with the permissible bearing stress

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

(where K_8 is used if applicable).

Note that throughout this procedure the wet exposure modification factors should be applied where necessary if the member is to be used externally.

Let us now look at some examples on the design of timber flexural members.

Example 2.1

A flat roof spanning 4.25 m is to be designed using timber joists at 600 m centres. The loads from the proposed roof construction are as follows:

Asphalt 20 mm thick	0.45 kN/m^2
Pre-screeded unreinforced woodwool	0.30 kN/m^2
Timber firrings	0.01 kN/m^2
Ceiling	0.15 kN/m^2

The imposed roof load due to snow may be taken as 0.75 kN/m^2 and the load due to the weight of the joists as 0.1 kN/m^2. The latter may be checked after the joists have been designed by taking the weight of timber as 540 kg/m^3.

Determine the size of suitable SC3 whitewood joists, checking shear and deflection. In addition, check the joists if a 75 mm deep notch were to be provided to the bottom edge at the bearings.

Loading

Before proceeding with the design routine for flexural members, the load carried by a joist must be computed in the manner described in Chapter 1:

Dead load:	asphalt	0.45
	woodwool	0.30
	firrings	0.01
	ceiling	0.15
	joists SW	0.10
		1.01 kN/m^2

Imposed load: 0.75 kN/m^2

Combined load:	dead	1.01
	imposed	0.75
		1.76 kN/m^2

From this the uniformly distributed load supported by a single joist can be calculated on the basis that they span 4.25 m and are spaced at 600 m centres.

UDL per joist = 1.76 × 4.25 × 0.6 = 4.49 kN, say 4.5 kN

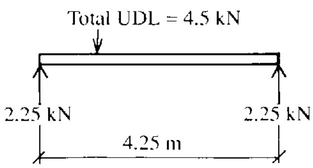

Figure 2.3 *Loaded joist*

This enables us to visualize the load condition for a single roof joist element in Figure 2.3.

The design procedure for timber flexural members can now be followed.

Bending

Maximum bending moment $M = \frac{WL}{8} = \frac{4.5 \times 4.25}{8} = 2.39\,\text{kN m}$

$= 2.39 \times 10^6\,\text{N mm}$

Grade bending stress parallel to grain (from Table 2.2 for SC3 whitewood timber) $\sigma_{m,g,par} = 5.3\,\text{N/mm}^2$

K_3 load duration factor, medium term (from Table 2.6) = 1.25

K_8 load sharing factor = 1.1

K_7 depth factor is unknown at this stage

Approximate Z_{xx} required (ignoring K_7)

$$= \frac{M}{\sigma_{m,g,par}K_3K_8} = \frac{2.39 \times 10^6}{5.3 \times 1.25 \times 1.1} = 327\,959\,\text{mm}^3 = 327.96 \times 10^3\,\text{mm}^3$$

Comparing this Z_{xx} required with the properties for sawn joists given in Table 2.4, a 50 mm × 200 mm joist has a Z_{xx} of $333 \times 10^3\,\text{mm}^3$, which is greater than that required. Therefore the section would be adequate in bending.

If the K_7 depth factor were to be included in the calculations now that a timber size has been determined, it would increase the adequacy of the chosen section since the approximate Z_{xx} required is divided by this factor. From Table 2.7 for a 200 mm joist, $K_7 = 1.046$. Therefore

$$\text{Final } Z_{xx} \text{ required} = \frac{\text{approximate } Z_{xx} \text{ required}}{K_7}$$

$$= \frac{327.96 \times 10^6}{1.046} = 313.54 \times 10^3\,\text{mm}^3$$

If it were considered necessary, a comparison could be made between the applied bending stress developed in the timber and the permissible bending stress. Such a comparison is not essential since the section has already been shown to be adequate in bending, but it will be included here to illustrate the calculation involved.

Applied bending stress parallel to grain:

$$\sigma_{m,a,par} = \frac{M}{Z_{xx}} = \frac{2.39 \times 10^6}{333 \times 10^3} = 7.18\,\text{N/mm}^2$$

Permissible bending stress parallel to grain:

$$\sigma_{m,adm,par} = \sigma_{m,g,par}K_3K_7K_8 = 5.3 \times 1.25 \times 1.046 \times 1.1 = 7.62\,\text{N/mm}^2$$

The risk of lateral buckling failure should also be considered:

Depth to breadth ratio $h/d = 200/50 = 4$