From equations (12.57) and (12.58)

$$(2.82m/\beta)\,(1+2\beta) = 28.14(4.17 - 3.17\beta)$$

or

$$m = 9.98\,\frac{(4.17\beta - 3.17\beta^2)}{1+2\beta} \tag{12.59}$$

For maximum value of moment $dm/d\beta = 0$, from which

$$4.17(1+2\beta) - 8.34\beta - [6.34\beta(1+2\beta) - 3.17\beta^2 \times 2] = 0$$

$$4.17 + 8.34\beta - 8.34\beta - 6.34\beta - 12.68\beta^2 + 6.34\beta^2 = 0$$

$$\beta^2 + \beta = 0.66$$

The positive root of this equation is

$$\beta = 0.45$$

Substituting the value of β in equation (12.59), we get

$$m = \frac{9.98(4.17 \times 0.45 - 3.17 \times 0.45^2)}{1 + 2 \times 0.45} = 6.49\ \text{kNm/m}$$

Then required A_s is

$$A_s = \frac{6.49 \times 10^6}{\gamma_m f_y Z} \qquad (\gamma_m = 1,\ \text{BS 8110, clause 2.4.4.2})$$

$$= \frac{6.49 \times 10^6}{1 \times 250 \times 90.25} \qquad (Z = 90.25,\ \text{see Appendix})$$

$$= 287.7\ \text{mm}^2 < 314\ \text{mm}^2 \quad \text{(hence the slab will not collapse)}$$

Owing to removal of support at the ground floor, there will be minimal increase in stresses in the outer cavity and corridor wall. The wall type A (AD and BC in Fig. 12.10) may be relieved of some of the design load, hence no further check is required.

12.10 APPENDIX: A TYPICAL DESIGN CALCULATION FOR INTERIOR-SPAN SOLID SLAB

This is shown in the form of a table (Table 12.5).

Table 12.5 Design calculation for interior span solid slab

BS 8110 ref.	*Calculations*	*Output*
	Durability and fire resistance	
Table 3.4	Nominal cover for mild conditions of exposure = 25 mm	Cover = 25 mm
Table 3.5	Max. fire resistance of 125 mm slab with 25 mm cover = 2 h > 1 h	therefore 1 h fire resistance OK
	Loading	
	Self-weight 0.125 × 24 = 3.0	
	Screed, finish and partition = 1.8	
	= 4.8 kN/m²	
	Characteristic dead load	$G_k = 4.8$ k/N/m²
3.5.2.4	Characteristic imposed load (section 12.21)	$Q_k = 1.5$ k/N/m²
Table 3.13	Design load = (1.4 × 4.8 + 1.6 × 1.5) × 3.0 = 27.36 kN/m width	$F = 27.36$ kN
	Ultimate BM	
Table 3.13	At 1st interior support and mid-span	
	0.063 FL = 0.063 × 27.36 × 3.0 = 5.34 kN m/m	
3.4.4.4	*Reinforcements*	$d = 95$
	1st interior mid-span and support	
	$\frac{M}{f_{cu}bd^2} = \frac{5.34 \times 10^6}{30 \times 10^3 \times 95^2} = 0.02$	
	$z = d\left[0.5 + \left(0.25 - \frac{0.02}{0.9}\right)^{1/2}\right]$	
	$z = 93$ (but $\not> 0.95 \times 95 = 90.25$)	
	$A_s = \frac{M}{0.87 f_y z} = \frac{5.34 \times 10^6}{0.87 \times 250 \times 90.25} = 272\ \text{mm}^2$	Top and bottom
Table 3.2.7	Minimum area of steel $= \frac{0.24 \times 1000 \times 125}{100}$	Provide 10Y at 250 mm OK.
	$= 300\ \text{mm}^2 > 272\ \text{mm}^2$	(Area provided 314 mm²/m)
3.4.6	*Deflection*	
Table 3.10	Basic span/effective depth ratio = 26 maximum	
	$\frac{M}{bd^2} = \frac{5.34 \times 10^6}{10^3 \times (95)^2} = 0.54$	
	$f_s = \frac{5 \times 250 \times 272}{8 \times 314} = 135.4\ \text{N/mm}^2$	
Table 3.11	Modification factor for tension reinforcement = 2.0	
	Therefore allowable span/effective depth ratio = 26 × 2.0 = 52.00	Therefore OK in deflection
	Therefore minimum depth $d = 3000/52.0 = 57.7 < 95$ mm	