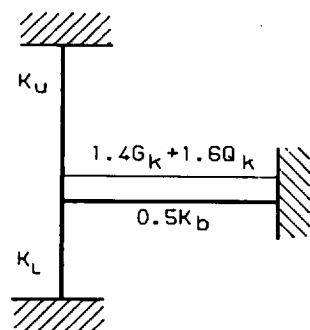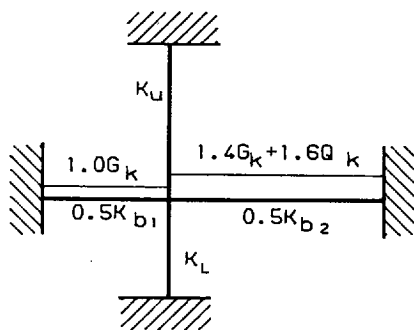External columns | Internal columns

$$MF_U = M_e \frac{K_U}{K_L + K_U + 0.5K_b}$$

$$MF_U = M_{es} \frac{K_U}{K_L + K_U + 0.5K_{b1} + 0.5K_{b2}}$$

$$MF_L = M_e \frac{K_L}{K_L + K_U + 0.5K_b}$$

$$MF_L = M_{es} \frac{K_L}{K_L + K_U + 0.5K_{b1} + 0.5K_{b2}}$$

M_e = Fixed end beam moment
M_{es} = Total out of balance fixed end beam moment
MF_U = Framing moment in upper column
MF_L = Framing moment in lower column
K_U = Stiffness of upper column
K_L = Stiffness of lower column
K_{b1} = Stiffness of left hand beam
K_{b2} = Stiffness of right hand beam

13 Subframes for column moments

4.5.5 Biaxial bending

Where it is necessary to consider bending about both axes, a symmetrically reinforced rectangular column section may be designed by increasing the moment about one of the axes using the procedure outlined below.

When $\dfrac{M_x}{M_y} \geq \dfrac{h'}{b'}$ the increased moment about the x–x axis is $M_x + \beta \dfrac{h'M_y}{b'}$

If $\dfrac{M_x}{M_y} < \dfrac{h'}{b'}$ the increased moment about the y–y axis is $M_y + \beta \dfrac{b'M_x}{h'}$

where b' and h' are the effective depths (see Fig. 14) and
β is obtained from Table 32.

IStructE/ICE reinforced concrete building structures

Table 32 Enhancement coefficients for biaxial bending

$\dfrac{N}{bh\,f_{cu}}$	0	0.1	0.2	0.3	0.4	0.5	≥0.6
β	1.00	0.88	0.77	0.65	0.53	0.42	0.30

where N is the design ultimate axial load in N and
b and h are in mm (see Fig. 14).

The section should then be designed by the charts in Appendix D for the combination of N and the relevant enhanced moment.
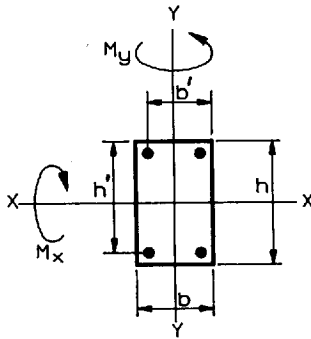
14 Biaxial bending in columns

4.5.6 Reinforcement

Minimum area of reinforcement should be 0.4% of the gross cross-sectional area of concrete.

Longitudinal bars should not be less than size 12.

Maximum area of reinforcement (other than at laps) should be 6% of the gross cross-sectional area of concrete but 4% is generally preferable. At laps the maximum total percentage should be 10%.

Maximum spacing of main bars should not exceed 250mm.

Columns should be provided with links whose size should be the greater of:

one-quarter the size of the largest longitudinal bar or size 6*.

Every corner bar and each alternate bar in an outer layer of reinforcement should have a link passing around it. The included angle of the links should not be more than 135° except for hoops or spirals in circular columns. No bar within a compression zone should be further than 150mm from a bar restrained by a link. The maximum spacing of links should be 12 times the size of the smallest compression bar but not more than the smallest cross-sectional dimension of the column.

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*This bar size may not be freely available.