Once again it is necessary to assume a trial section for checking: try $203 \times 203 \times 60$ kg/m UC. The relevant properties from section tables are as follows:

Depth $D = 209.6$ mm; width $B = 205.2$ mm

Flange thickness $T = 14.2$ mm

Web thickness $t = 9.3$ mm

Area $A_g = 75.8\,\text{cm}^2 = 75.8 \times 10^2\,\text{mm}^2$

Radius of gyration $r_x = 8.96$ cm $= 89.6$ mm

Radius of gyration $r_y = 5.19$ cm $= 51.9$ mm

Plastic modulus $S_x = 652\,\text{cm}^3 = 652 \times 10^3\,\text{mm}^3$

It has already been stated that all UC sections are semi-compact, and therefore it is unnecessary to show that the section is not slender.

The eccentricity $e_x$ is given by

$$e_x = \frac{D}{2} + 100 = \frac{209.6}{2} + 100 = 204.8\,\text{mm}$$

Then

$$\text{Nominal moment } M_x = \text{beam reaction} \times e_x$$
$$= 285 \times 204.8 = 58\,368\,\text{kN mm} = 58.368 \times 10^6\,\text{N mm}$$

Since the beam reactions are the same on either side of the $y$–$y$ axis there will be no bending about this axis: therefore $M_y = 0$.

It is not necessary to check the local buckling capacity of columns subject to nominal moments. The overall buckling check using the simplified approach should be carried out to ensure that the following relationship is satisfied:

$$\frac{F}{A_g p_c} + \frac{mM_x}{M_b} + \frac{mM_y}{p_y Z_y} \leqslant 1$$

The compression strength $p_c$ is calculated as follows. First, $T = 14.2\,\text{mm} < 16\,\text{mm}$. Therefore $p_y = 275\,\text{N/mm}^2$. The slenderness values are given by

$$\lambda_x = \frac{L_E}{r_x} = \frac{0.85L}{r_x} = \frac{0.85 \times 6000}{89.6} = 57 < 180$$

$$\lambda_y = \frac{L_E}{r_y} = \frac{0.85L}{r_y} = \frac{0.85 \times 6000}{51.9} = 98 < 180$$

These are satisfactory.

The relevant BS 5950 strut tables to use may be determined from Table 5.11. For buckling about the $x$–$x$ axis use Table 27b; for buckling about the $y$–$y$ axis use Table 27c. Hence

For $\lambda_x = 57$ and $p_y = 275\,\text{N/mm}^2$: $p_c = 225\,\text{N/mm}^2$

For $\lambda_y = 98$ and $p_y = 275\,\text{N/mm}^2$: $p_c = 129\,\text{N/mm}^2$

Therefore $p_c$ for design is $129\,\text{N/mm}^2$.

For columns subject to nominal moments, $m$ may be taken as 1.0.

The buckling resistance moment $M_b$ for columns subject to nominal moments is calculated as follows. First,

$$\lambda_{LT} = \frac{0.5L}{r_y} = \frac{0.5 \times 6000}{51.9} = 58$$

Next, $p_b = 218\ \text{N/mm}^2$ by interpolation from Table 5.5. Therefore

$$M_b = p_b S_x = 218 \times 652 \times 10^3 = 142.14 \times 10^6\ \text{N mm}$$

Hence

$$\frac{F}{A_g p_c} + \frac{mM_x}{M_b} + \frac{mM_y}{p_y Z_y} = \frac{540 \times 10^3}{75.8 \times 10^2 \times 129} + \frac{1 \times 58.368 \times 10^6}{142.14 \times 10^6} + 0$$
$$= 0.55 + 0.41 + 0 = 0.96 < 1.0$$

Adopt 203 × 203 × 60 kg/m UC.

### 5.12.5 Cased columns

If steel columns are to be cased in concrete, for fire protection perhaps, structural advantage may be taken of the casing if certain requirements are met with respect to the concrete and reinforcement. The requirements in relation to UC sections are basically as follows:

(a) The steel section is unpainted and free from oil, grease, dirt or loose rust and millscale.

(b) The steel section is solidly encased in ordinary dense structural concrete of at least grade 30 to BS 8110.

(c) The surface and edges of the flanges of the steel section have a concrete cover of not less than 50 mm.

(d) The casing is reinforced using steel fabric, reference D 98, complying with BS 4483. Alternatively steel reinforcement not less than 5 mm diameter, complying with BS 4449 or BS 4482, may be used in the form of a cage of longitudinal bars held by closed links at a maximum spacing of 200 mm. The maximum lap of the reinforcement and the details of the links should comply with BS 8110.

(e) The reinforcement is so arranged as to pass through the centre of the concrete cover.

A typical cross-section through a cased UC satisfying these requirements is shown in Figure 5.39.

The allowable load for concrete cased columns is based upon certain empirical rules given in BS 5950. Those relating to axially loaded cased columns are as follows:

(a) The effective length $L_E$ is limited to the least of $40b_c$ or $100b_c^2/d_c$ or $250r$, where