Imposed load: $1.5\,kN/m^2$

Combined load: dead 0.45
imposed 1.5
$1.95\,kN/m^2$

This combined load is a load per unit area. In order to convert it into a UDL, it must be multiplied by the area supported of 4 m span by 3 m centres. An allowance must also be included for the load due to the self-weight (SW) of the timber beam.

$$\text{Total UDL} = (1.95 \times 4 \times 3) + \text{SW}$$
$$= 23.4 + \text{say } 0.6 = 24.0\,kN$$

The allowance assumed for the self-weight can be checked after a size for the member has been determined. To illustrate such a check, consider a beam size of 250 mm deep by 100 mm wide and take the average weight of softwood timber as $540\,kg/m^3$.

$$\text{SW} = (540/100) \times 4 \times 0.25 \times 0.1 = 0.54\,kN$$

Thus the SW of 0.6 assumed was satisfactory.

Example 1.2

Steel floor beams arranged as shown in Figure 1.3 support a 150 mm thick reinforced concrete slab. If the floor has to carry an imposed load of $5\,kN/m^2$ and reinforced concrete weighs $2400\,kg/m^3$, calculate the total UDL that each floor beam supports.

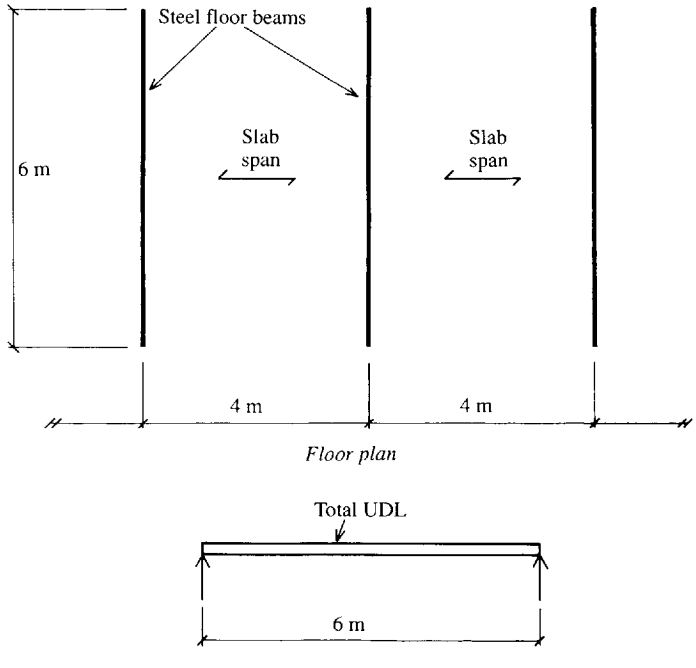

Figure 1.3 *Floor beam arrangement*

The procedure to calculate the UDL is similar to Example 1.1 except that in this case the weight of concrete relates to volume and so needs resolving into a load per unit area to arrive at the dead load of the 150 mm thick slab.

Dead load 150 mm slab: $0.15 \times 2400/100 = 3.6\,\text{kN/m}^2$

Imposed load: $5\,\text{kN/m}^2$

Combined load: dead 3.6
imposed 5.0
$8.6\,\text{kN/m}^2$

Total UDL $= (8.6 \times 6 \times 4) + \text{SW}$
$= 206.4 + \text{say } 3.6 = 210\,\text{kN}$

To check the assumed self-weight, consider that the eventual weight of steel beam will be 60 kg/m run. Then

$\text{SW} = (60/100) \times 6 = 3.6\,\text{kN}$

which is satisfactory.

Example 1.3

Calculate the beam loads and the reactions transmitted to the walls for the steelwork arrangement shown in Figure 1.4. Beam A supports a 100 mm thick reinforced concrete slab, spanning in the direction shown, which carries an imposed load of $3\,\text{kN/m}^2$. The weight of concrete may be taken as $2400\,\text{kg/m}^3$ and the weight of the beams as 80 kg/m run.

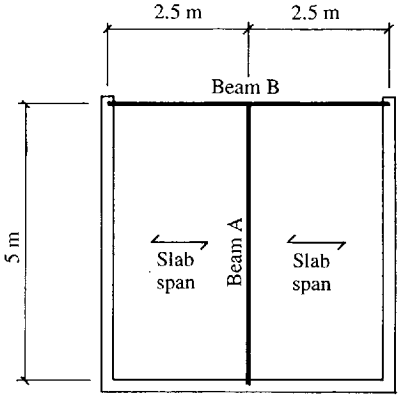

Figure 1.4 *Floor plan*

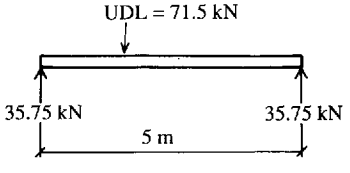

Figure 1.5 *Beam A isolated*

Beam A (Figure 1.5) supports a UDL from a 2.5 m width of slab:

Dead load 100 mm slab: $0.1 \times 2400/100 = 2.4\,\text{kN/m}^2$

Imposed load: $3\,\text{kN/m}^2$

Combined load: dead 2.4
imposed 3.0
$5.4\,\text{kN/m}^2$