Calculate λ from either of the following:

$$\lambda = \frac{L_e}{i} = \frac{2750}{18.2} = 151 < 180$$

$$\lambda = \frac{L_e}{b} = \frac{2750}{63} = 43.65 < 52$$

Both values are satisfactory. Next,

$$\frac{E_{min}}{\sigma_{c,g,par}K_3} = \frac{5800}{6.8 \times 1.25} = 682.35$$

Thus from Table 2.9, $K_{12} = 0.168$. Finally, compare stresses:

Permissible compression stress:

$$\sigma_{c,adm,par} = \sigma_{c,g,par}K_3K_{12} = 6.8 \times 1.25 \times 0.168 = 1.43\,\text{N/mm}^2$$

Applied compression stress:

$$\sigma_{c,a,par} = \frac{\text{applied load}}{\text{section area}} = \frac{12.5 \times 10^3}{9.45 \times 10^3} = 1.32\,\text{N/mm}^2 < 1.43\,\text{N/mm}^2$$

Thus the section is adequate.

Alternatively the section may be checked by calculating the safe load it would sustain and comparing it with the applied load:

Safe load = permissible stress × section area
$= 1.43 \times 9.45 \times 10^3 = 13.51 \times 10^3\,\text{N} = 13.51\,\text{kN} > 12.5\,\text{kN}$

Use 63 mm × 150 mm sawn GS grade redwood or whitewood post.

Example 2.7

An SS grade Scots pine post 2.5 m in height supports a total long term load of 40 kN applied 75 mm eccentric to its x–x axis as shown in Figure 2.7. Check the adequacy of a 100 mm × 250 mm sawn section if it is restrained at both ends in position and one end in direction.

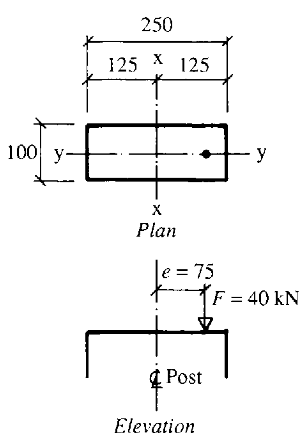

Figure 2.7 *Post loading and dimensions*

Since the load is applied eccentrically, a bending moment will be developed for which the section must also be checked. The eccentricity moment about the x–x axis is given by

$$M_e = Fe = 40 \times 10^3 \times 75 = 3 \times 10^6\,\text{N mm}$$

Calculate λ from either of the following:

$$\lambda = \frac{L_e}{i} = \frac{2500 \times 0.85}{28.9} = 73.53 < 180$$

$$\lambda = \frac{L_e}{b} = \frac{2500 \times 0.85}{100} = 21.25 < 52$$

Both values are satisfactory.

The grade compression stress $\sigma_{c,g,par} = 7.9\ \text{N/mm}^2$, and

$$\frac{E_{min}}{\sigma_{c,g,par}K_3} = \frac{6600}{7.9 \times 1} = 835.44$$

Thus from Table 2.9, $K_{12} = 0.553$. Next, compare stresses:

Permissible compression stress:

$$\sigma_{c,adm,par} = \sigma_{c,g,par}K_3K_{12} = 7.9 \times 1 \times 0.553 = 4.36\ \text{N/mm}^2$$

Applied compression stress:

$$\sigma_{c,a,par} = \frac{F}{A} = \frac{40 \times 10^3}{25 \times 10^3} = 1.6\ \text{N/mm}^2 < 4.36\ \text{N/mm}^2$$

Thus the section is satisfactory.

Having checked the effect of direct compression, the effect of the eccentricity moment must also be checked:

Grade bending stress $\sigma_{m,g,par} = 7.5\ \text{N/mm}^2$

Permissible bending stress:

$$\sigma_{m,adm,par} = \sigma_{m,g,par}K_3K_7 = 7.5 \times 1 \times 1.02 = 7.65\ \text{N/mm}^2$$

Applied bending stress:

$$\sigma_{m,a,par} = \frac{M_e}{Z_{xx}} = \frac{3 \times 10^6}{1040 \times 10^3} = 2.89\ \text{N/mm}^2 < 7.65\ \text{N/mm}^2$$

Again this is adequate.

Finally, the interaction quantity must be checked:

$$\frac{\sigma_{m,a,par}}{\sigma_{m,adm,par}\{1 - [1.5\sigma_{c,a,par}K_{12}(L_e/i)^2/\pi^2 E_{min}]\}} + \frac{\sigma_{c,a,par}}{\sigma_{c,adm,par}}$$

$$= \frac{2.89}{7.65\{1 - [1.5 \times 1.6 \times 0.553 \times (73.53)^2/\pi^2 \times 6600]\}} + \frac{1.6}{4.36}$$

$$= 0.425 + 0.367 = 0.792 < 1$$

Thus the 100 mm × 250 mm sawn section is adequate.

2.15 Load bearing stud walls

A cross-sectional plan through a typical stud wall is shown in Figure 2.8. For the purpose of design the studs may be regarded as a series of posts.

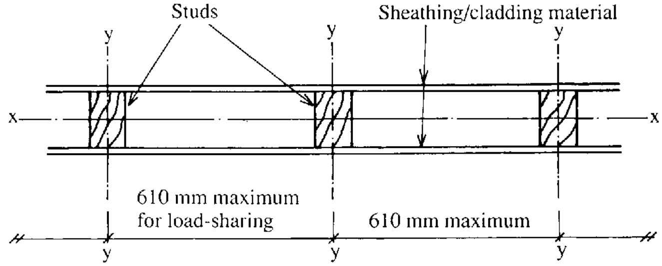

Figure 2.8 *Plan on a typical stud wall*