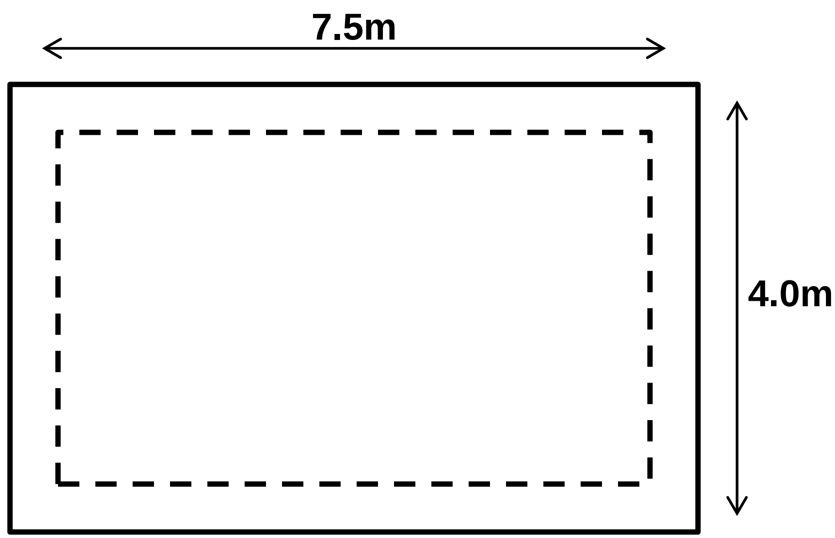
DESIGN OF SLABS : Two-Way Slab

Department of Structures and Materials Engineering
Faculty of Civil and Environmental Engineering
University Tun Hussein Onn Malaysia

Design 1

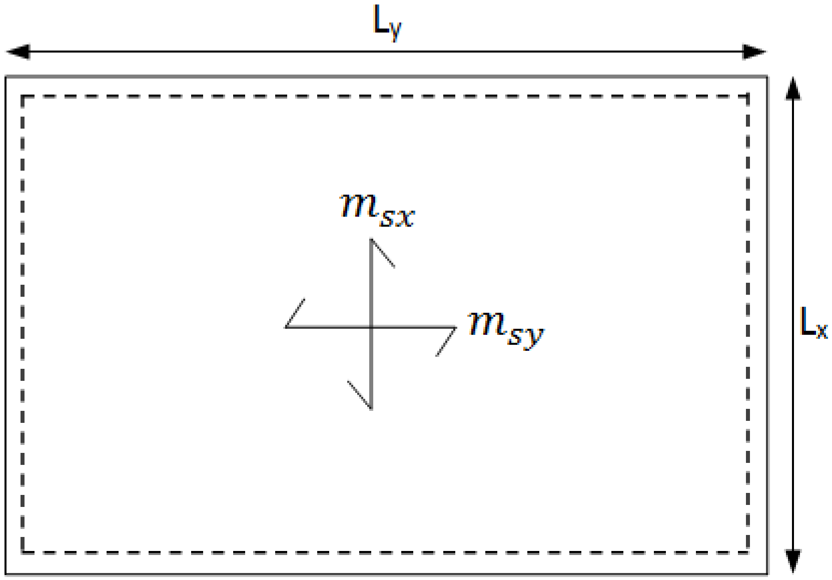
Simply Supported (Two-Way Spanning Slab)

Design a reinforced concrete slab for a room measuring 7.5m x 5.0m. The slab carries a variable action of 2.5kN/m^2 and permanent action due to finishes of 1.0kN/m^2. The characteristic material strength are f_{ck}=25N/mm^2 and f_{yk}=500N/mm^2. The slab can be considered simply supported on all four edges with corners free to lift. The slab is inside buildings which subjected to 1.5 hours fire resistance and 50 years design life.



A slab simply supported on its four sides will deflect about both axes under load and the corner will tend to lift and curl up from the support, causing torsional moments. When no provision has been made to prevent this lifting or to resist the torsion, then the moment coefficient of *Table 3.13 BS8110: 1997* may be used and the maximum moments as given by:

$$m_{sx} = \alpha_{sx} n l_x^2$$
$$m_{sy} = \alpha_{sy} n l_x^2$$



where;

n = total ultimate load per unit area

l_x = length of shorter side

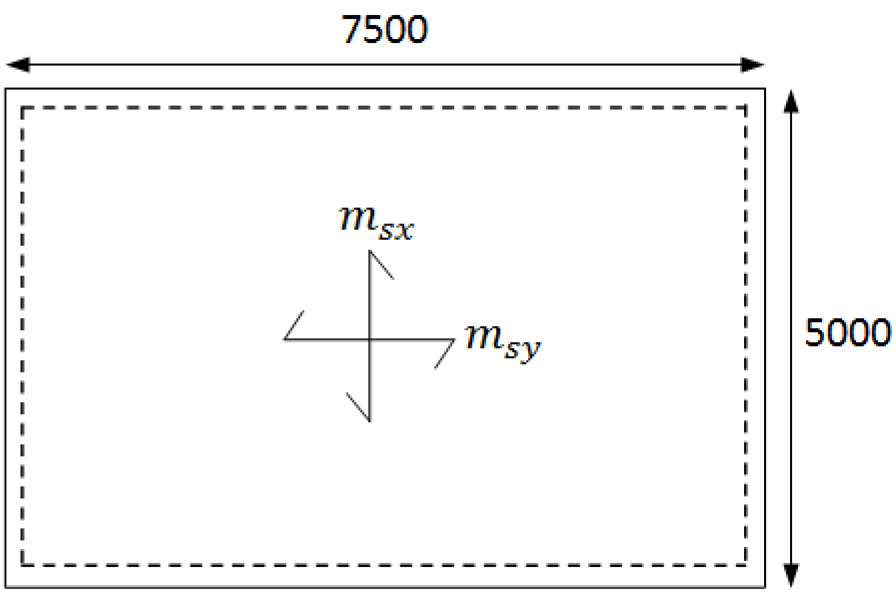
l_y = length of longer side

α_{sx} and α_{sy} are the moment coefficient

Table 3.13 BS8110: 1997

L_y/L_x	1.0	1.1	1.2	1.3	1.4	1.5	1.75	2.0
α_{sx}	0.062	0.074	0.084	0.093	0.099	0.104	0.113	0.118
α_{sy}	0.062	0.061	0.059	0.055	0.051	0.046	0.037	0.029

1.0 SPECIFICATION



Long span, L_y	= 7500mm	
Short span, L_x	= 5000mm	
L_y/L_x	= 7500/5000	
	= 1.5 < 2.0	∴ Two-way slab

Characteristic actions:

Permanent, g_k	= 1.2kN/m^2 (excluding selfweight)
Variable, q_k	= 2.5kN/m^2
Design life	= 50 Years
Fire resistance	= R90
Exposure classes	= XC1
Materials:	
Characteristic strength of concrete, f_{ck}	= 25N/mm^2
Characteristic strength of steel, f_{yk}	= 500N/mm^2
Unit weight of reinforced concrete	= 25kN/m^3
Assumed: $Ø_{bar}$	= 10mm

2.0 SLAB THICKNESS

Min. thickness for fire resistance	= 120mm	
Estimated thickness for deflection control, h	= L_x/26	
	= 192mm	Use, h = 200mm

3.0 DURABILITY, FIRE AND BOND REQUIREMENTS

Min. concrete cover regard to bond, $C_{min,b}$	= 10mm
Min. concrete cover regard to durability, $C_{min,dur}$	= 15
Min. required axis distance for R90, a	= 15mm

Min. concrete cover regard to fire

$C_{min,fire} = a - Ø_{bar}/2$ = 15-(10/2)

= 10mm

Allowance in design for deviation, ΔC_{dev} = 10mm

Nominal cover,

$C_{nom} = C_{min} + \Delta C_{dev}$ = 15+10

= 25mm

$\therefore$ **C_{nom} = 25mm**

Table 5.8: Minimum dimensions and axis distances for reinforced and prestressed concrete simply supported one-way and two-way solid slabs

Standard fire resistance	Minimum dimensions (mm)			
	slab thickness h_s (mm)	axis-distance a		
		one way	two way: $l_y/l_x \le 1,5$	two way: $1,5 < l_y/l_x \le 2$
1	2	3	4	5
REI 30	60	10*	10*	10*
REI 60	80	20	10*	15*
REI 90	100	30	15*	20
REI 120	120	40	20	25
REI 180	150	55	30	40
REI 240	175	65	40	50

l_x and l_y are the spans of a two-way slab (two directions at right angles) where l_y is the longer span.

For prestressed slabs the increase of axis distance according to 5.2(5) should be noted.

The axis distance a in Column 4 and 5 for two way slabs relate to slabs supported at all four edges. Otherwise, they should be treated as one-way spanning slab.

* Normally the cover required by EN 1992-1-1 will control.

4.0 LOADING AND ANALYSIS

Slab self-weight	= 0.2x25
	= 5.0kN/m^2
Permanent load (excluding self-weight)	= 1.2kN/m^2
Characteristic permanent action, G_k	= 6.2kN/m^2
Characteristic variable action, Q_k	= 2.5kN/m^2
Design action, n_d	= $1.35G_k+1.5Q_k$
	= 1.35(6.2) + 1.5(2.5)
	= 12.12kN/m^2
	= 11.76kN/m

<u>Moment</u>:

Short span, $M_{sx} = \alpha_{sx} n L_x^2$	= 0.104x12.12x5.02	
	= 31.51kNm/m	
Long span, $M_{sy} = \alpha_{sy} n L_x^2$	= 0.046x12.12x5.02	= 13.94kNm/m

5.0 MAIN REINFORCEMENT

Effective depth:

$d_x = h - C_{nom} - 0.5Ø_{bar}$ $= 200-30-(0.5x10)$

$= 170mm$

$d_y = h - C_{nom} - 1.5Ø_{bar}$ $= 200-30-(1.5x10)$

$= 160mm$

Short span:

M_{sx} $= 31.5kNm/m$

$K = M/bd^2f_{ck}$ $= 31.5x10^6/(1000x170^2x25)$

$= 0.044 < K_{bal}=0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.96d \geq 0.95d$

Use 0.95d

$A_s = M/0.87f_{yk}z$ $= 31.5\times10^6/(0.87\times500\times0.95\times170)$

$= 449mm^2/m$

H10-175 (top)
($449mm^2/m$)

<u>Long span</u>:

M_{sx} $= 13.9kNm/m$

$K = M/bd^2f_{ck}$ $= 13.9\times10^6/(1000\times160^2\times25)$

$= 0.022 < K_{bal}=0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.98d \geq 0.95d$

Use 0.95d

$A_s = M/0.87 f_{yk} z$

$= 13.9 \times 10^6 / (0.87 \times 500 \times 0.95 \times 170)$
$= 211 mm^2/m$

H10-325 (bot) ($242 mm^2/m$)

Min. and max. reinforcement area,

$A_{s,min} = 0.26(f_{ctm}/f_{yk})bd$

$= 0.26 \times (2.56/500)bd$
$= 0.0013bd > 0.0013bd$

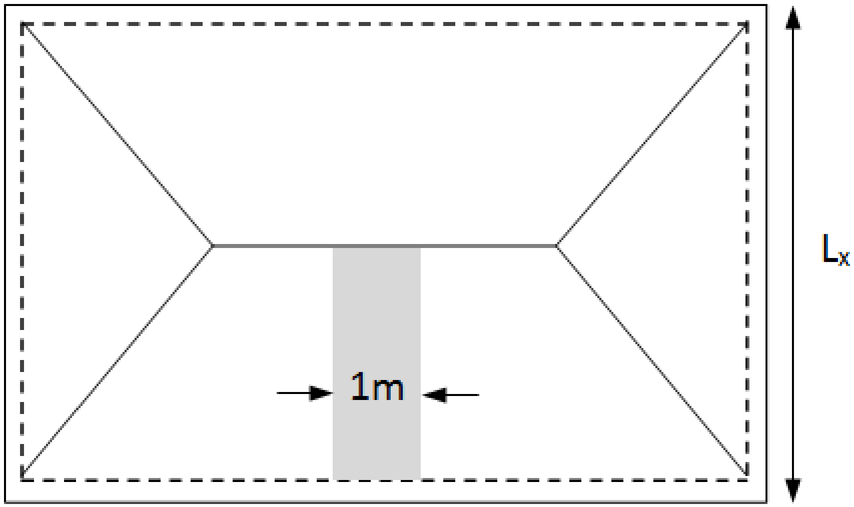
Use 0.0013bd

$= 0.0013 \times 1000 \times 170$
$= 227 mm^2/m$

$A_{s,max} = 0.04A_c = 0.04bh$

$= 0.04 \times 1000 \times 200$
$= 8000 mm^2/m$

6.0 SHEAR



Max. design shear force, V_{Ed}

$= n_d L_x/2$
$= 12.1x(5.0/2)$
$= 30.3kN$

Design shear resistance,

$k = 1+(200/d)^{1/2} \leq 2.0$ $= 1+(200/170)^{1/2}$
$= 2.08 \geq 2.0$

$\rho^1 = A_{s1}/bd \leq 0.02$ $= 449/(1000x170)$
$= 0.0026 \leq 0.02$

$V_{Rd,c} = [0.12k(100\rho^1 f_{ck})^{1/3}]bd$ $= [0.12x2.0(100x0.0026x30)^{1/3}]x1000x170$
$= 76535N = 76.5kN$

$V_{min} = [0.35k^{3/2} f_{ck}^{1/2}]bd$ $= [0.0035x2.0^{3/2}x25^{1/2}]x1000x170$
$= 84146N = 84.1kN$

$V_{Rd,c}$; $V_{min} > V_{Ed}$ (OK)

7.0 DEFLECTION

Percentage of required tension reinforcement,

$\rho = A_{s,req}/bd$ $= 449/(1000 \times 170)$
$= 0.0026$

Reference reinforcement ratio,

$\rho_0 = (f_{ck})^{1/2} \times 10^{-3}$ $= (25)^{1/2} \times 10^{-3}$
$= 0.0050$

Percentage of required compression reinforcement

$\rho' = A_{s',req}/bd$ $= 0/(1000 \times 139)$
$= 0.000$

Factor for structural system,

K = 1.0

$\rho < \rho_0$ ∴use equation (2)

$$\frac{l}{d} = K\left[11 + 1.5\sqrt{f_{ck}}\frac{\rho_0}{\rho} + 3.2\sqrt{f_{ck}}\left(\frac{\rho_0}{\rho} - 1\right)\right]^{3/2}$$

= 1.0(11+14.2+13.55)
= 38.8

Modification factor for span less than 7m = 1.0

Modification factor for steel area provided = $A_{s,prov}/A_{s,req}$
= 449/449
= $1.0 \leq 1.5$

Therefore allowable span-effective depth ratio = $(l/d)_{allowable}$
= 38.8x1.0x1.0
= 38.8

Actual span-effective depth = $(l/d)_{actual}$
= 5000/170
= $29.4 < (l/d)_{allowable}$ (OK)

8.0 CRACKING

h = 200mm < 200mm

Main bar,

$S_{max,slabs}$ = 3h or 400mm = 600mm > 400mm

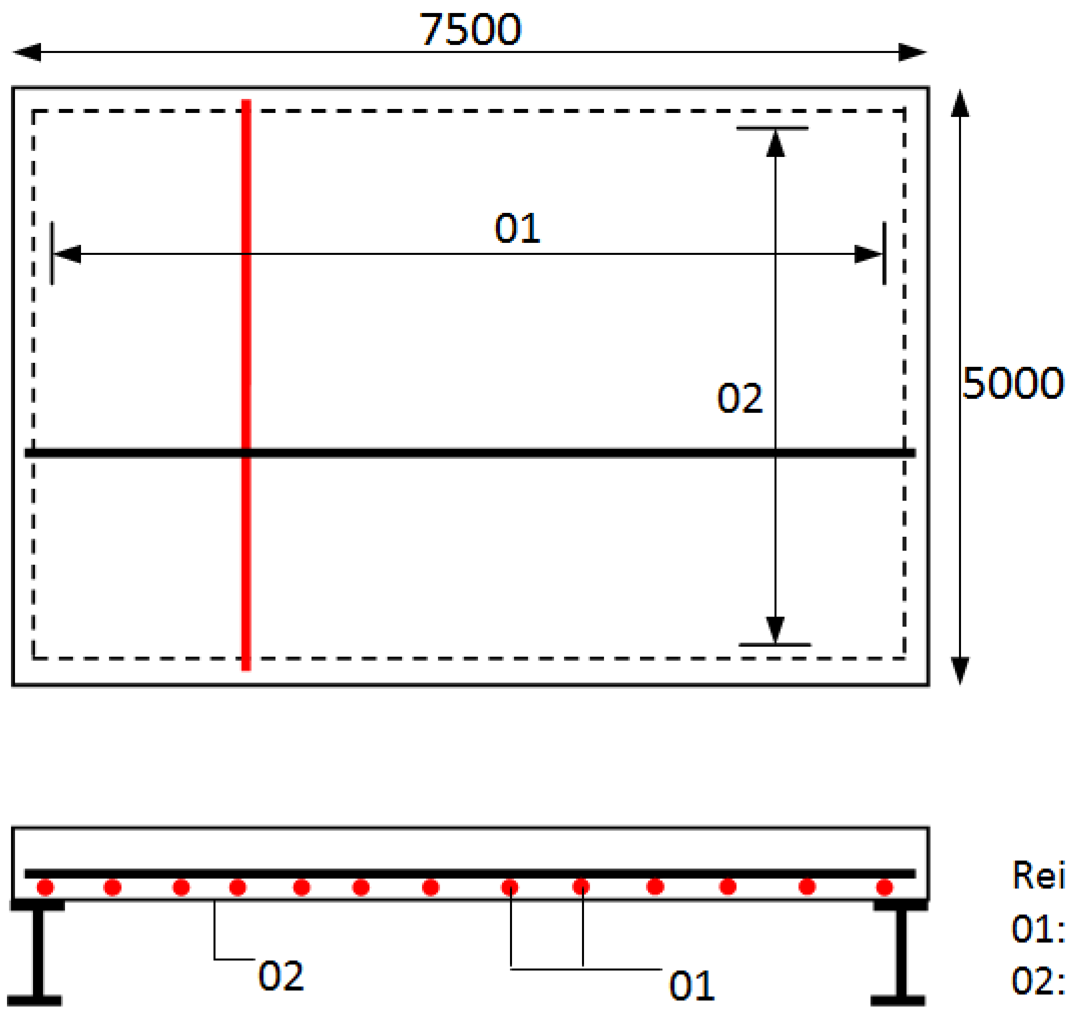
Max. bar spacing = 325mm ≤ $S_{max,slab}$ = 400mm (OK)

Secondary bar,

$S_{max,slabs}$ = 3.5h or 450mm = 700mm > 450mm

Max. bar spacing = 350mm ≤ $S_{max,slab}$ = 450mm (OK)

9.0 DETAILING

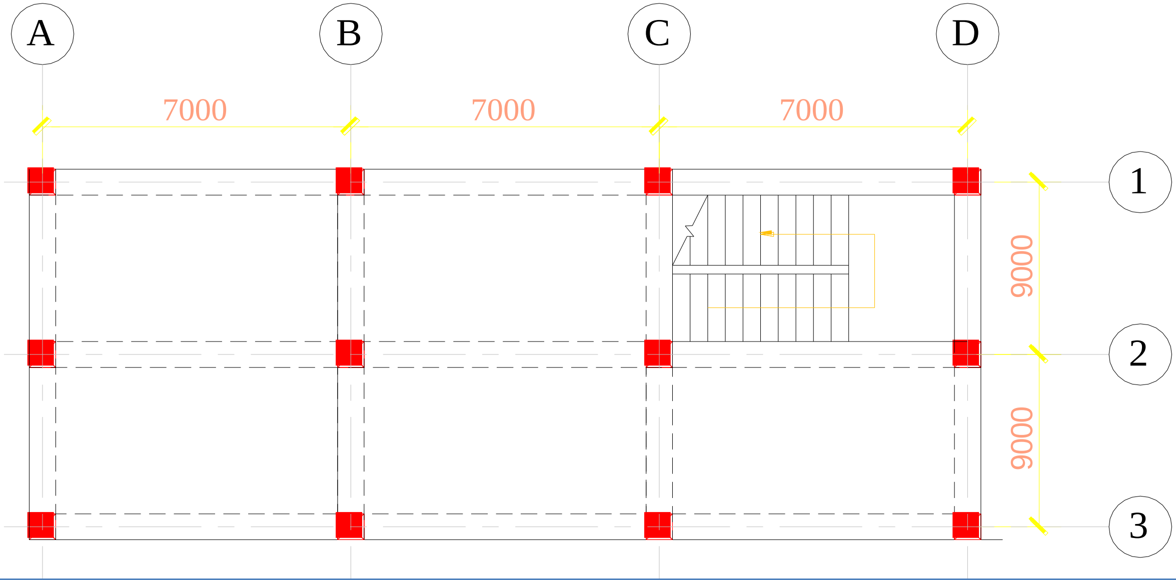


Reinforcement:
01: H10 – 175
02: H10 – 325

Design 2

Restrained (Two-Way Spanning Slab)

The figure below shows part of the first floor plan of a reinforced concrete office building. During construction, slabs and beams are cast together. The finishes, ceiling and services form a characteristic permanent action of 1.5kN/m^2 (excluding self-weight). The characteristic variable action is 4.0kN/m^2. The floor is inside enclosed building and subjected to 1 hour fire resistance requirements. The construction materials consist of grade C25 concrete and 500 steel. Based on the information provided, design slab panel B-C/1-2.



When the slab are provided with different edge conditions like fixed or continuous edges, the maximum moments per unit width are given by:

$$m_{sx} = \beta_{sx} n l_x^2$$
$$m_{sy} = \beta_{sy} n l_x^2$$

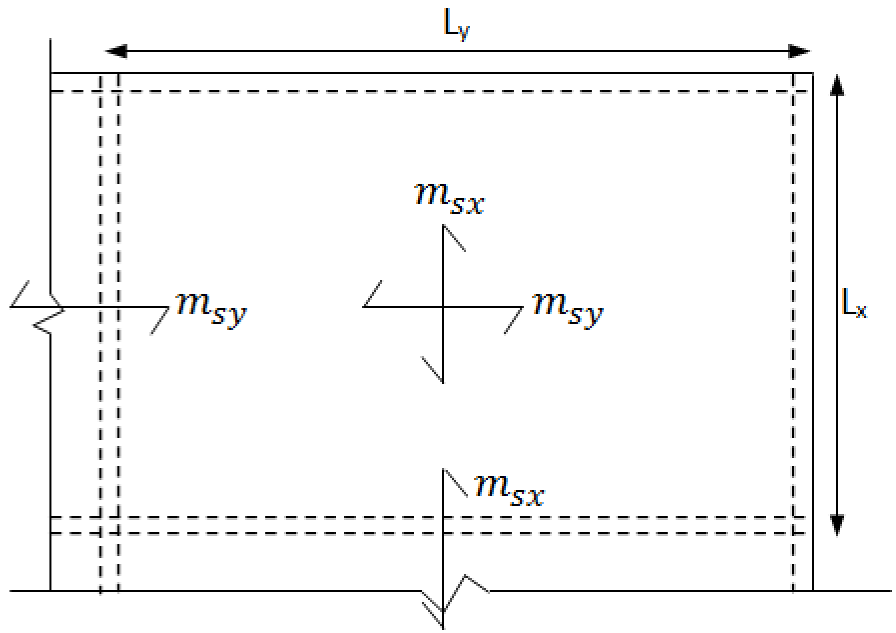
where;

n = total ultimate load per unit area

l_x = length of shorter side

l_y = length of longer side

β_{sx} and β_{sy} are the moment coefficient from Table 3.14 BS8110: Part 1: 1997



There are nine different types of support conditions to be considered which relate to the particular support/restraint provided on edge of individual slabs.

Case 1: Four edges continuous
Case 2: One short edge discontinuous
Case 2: One long edge discontinuous
Case 4: Two adjacent edge discontinuous
Case 5: Two short edge discontinuous
Case 6: Two long edges discontinuous
Case 7: Three edges discontinuous (one long edge continuous)
Case 8: Three edges discontinuous (one short edge continuous)
Case 9: Four edges discontinuous

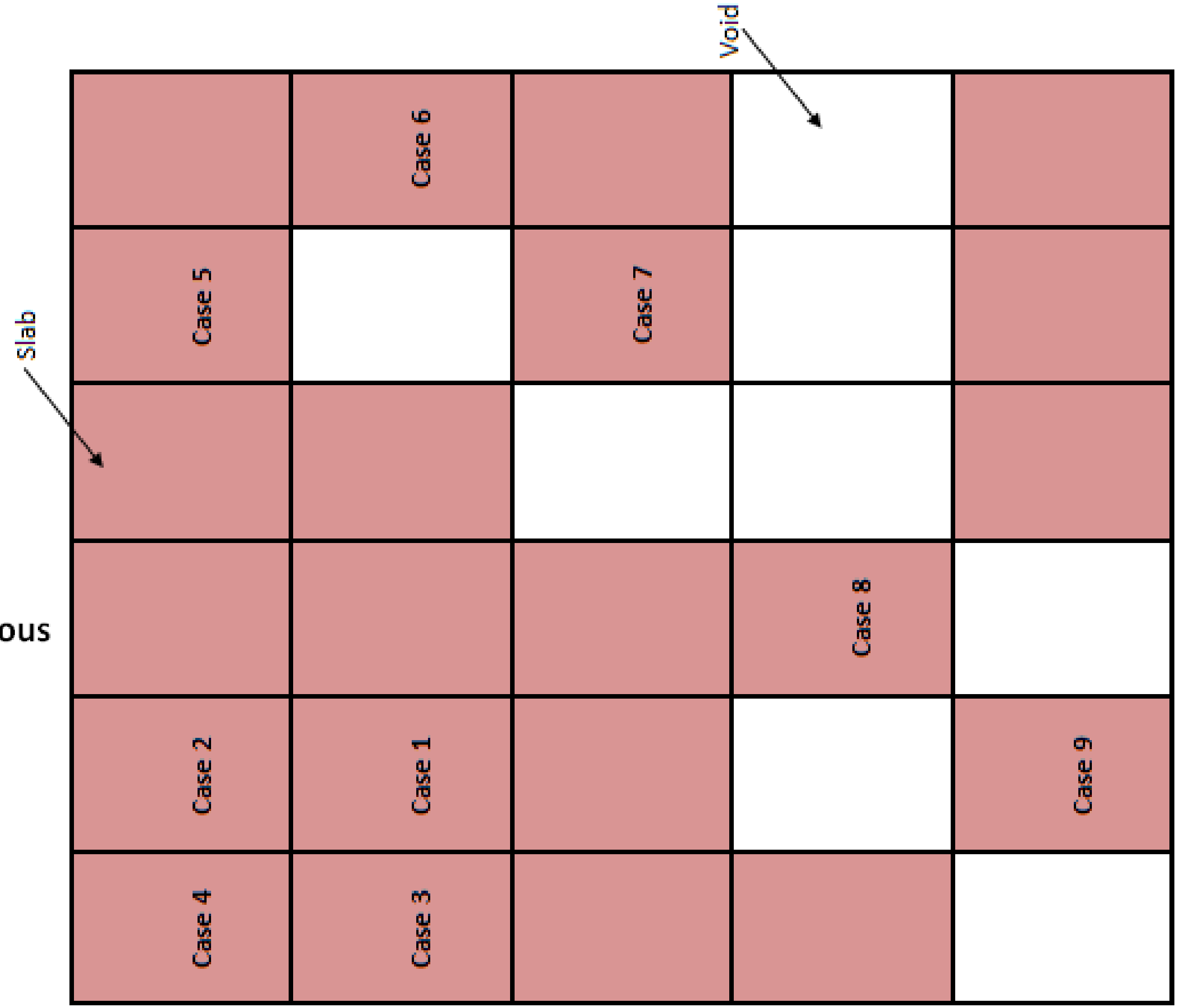


Table 3.14 — Bending moment coefficients for rectangular panels supported on four sides with provision for torsion at corners

Type of panel and moments considered	Short span coefficients, β_{sx}								Long span coefficients, β_{sy} for all values of l_y/l_x
	Values of l_y/l_x								
	1.0	1.1	1.2	1.3	1.4	1.5	1.75	2.0	
Interior panels									
Negative moment at continuous edge	0.031	0.037	0.042	0.046	0.050	0.053	0.059	0.063	0.032
Positive moment at mid-span	0.024	0.028	0.032	0.035	0.037	0.040	0.044	0.048	0.024
One short edge discontinuous									
Negative moment at continuous edge	0.039	0.044	0.048	0.052	0.055	0.058	0.063	0.067	0.037
Positive moment at mid-span	0.029	0.033	0.036	0.039	0.041	0.043	0.047	0.050	0.028
One long edge discontinuous									
Negative moment at continuous edge	0.039	0.049	0.056	0.062	0.068	0.073	0.082	0.089	0.037
Positive moment at mid-span	0.030	0.036	0.042	0.047	0.051	0.055	0.062	0.067	0.028
Two adjacent edges discontinuous									
Negative moment at continuous edge	0.047	0.056	0.063	0.069	0.074	0.078	0.087	0.093	0.045
Positive moment at mid-span	0.036	0.042	0.047	0.051	0.055	0.059	0.065	0.070	0.034
Two short edges discontinuous									
Negative moment at continuous edge	0.046	0.050	0.054	0.057	0.060	0.062	0.067	0.070	—
Positive moment at mid-span	0.034	0.038	0.040	0.043	0.045	0.047	0.050	0.053	0.034
Two long edges discontinuous									
Negative moment at continuous edge	—	—	—	—	—	—	—	—	0.045
Positive moment at mid-span	0.034	0.046	0.056	0.065	0.072	0.078	0.091	0.100	0.034
Three edges discontinuous (one long edge continuous)									
Negative moment at continuous edge	0.057	0.065	0.071	0.076	0.081	0.084	0.092	0.098	—
Positive moment at mid-span	0.043	0.048	0.053	0.057	0.060	0.063	0.069	0.074	0.044
Three edges discontinuous (one short edge continuous)									
Negative moment at continuous edge	—	—	—	—	—	—	—	—	0.058
Positive moment at mid-span	0.042	0.054	0.063	0.071	0.078	0.084	0.096	0.105	0.044
Four edges discontinuous									
Positive moment at mid-span	0.055	0.065	0.074	0.081	0.087	0.092	0.103	0.111	0.056

Shear force and actions on supporting beams

The design shear forces of slab or loads on beams which supported the slab can be evaluated using the equations below:

$$v_{sx} = \beta_{vx} n l_x$$

$$v_{sy} = \beta_{vy} n l_x$$

where;

n = total ultimate load per unit area

l_x = length of shorter side

l_y = length of longer side

β_{vx} and β_{vy} are the shear coefficient from Table 3.115 BS8110: Part 1: 1997

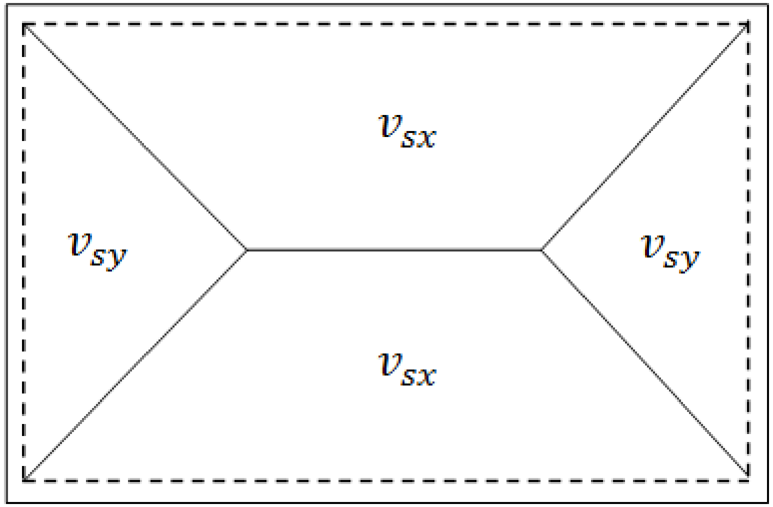


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Table 3.15 — Shear force coefficient for uniformly loaded rectangular panels supported on four sides with provision for torsion at corners

Type of panel and location	β_{vx} for values of l_y/l_x								β_{vy}
	1.0	1.1	1.2	1.3	1.4	1.5	1.75	2.0	
Four edges continuous									
Continuous edge	0.33	0.36	0.39	0.41	0.43	0.45	0.48	0.50	0.33
One short edge discontinuous									
Continuous edge	0.36	0.39	0.42	0.44	0.45	0.47	0.50	0.52	0.36
Discontinuous edge	—	—	—	—	—	—	—	—	0.24
One long edge discontinuous									
Continuous edge	0.36	0.40	0.44	0.47	0.49	0.51	0.55	0.59	0.36
Discontinuous edge	0.24	0.27	0.29	0.31	0.32	0.34	0.36	0.38	—
Two adjacent edges discontinuous									
Continuous edge	0.40	0.44	0.47	0.50	0.52	0.54	0.57	0.60	0.40
Discontinuous edge	0.26	0.29	0.31	0.33	0.34	0.35	0.38	0.40	0.26
Two short edges discontinuous									
Continuous edge	0.40	0.43	0.45	0.47	0.48	0.49	0.52	0.54	—
Discontinuous edge	—	—	—	—	—	—	—	—	0.26
Two long edges discontinuous									
Continuous edge	—	—	—	—	—	—	—	—	0.40
Discontinuous edge	0.26	0.30	0.33	0.36	0.38	0.40	0.44	0.47	—
Three edges discontinuous (one long edge discontinuous)									
Continuous edge	0.45	0.48	0.51	0.53	0.55	0.57	0.60	0.63	—
Discontinuous edge	0.30	0.32	0.34	0.35	0.36	0.37	0.39	0.41	0.29
Three edges discontinuous (one short edge discontinuous)									
Continuous edge	—	—	—	—	—	—	—	—	0.45
Discontinuous edge	0.29	0.33	0.36	0.38	0.40	0.42	0.45	0.48	0.30
Four edges discontinuous									
Discontinuous edge	0.33	0.36	0.39	0.41	0.43	0.45	0.48	0.50	0.33

1.0 SPECIFICATION

Long span, L_y	= 7000mm
Short span, L_x	= 4000mm
L_y/L_x	= 7000/4000
	= 1.75 < 2.0

∴ Two-way slab

Characteristic actions:	
Permanent, g_k	= 1.5kN/m^2 (excluding selfweight)
Variable, q_k	= 4.0kN/m^2
D Assumed: $Ø_{bar}$	= 10mm
Fire resistance	= R60
Exposure classes	= XC1
Materials:	
Characteristic strength of concrete, f_{ck}	= 25N/mm^2
Characteristic strength of steel, f_{yk}	= 500N/mm^2
Unit weight of reinforced concrete	= 25kN/m^3

Assumed: $Ø_{bar}$ = 10mm

2.0 SLAB THICKNESS

Min. thickness for fire resistance = 80mm

Estimated thickness for deflection control, h = $L_x/35$ (Based on Table 5.4N, L/30)

= 4000/35

= 114mm

Use, h = 125mm

3.0 DURABILITY, FIRE AND BOND REQUIREMENTS

Min. concrete cover regard to bond, $C_{min,b}$	= 10mm
Min. concrete cover regard to durability, $C_{min,\ dur}$	= 15
Min. required axis distance for R60, a	= 15mm
Min. concrete cover regard to fire	
$C_{min,fire} = a - Ø_{bar}/2$	= 15-(10/2)
	= 10mm
Allowance in design for deviation, ΔCdev	= 10mm
Nominal cover,	
$C_{nom} = C_{min} + \Delta C_{dev}$	= 15+10
	= 25mm

$\therefore C_{nom} = 25mm$

4.0 LOADING AND ANALYSIS

Slab self-weight = 0.125x25
= $3.13 kN/m^2$

Permanent load (excluding self-weight) = $1.50 kN/m^2$
Characteristic permanent action, G_k = $4.63 kN/m^2$
Characteristic variable action, Q_k = $4.00 kN/m^2$

Design action, n_d = $1.35G_k + 1.5Q_k$
= 1.35(4.63) + 1.5(4.00)
= $12.24 kN/m^2$

Moment:

Short span, $M_{sx1} = \beta_{sx1} n_d L_x^2$ = $0.065 \times 12.24 \times 4.0^2$
= 12.7kNm/m

$M_{sx2} = \beta_{sx2} n_d L_x^2$ = $0.087 \times 12.24 \times 4.0^2$
= 17.0kNm/m

Long span, $M_{sy1} = \beta_{sy1} n_d L_x^2$ $= 0.034 \times 12.24 \times 4.0^2$

$= 6.66$kNm/m

$M_{sy2} = \beta_{sy2} n_d L_x^2$ $= 0.045 \times 12.24 \times 4.0^2$

$= 8.82$kNm/m

<u>Shear</u>:

Short span, $V_{sx1} = \beta_{vx1} n_d L_x$ $= 0.57 \times 12.24 \times 4.0$

$= 27.9$kNm/m

$V_{sx2} = \beta_{vx2} n_d L_x$ $= 0.38 \times 12.24 \times 4.0$

$= 18.6$kNm/m

Long span, $V_{sy1} = \beta_{vy1} n_d L_x$ $= 0.40 \times 12.24 \times 4.0$

$= 19.6$kNm/m

$V_{sy2} = \beta_{vy2} n_d L_x$ $= 0.26 \times 12.24 \times 4.0$

$= 12.7$kNm/m

5.0 MAIN REINFORCEMENT

Effective depth:

$d_x = h - C_{nom} - 0.5Ø_{bar}$ $= 125-20-(0.5x10)$

$= 95mm$

$d_y = h - C_{nom} - 1.5Ø_{bar}$ $= 125-20-(1.5x10)$

$= 85mm$

Short span (Midspan):

M_{sx} $= 12.7kNm/m$

$K = M/bd^2f_{ck}$ $= 12.7x10^6/(1000x95^2x25)$

$= 0.056 < K_{bal} = 0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.95d \geq 0.95d$ → Use 0.95d

$As = M/0.87f_{yk}z$ $= 12.7x10^6/(0.87x500x0.95x95)$
$= 325mm^2/m$

H10-200 (bot)
($393mm^2/m$)

Short span (Support):

M_{sx} $= 17.0kNm/m$

$K = M/bd^2f_{ck}$ $= 17.0x10^6/(1000x95^2x25)$
$= 0.076 < K_{bal}=0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.93d \leq 0.95d$

Use 0.93d

$A_s = M/0.87f_{yk}z$ $= 17.0\text{x}10^6/(0.87\text{x}500\text{x}0.93\text{x}95)$

$= 444\text{mm}^2/\text{m}$

H10-175 (top)
($449\text{mm}^2/\text{m}$)

<u>Long span (Midspan)</u>:

M_{sy} $= 6.7\text{kNm/m}$

$K = M/bd^2f_{ck}$ $= 6.7\text{x}10^6/(1000\text{x}85^2\text{x}25)$

$= 0.037 < K_{bal}=0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.97d \geq 0.95d$

Use 0.95d

$A_s = M/0.87f_{yk}z$ $= 6.7\text{x}10^6/(0.87\text{x}500\text{x}0.95\text{x}85)$

$= 190\text{mm}^2/\text{m}$

H10-350 (bot)
($224\text{mm}^2/\text{m}$)

<u>Long span (Support)</u>:

M_{sy} $= 8.8\text{kNm/m}$

$K = M/bd^2f_{ck}$ $= 8.8\text{x}10^6/(1000\text{x}85^2\text{x}25)$

$= 0.039 < K_{bal}=0.167$

∴ Compression reinforcement is not required

$z = d[0.5+\sqrt{0.25 - K/1.134}]$ $= 0.96d \geq 0.95d$

Use 0.95d

$A_s = M/0.87f_{yk}z$ $= 8.8x10^6/(0.87x500x0.95x85)$
$= 225mm^2/m$

H10-325 (top)
(242mm²/m)

Min. and max. reinforcement area,

$A_{s,min} = 0.26(f_{ctm}/f_{yk})bd$ $= 0.26x(2.56/500)bd$
$= 0.0013bd > 0.0013bd$

Use 0.0013bd

$= 0.0013x1000x95$
$= 127mm^2/m$

$A_{s,max} = 0.04A_c = 0.04bh$ $= 0.04x1000x125$
$= 5000mm^2/m$

H10-425
(185mm²/m)

6.0 SHEAR

Max. design shear force, V_{Ed} = 27.9kN

Design shear resistance,

$k = 1+(200/d)^{1/2} \leq 2.0$ $= 1+(200/95)^{1/2}$

$= 2.45 \geq 2.0$

$\rho^1 = A_{s1}/bd \leq 0.02$ $= 449/(1000x95)$

$= 0.0047 \leq 0.02$

$V_{Rd,c} = [0.12k(100\rho^1 f_{ck})^{1/3}]bd$ $= [0.12x2.0(100x0.0047x25)^{1/3}]x1000x95$

$= 51925N = 51.9kN$

$V_{min} = [0.35k^{3/2}f_{ck}^{1/2}]bd$ $= [0.0035x2.0^{3/2}x25^{1/2}]x1000x95$

$= 47023N = 47.0kN$ ➡ $V_{Rd,c}$; $V_{min} > V_{Ed}$ (OK)

7.0 DEFLECTION

Percentage of required tension reinforcement,

$\rho = A_{s,req}/bd$ $= 325/(1000x95)$

$= 0.0034$

Reference reinforcement ratio,

$\rho_0 = (f_{ck})^{1/2} x10^{-3}$ $= (25)^{1/2} x10^{-3}$

$= 0.0050$

Percentage of required compression reinforcement

$\rho' = A_{s',req}/bd$ $= 0/(1000x139)$

$= 0.000$

Factor for structural system, K = 1.3

$\rho < \rho_0$ ∴use equation (2)

$$\frac{l}{d} = K\left[11 + 1.5\sqrt{f_{ck}}\frac{\rho_0}{\rho} + 3.2\sqrt{f_{ck}}\left(\frac{\rho_0}{\rho} - 1\right)\right]^{3/2}$$

= 1.3(11+11+5)
= 35

Modification factor for span less than 7m = 1.0

Modification factor for steel area provided = $A_{s,prov}/A_{s,req}$
= 393/325
= $1.21 \leq 1.5$

Therefore allowable span-effective depth ratio = $(l/d)_{allowable}$
= 35x1.0x1.21
= 42.3

Actual span-effective depth = $(l/d)_{actual}$
= 4000/95
= $42.1 < (l/d)_{allowable}$
(OK)

8.0 CRACKING

$h = 125mm < 200mm$

Main bar,

$S_{max,slabs} = 3h$ or $400mm$ $= 375mm < 400mm$

Max. bar spacing $= 350mm \leq S_{max,slab} = 375mm$ (OK)

Secondary bar,

$S_{max,slabs} = 3.5h$ or $450mm$ $= 438mm < 450mm$

Max. bar spacing $= 425mm \leq S_{max,slab} = 438mm$ (OK)