Example 3.12

A short braced column in a situation of mild exposure supports an ultimate axial load of 1000 kN, the size of the column being 250 mm × 250 mm. Using grade 30 concrete with mild steel reinforcement, calculate the size of all reinforcement required and the maximum effective height for the column if it is to be considered as a short column.

Since the column is axially loaded, equation 38(a) will apply:

$$N = 0.4f_{cu}(A_g - A_{sc}) + 0.75A_{sc}f_y$$
$$1000 \times 10^3 = 0.4 \times 30[(250 \times 250) - A_{sc}] + 0.75A_{sc} \times 250$$
$$1\,000\,000 = 750\,000 - 12A_{sc} + 187.5A_{sc}$$

Hence

$$A_{sc} \text{ required} = \frac{250\,000}{175.5} = 1424.5\,\text{mm}^2$$

This area can be compared with the reinforcement areas given in Table 3.8 to enable suitable bars to be selected:

Provide four 25 mm diameter MS bars ($A_{sc} = 1966\,\text{mm}^2$).

Now determine the size and pitch needed for the lateral ties. The diameter required is the greater of (a) one-quarter of the diameter of the largest main bar, that is 25/4 = 6.25 mm, or (b) 6 mm. The pitch required is the lesser of (a) 12 times the diameter of the smallest main bar, that is 12 × 25 = 300 mm, or (b) the smallest cross-sectional dimension of column, that is 250 mm. Thus:

Provide 8 mm diameter MS links at 250 mm pitch.

Now the maximum effective height ratio l_e/h for a short braced column is 15. Hence the maximum effective height is

$$l_e = 15h = 15 \times 250 = 3750\,\text{mm}$$

Thus the maximum effective height for this column to be considered as a short column would be 3.75 m.

A cross-section through the finished column is shown in Figure 3.48.

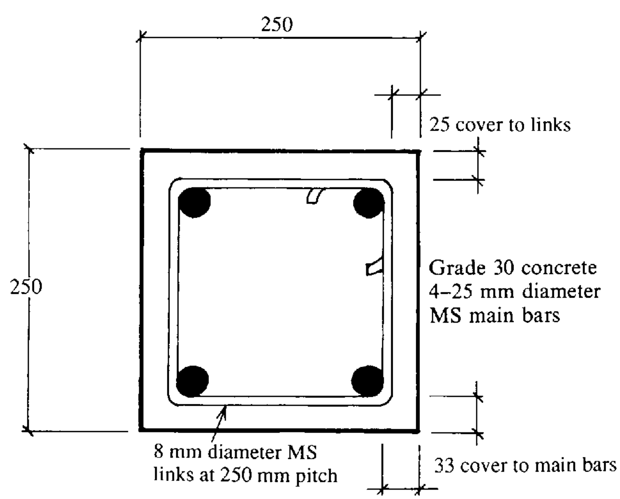

Figure 3.48 *Cross-section through finished column*

Example 3.13

A short braced reinforced concrete column is required to support an ultimate axial load of 1300 kN. Assuming 2 per cent main steel, calculate the diameter of circular column required and choose suitable MS main bars if grade 30 concrete is used.

Since the column is axially loaded, equation 38(a) will apply:

$$N = 0.4f_{cu}(A_g - A_{sc}) + 0.75A_{sc}f_y$$

In this example both the size of column and the area of reinforcement are unknown. However, a 2 per cent steel content may be assumed; therefore A_{sc} is 2 per cent of A_g or $0.02A_g$. By substituting this in the expression, only one unknown A_g remains:

$$1300 \times 10^3 = 0.4 \times 30(A_g - 0.02A_g) + 0.75 \times 0.02A_g \times 250$$

$$1300 \times 10^3 = 12A_g - 0.24A_g + 3.75A_g = 15.51A_g$$

$$A_g = \frac{1300 \times 10^3}{15.51} = 83\,816.89\,\text{mm}^2$$

Since the column is circular,

$$A = \frac{\pi d^2}{4} = 83\,816.89$$

$$d = \sqrt{\left(\frac{4 \times 83\,816.89}{\pi}\right)} = 326.7\,\text{mm}$$

Provide a 330 mm diameter grade 30 concrete circular column.

The actual A_g is $\pi 330^2/4 = 85\,529.86\,\text{mm}^2$. Therefore if 2 per cent steel content is to be provided,

$$\text{Area of main bars} = 2 \text{ per cent of } A_g = \frac{85\,529.86}{50} = 1711\,\text{mm}^2$$

Provide six 20 mm diameter MS bars ($A_{sc} = 1884\,\text{mm}^2$).

Example 3.14

A short braced reinforced concrete column supports an approximately symmetrical arrangement of beams which result in a total ultimate vertical load of 1500 kN being applied to the column. Assuming the percentage steel content to be 1 per cent, choose suitable dimensions for the column and the diameter of the main bars. Use grade 35 concrete with HY reinforcement in a square column.

Since the column supports an approximately symmetrical arrangement of beams, we will assume that their spans do not differ by 15 per cent and hence equation 39(a) will apply:

$$N = 0.35f_{cu}(A_g - A_{sc}) + 0.67A_{sc}f_y$$