{CI}{1000}$$

where C = deflection coefficient tabulated for span L in m
 E = modulus of elasticity = 21000kN/cm² (=210000N/mm²)
 I = moment of inertia of beam, in cm⁴

The load W_D will be less than the tabular load if the span exceeds 12.17, 16.97 or 10.00 times the beam depth for grades 50, 43 or 55 steel respectively. For such cases, it may be necessary to confirm that the total load is within the capacity of the beam and that the loads to be considered for deflection purposes do not exceed W_D .

The table below gives limiting values of the span/depth ratio for uniformly loaded simply supported beams for different grades of steel for various ratios of W_d/W_t where W_d = load considered for deflection purposes and W_t = total load on beam. If the appropriate span/depth ratio is exceeded, then the relevant deflection will exceed 1/360th of the span unless the bending stress is reduced.

Material	Limiting values of span to depth ratio for W_d/W_t					
	1.0	0.9	0.8	0.7	0.6	0.5
Grade 50	12.17	13.53	15.22	17.39	20.29	24.35
Grade 43	16.97	18.86	21.21	24.24	28.28	33.94
Grade 55	10.00	11.11	12.50	14.29	16.67	20.00

SAFE LOADS (for as-rolled sections)

These are the safe uniformly distributed loads (including self weight) which can be carried by simply supported beams with adequate lateral restraint to the compression flange. They have therefore generally been calculated in accordance with the allowable bending stresses given in BS 449.

The loads are printed in three different type faces to draw attention to particular criteria which may affect the load-carrying capacity of a beam. Bold, italic and ordinary type faces have been used in that sequence for maximum clarity and the significance of each is explained below.

Bold face. Loads printed in this type are greater than the web buckling capacity of the beam (UB, joist or channel) alone. If sufficient additional capacity is not provided by the bearing, web stiffeners will be necessary to realise the full web capacity.

Italic face. Loads printed in this type are within the buckling capacity of the unstiffened web and produce a maximum deflection of less than 1/360th of the span.

Ordinary face. Loads printed in this type produce a maximum deflection exceeding 1/360th of the span. Such cases should therefore be examined as indicated above under 'Deflection coefficients'.

In addition to the criteria covered by the use of different type faces, two other matters require comment.

- Shear capacity.* Where the shear capacity of the unstiffened web is less than the bending capacity of a beam, the safe load is calculated on the allowable average shear stress given in BS 449.
- Web crushing.* Many of the loads tabulated, in the various type faces, exceed the beam component of the direct bearing capacity of the web at its junction with the flange. The designer should therefore ensure that the length of stiff bearing and thickness of flange plate or packing (if any) provide a sufficient additional length of web in bearing.