The effective depth h_e of timber remaining should never be less than half the member depth, that is $0.5h$.

It should be appreciated that the area used in the expression for calculating r_a at a notched end is the net area after notching, that is $A = bh_e$.

2.12.4 Bearing

The compression stress perpendicular to the grain, or the bearing stress, which is developed at points of support should also be checked. Where the length of bearing at a support is not less than 75 mm the bearing stress will not usually be critical. If flexural members are supported on narrow beams or ledgers the bearing stress could influence the member size.

The applied compression stress perpendicular to the grain, $\sigma_{c,a,perp}$, may be calculated from the following expression:

$$\sigma_{c,a,perp} = \frac{F}{\text{bearing area}}$$

where F is the bearing force, usually maximum reaction, and the bearing area is the bearing length times the breadth of the section.

This stress must be less than the permissible compression stress perpendicular to the grain, $\sigma_{c,adm,perp}$. This is obtained by multiplying the grade compression stress perpendicular to the grain, $\sigma_{c,g,perp}$ (Table 2.2), by the K_3 load duration and K_8 load sharing factors as appropriate. Therefore

$$\sigma_{c,a,perp} \leqslant \sigma_{c,adm,perp}$$
$$\sigma_{c,a,perp} \leqslant \sigma_{c,g,perp} K_3 K_8$$

Two values for the grade compression stress perpendicular to the grain are given for each strength class in Table 2.2. The higher value may be used when the specification will prohibit wane from occurring at bearing areas; otherwise the lower value must be adopted.

Reference should be made to BS 5268 for the modification factor K_4, which should be used for the special case of bearing less than 150 mm long located 75 mm or more from the end of a flexural member.

2.12.5 Design summary for timber flexural members

The design procedure for timber flexural members such as beams, joists and rafters may be summarized as follows.

Bending

Check using the theory of bending principles, taking into account modification factors for load duration K_3, load sharing K_8 (if applicable), depth

K_7 and so on. First, calculate the bending moment M. Then

$$\text{Approximate } Z_{xx} \text{ required} = \frac{M}{\sigma_{m,g,par} K_3 K_8}$$

Choose a suitable timber section from tables, and recheck the Z_{xx} required with a K_7 factor for depth included:

$$\text{Final } Z_{xx} \text{ required} = \frac{M}{\sigma_{m,g,par} K_3 K_7 K_8}$$

The risk of lateral buckling failure should also be checked at this stage by ensuring that the depth to breadth ratio is less than the relative maximum value given in Table 2.8.

Deflection

Compare the permissible deflection $\delta_p = 0.003 \times$ span with the actual deflection $\delta_a = \delta_m + \delta_v$:

For a UDL: $$\delta_a = \frac{5}{384} \frac{WL^3}{EI} + \frac{19.2M}{AE}$$

For a central point load: $$\delta_a = \frac{1}{48} \frac{WL^3}{EI} + \frac{19.2M}{AE}$$

Use E_{mean} for load sharing members and E_{min} for isolated members.

Shear

Compare the applied shear stress

$$r_a = \frac{3}{2} \frac{F_v}{A}$$

with the permissible shear stress

$$r_{adm} = r_g K_3 K_8$$

(where K_8 is used if applicable). Then if the member is notched, check the shear with a notch.

Bearing

Compare the applied bearing stress

$$\sigma_{c,a,perp} = \frac{F}{\text{bearing area}}$$