deflect due to the removal of this support but also have to carry the wall load above it without collapsing. As long as every floor takes care of the load imposed on it without collapsing, there is no likelihood of the progressive collapse of the building. This is safer than assuming that the wall above may arch over and transfer the load to the outer cavity and inner corridor walls. Fig. 12.12 shows one of the interior first floor slabs, and the collapse—moment will be calculated by the yield line method. The interior slab has been considered, because this may be more critical than the first interior span, in which reinforcement provided will be higher compared with the interior span. The design calculation for the interior span is given in section 12.10.

The yield-line method gives an upper-bound solution; hence other possible modes were also tried and had to be discarded. It seems that the slab may collapse due to development of yield lines as shown in Fig. 12.12. On removal of wall A below, it is assumed that the slab will behave as simply supported between corridor and outer cavity wall (Fig. 12.1) because of secondary or tie reinforcement.

(a) Floor loading

$$\text{Design dead weight} = \gamma_f \times \text{characteristic dead weight}$$

$$= 1.05 \times 4.8 = 5.04\ \text{kN/m}^2$$

(clause 22d, BS 5628 and Appendix)

$$\text{design imposed load} = \gamma_f \times \text{characteristic imposed load}$$

$$= 1.05 \times 1.5 = 1.58\ \text{kN/m}^2$$

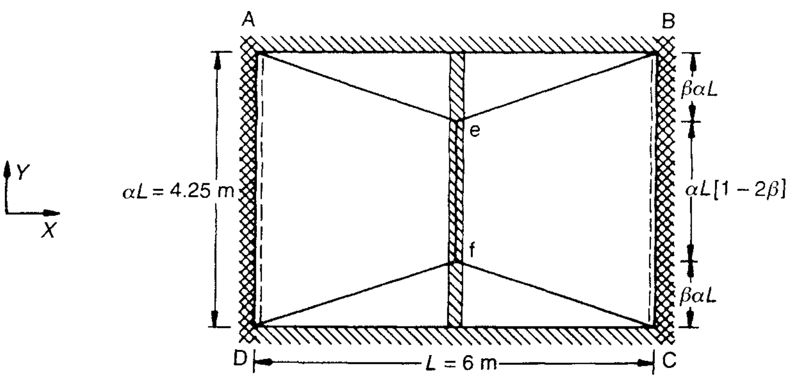

Fig. 12.12 The yield-line patterns at the collapse of the first floor slab under consideration.

Note that γ_f can be reduced to 0.35. According to the code in combination with DL, γ_f factor for LL can be taken as 0.35 in the case of accidental damage. However, it might just be possible that the live load will be acting momentarily after the incident.

$$\text{Total design load } w = 5.04 + 1.58 = 6.62\,\text{kN/m}^2$$

$$\text{Wall load } w' = \gamma_f \times 7.4 \quad \text{(see Table 12.4)}$$

$$= 1.05 \times 7.4 = 7.77\,\text{kN/m}^2$$

(b) Calculation for failure moment

The chosen x and y axes are shown in Fig. 12.12. The yield line ef is given a virtual displacement of unity. External work done=$\Sigma w\delta$, where w is the load and δ is the deflection of the CG of the load. So

$$\Sigma w\delta = 4 \times \tfrac{1}{2} \times w \times \beta\alpha L \times \frac{L}{2} \times \tfrac{1}{3} + 2 \times w \times \frac{L^2}{2}\alpha(1-2\beta) \times \tfrac{1}{2}$$

$$+ 2 \times \tfrac{1}{2} \times w \times \beta\alpha L \times \frac{L}{3} + \frac{2w'\beta\alpha L}{2} + w'\alpha L\,(1-2\beta) \times 1$$

$$= \frac{w\alpha L^2}{6}(3-2\beta) + w'\alpha L - w'\beta\alpha L$$

$$= \frac{6.62 \times 4.25 \times 6}{6}(3-2\beta) + 7.77 \times 4.25 - 7.77 \times 4.25\beta$$

$$= 28.14(3-2\beta) + 33.02 - 33.02\beta$$

$$= 28.14(4.17 - 3.17\beta)$$

Internal work done on the yield lines $= \Sigma(m_x l_x \theta_x + m_y l_y \theta_y)$. So

$$\sum(m_x l_x \theta_x + m_y l_y \theta_y) = \frac{2mL}{\beta\alpha L} + \frac{4m\alpha L}{L/2}$$

$$= \frac{2m}{\beta\alpha} + 8m\alpha$$

$$= \frac{2m}{\beta\alpha}(1 + 4\alpha^2\beta)$$

$$= \frac{2m}{0.71\beta}(1 + 4 \times 0.5\beta) = \frac{2.82m}{\beta}(1+2\beta) \qquad (12.58)$$