5.10.6 Web buckling resistance

When a concentrated load, such as the reaction, is transmitted through the flange of a beam to the web, it may cause the web to buckle. In resisting such buckling the web of the beam behaves as a strut. The length of web concerned is determined on the assumption that the load is dispersed at 45° from the edge of stiff bearing to the neutral axis of the beam, as shown in Figure 5.20. The buckling resistance P_w of the unstiffened web is calculated from the following expression:

$$P_w = (b_1 + n_1)tp_c$$

where

b_1 stiff bearing length
n_1 length obtained by dispersion through half the depth of the section
t web thickness, from section tables
p_c compressive strength of the steel

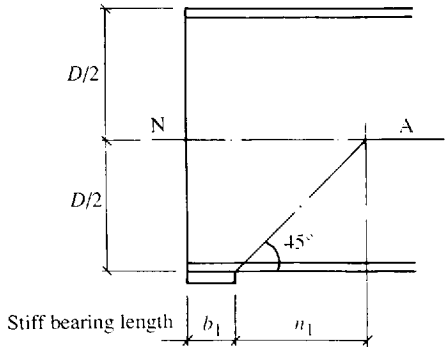

Figure 5.20 *Web buckling resistance: load dispersal*

The compressive strength p_c of the steel should be obtained from BS 5950 Table 27c in relation to the ultimate design strength of the steel and the web slenderness λ.

When the beam flange through which the load is applied is restrained against rotation relative to the web and against lateral movement relative to the other flange, then the slenderness is given by the following expression from BS 5950:

$$\lambda = 2.5\frac{d}{t}$$

Should these conditions not apply, then the slenderness may conservatively be obtained using the following expression:

$$\lambda = 3.46\frac{d}{t}$$

Example 5.8

Check the web buckling capacity of the beam that was designed for bending in Example 5.1. It may be assumed that the beam is supported on a stiff bearing length of 75 mm as indicated in Figure 5.21.

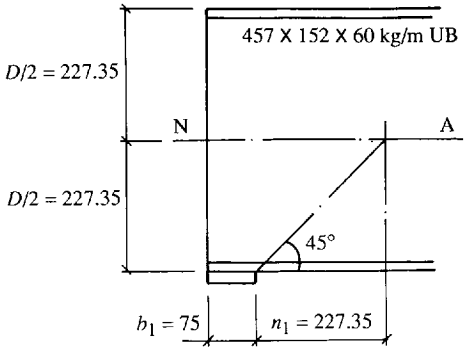

Figure 5.21 *Web buckling check dimensions*

From the loading diagram for this beam, shown in Figure 5.17, the maximum ultimate reaction is 198.4 kN.

The section selected to resist bending was a 457 × 152 × 60 kg/m UB, for which the relevant properties for checking web buckling, from Table 5.2, are as follows:

$$D = 454.7\,\text{mm} \qquad \frac{D}{2} = \frac{454.7}{2} = 227.35\,\text{mm}$$

$$\frac{d}{t} = 51.00 \qquad t = 8.0\,\text{mm}$$

With both flanges restrained,

$$\lambda = 2.5\frac{d}{t} = 2.5 \times 51 = 127.5$$

Also $p_y = 275\,\text{N/mm}^2$. Thus by interpolation from BS 5950 Table 27c, $p_c = 88.5\,\text{N/mm}^2$.

The stiff bearing length $b_1 = 75\,\text{mm}$, and $n_1 = D/2 = 227.35\,\text{mm}$. Hence

$$P_w = (b_1 + n_1)tp_c = (75 + 227.35)8 \times 88.5 = 214\,064\,\text{N} = 214\,\text{kN} > 198.4\,\text{kN}$$

Thus the buckling resistance of the unstiffened web is greater than the maximum reaction, and therefore the web does not require stiffening to resist buckling.

5.10.7 Web bearing resistance

The web bearing resistance of a beam is the ability of its web to resist crushing induced by concentrated loads such as the reactions. These are