Two-way slab

Solid slabs on four supports · coefficient method · EN 1992-1-1 §6.1, §6.2, §7.4, §9.3 · UK NA / PN-EN

Reference	NAE-RC-013 · version 1.0
Standards	BS EN 1992-1-1:2004 with UK NA · PN-EN 1992-1-1:2008 with Polish NA (NDP sources listed on the NDP sheet) · moment coefficients: BS 8110-1 Table 3.14 / IStructE Manual (EC2) Table 5.3
National Annex	Selectable: UK NA to BS EN 1992-1-1 or Polish NA to PN-EN 1992-1-1
Issued	29 October 2026

What it does

Design of a rectangular solid slab panel supported on four sides: design moments per metre in the short and long span from the coefficient method for nine edge conditions, bottom and top reinforcement in both directions, shear without links, deflection by the span to depth ratio and the slab detailing rules.

How to use

1. Open the Calculation sheet and select the National Annex.
2. Fill in the shaded input cells. Everything else is calculated.
3. Read the Results block; every step below it quotes its clause. Print or save as PDF for your calculation package.

Scope and limitations

Uniformly loaded rectangular panel on linear supports with the corners held down and torsion reinforcement provided at the corners, $1 \le l_y / l_x \le 2$ (beyond 2 every result fails: design as one-way), adjacent panels of similar span and load. Moments $m = \beta\, n\, l_x^2$ (BS 8110-1 Table 3.14) and edge shears $v = \beta_v\, n\, l_x$ (Table 3.15), interpolated linearly in l_y / l_x; the IStructE Manual for EC2 uses the same method. Short-span bars in the outer layer, long-span bars inside them; the thickness must hold all four layers. Shear at every edge with the bars in tension there (top at a continuous edge, bottom at a discontinuous one, assumed anchored). Deflection by (7.16) on the short span with K from the long edges (both continuous 1.5, one 1.3, none 1.0), the $(A_{s,prov} / A_{s,req})(500/f_{yk})$ factor (UK ≤ 1.5), 7/l for spans over 7 m with brittle partitions and the UK 40K cap. The 0.45 x/d limit assumes the coefficients' redistribution stays within 5.5 (as in the source method). Rectangular stress block, no compression bars, concrete classes up to C50/60. Corner torsion reinforcement (9.3.1.1, BS 8110 3.5.3.5), punching and crack widths are separate checks.
The second-generation EN 1992-1-1:2023 is not yet implemented.

Further reading and independent cross-check

- IStructE, Manual for the design of concrete building structures to Eurocode 2, 5.2.3.3 and Table 5.3.
- The Concrete Centre, How to design concrete structures using Eurocode 2: Slabs.
- The Concrete Centre, RC Spreadsheets v4, TCC94 Two-way slabs (licensed product) can be used as an independent cross-check.

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Disclaimer

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Revision history

v1.0	29 Oct 2026 · First issue

Project		Job no.	
Element		Made by	
Date		Checked	

Inputs · panel

Shaded cells only

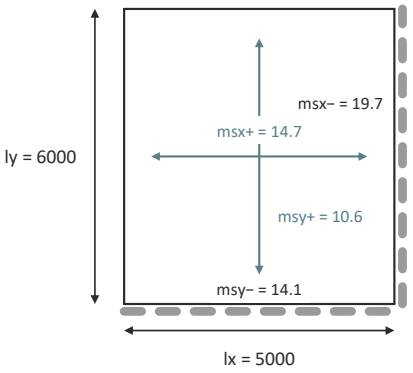
	National Annex		**UK NA (BS EN)**	
Table 3.1	Concrete strength class		**C32/40**	
3.2.2	Reinforcement characteristic yield strength (≤ 500 MPa)	f_{yk}	**500**	MPa
8.2(2)	Maximum aggregate size	d_g	**20**	mm
	Panel type (edge conditions)		**Two adjacent edges discontinuous**	
	Short span lx	l_x	**5000**	mm
	Long span ly (≥ lx)	l_y	**6000**	mm
	Slab thickness	h	**200**	mm
4.4.1	Nominal cover	c_{nom}	**25**	mm
	Bottom, short span (outer layer): diameter	φ_x	**10**	mm
	Bottom, short span: spacing	s_x	**200**	mm
	Bottom, long span (inner layer): diameter	φ_y	**10**	mm
	Bottom, long span: spacing	s_y	**250**	mm
	Top over continuous edges, short span: diameter	φ_{tx}	**12**	mm
	Top, short span: spacing	s_{tx}	**200**	mm
	Top over continuous edges, long span: diameter	φ_{ty}	**10**	mm
	Top, long span: spacing	s_{ty}	**250**	mm

Inputs · loads

Characteristic, per m²

	Permanent load in addition to the self weight	g_k	**1.50**	kN/m²
	Variable load	q_k	**2.50**	kN/m²
EN 1990 A1.2(B)	Partial factor, permanent	γ_G	**1.35**	
EN 1990 A1.2(B)	Partial factor, variable	γ_Q	**1.50**	
7.4.2(2)	Brittle partitions on a span over 7 m?		**No**	
	Inputs valid and consistent			**OK**

Your panel, to scale · continuous edges marked with a thick dashed line · design moments in kNm/m



Results

Short span, bottom As,req / As,prov	**0.68**		OK
Long span, bottom As,req / As,prov	**0.80**		OK
Short span, top at continuous edges As,req / As,prov	**0.50**		OK
Long span, top at continuous edges As,req / As,prov	**0.79**		OK
Shear without links VEd / VRd,c (worst edge)	**0.31**		OK
Deflection actual l/d ÷ limiting l/d (short span)	**0.57**		OK
Detailing (spacing, clear gap, As,max)	**250**	mm	OK
Aspect ratio ly / lx (1 to 2)	**1.20**		OK

Beyond ly / lx = 2 the panel spans one way: use NAE-RC-012. Provide torsion reinforcement at corners where the edges are discontinuous.

Calculation · loads and moments (per m width)

2.4.2.4(1)	Partial factor, concrete	γ_c	1.50		NDP sheet
2.4.2.4(1)	Partial factor, reinforcement	γ_s	1.15		NDP sheet
3.1.6(1)	Coefficient on compressive strength (flexure)	α_{cc}	0.85		NDP sheet
6.2.2(1), 6.4.4(1)	Coefficient 0.18 / γc	$C_{Rd,c}$	0.120		NDP sheet
7.4.2(2)	Upper limit on the stress / area factor		1.50		NDP sheet
7.4.2(2)	L/d ≤ 40K applies (1 = yes)		1.00		NDP sheet
Table 3.1	Characteristic cylinder strength	f_{ck}	32	MPa	
Table 3.1	Mean tensile strength	f_{ctm}	3.02	MPa	
3.1.6(1)	Design compressive strength αcc fck / γc	f_{cd}	18.13	MPa	
3.2.7	Design yield strength	f_{yd}	434.8	MPa	
	Design load n = γG (gk + 25 h) + γQ qk	n	12.53	kN/m²	
	Span ratio ly / lx (look-up within 1 – 2)	l_{y/l_x}	1.200		
BS 8110 T 3.14	βsx, negative (continuous edges)	β_{sx-}	0.0630		
BS 8110 T 3.14	βsx, positive (mid-span)	β_{sx+}	0.0470		
BS 8110 T 3.14	βsy, negative	β_{sy-}	0.045		
BS 8110 T 3.14	βsy, positive	β_{sy+}	0.034		
5.2.3.3	Design moment msx− = β n lx²	m_{xn}	**19.7**	kNm/m	
5.2.3.3	Design moment msx+ = β n lx²	m_{xp}	**14.7**	kNm/m	
5.2.3.3	Design moment msy− = β n lx²	m_{yn}	**14.1**	kNm/m	
5.2.3.3	Design moment msy+ = β n lx²	m_{yp}	**10.6**	kNm/m	

Calculation · bending

5.6.3	Limit on K without compression bars (ξ ≤ 0.45)	K'	0.167		
	Short span, bottom: effective depth	d	170	mm	
(9.1N)	Short span, bottom: As,min max(0.26 fctm/fyk; 0.0013) b d	$A_{s,min}$	267	mm²/m	
	Short span, bottom: K = m / (b d² fck)	K	0.016		
	Short span, bottom: As required m / (fyd z), z = d(1 − 0.4ξ) ≤ 0.9	$A_{s,req}$	210	mm²/m	
	Short span, bottom: As provided	$A_{s,prov}$	393	mm²/m	
	Short span, bottom: As,prov ≥ max(As,req; As,min)	A_s	393	mm²/m	OK
	Long span, bottom: effective depth	d	160	mm	
(9.1N)	Long span, bottom: As,min max(0.26 fctm/fyk; 0.0013) b d	$A_{s,min}$	252	mm²/m	
	Long span, bottom: K = m / (b d² fck)	K	0.013		
	Long span, bottom: As required m / (fyd z), z = d(1 − 0.4ξ) ≤ 0.9	$A_{s,req}$	161	mm²/m	
	Long span, bottom: As provided	$A_{s,prov}$	314	mm²/m	
	Long span, bottom: As,prov ≥ max(As,req; As,min)	A_s	314	mm²/m	OK
	Short span, top: effective depth	d	169	mm	
(9.1N)	Short span, top: As,min max(0.26 fctm/fyk; 0.0013) b d	$A_{s,min}$	266	mm²/m	
	Short span, top: K = m / (b d² fck)	K	0.022		
	Short span, top: As required m / (fyd z), z = d(1 − 0.4ξ) ≤ 0.95 d	$A_{s,req}$	283	mm²/m	
	Short span, top: As provided	$A_{s,prov}$	565	mm²/m	

	Short span, top: As,prov ≥ max(As,req; As,min)	A_s	565	mm²/m	**OK**
	Long span, top: effective depth	d	158	mm	
(9.1N)	Long span, top: As,min max(0.26 fctm/fyk; 0.0013) b d	$A_{s,min}$	248	mm²/m	
	Long span, top: K = m / (b d² fck)	K	0.018		
	Long span, top: As required m / (fyd z), z = d(1 − 0.4ξ) ≤ 0.95 d	$A_{s,req}$	216	mm²/m	
	Long span, top: As provided	$A_{s,prov}$	314	mm²/m	
	Long span, top: As,prov ≥ max(As,req; As,min)	A_s	314	mm²/m	**OK**

Calculation · shear, deflection and detailing

Table 3.15	Long edge, continuous (top short-span bars): v = βv n lx	v_{Ed}	29.4	kN/m	
(6.2)	Long edge, continuous (top short-span bars): VRd,c	$V_{Rd,c}$	94.6	kN/m	
Table 3.15	Long edge, discontinuous (bottom short-span bars): v = βv n lx	v_{Ed}	19.4	kN/m	
(6.2)	Long edge, discontinuous (bottom short-span bars): VRd,c	$V_{Rd,c}$	95.2	kN/m	
Table 3.15	Short edge, continuous (top long-span bars): v = βv n lx	v_{Ed}	25.1	kN/m	
(6.2)	Short edge, continuous (top long-span bars): VRd,c	$V_{Rd,c}$	88.5	kN/m	
Table 3.15	Short edge, discontinuous (bottom long-span bars): v = βv n lx	v_{Ed}	16.3	kN/m	
(6.2)	Short edge, discontinuous (bottom long-span bars): VRd,c	$V_{Rd,c}$	89.6	kN/m	
(6.2)	Shear utilisation max(vEd / VRd,c) over the edges		0.31		
(6.2)	Shear at every edge vEd ≤ VRd,c		0.31		**OK**
Table 7.4N	K for the short span (long edges: both continuous 1.5, one 1.3,	K	1.3		
7.4.2	ρ = max(As,req; As,min) / (b d), short span	ρ	0.00157		N/A: bending fails
(7.16)	ρ0 = √fck · 10⁻³	ρ_0	0.00566		
(7.16)	Basic span to depth ratio	l/d	152.5		
7.4.2(2)	Steel stress factor (As,prov / As,req)(500 / fyk) (UK ≤ 1.5)	F_3	1.469		
7.4.2(2)	Long span factor 7 / lx (lx > 7 m, brittle partitions)	F_2	1.000		
7.4.2	Limiting span to depth ratio (UK NA: ≤ 40 K)	l/d_{lim}	**52.0**		
	Actual lx / d	l/d	29.4		
7.4.2	Deflection l/d ≤ limit (with every bending check passing)	l/d	29.4		**OK**
9.3.1.1(3)	Maximum bar spacing at maximum moments min(2h; 250)	s_{max}	250	mm	
8.2(2)	Minimum clear gap max(ϕ; dg + 5; 20)	a_{min}	25	mm	
9.3.1.1(3)	Spacing, clear gap and As,max	s	250	mm	**OK**

Curtail and anchor the top bars over continuous edges for the support moments (9.2.1.3). Where an edge taken as discontinuous has partial fixity, provide top bars for 25 % of the adjacent span moment extending 0.2 of that span (9.3.1.2(2)), and torsion reinforcement at the corners.

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Bending moment coefficients for two-way slabs (corners held down)

BS 8110-1 Table 3.14 (moments) and Table 3.15 (shears, below). The IStructE Manual for EC2 (5.2.3.3, Table 5.3) uses the same method: $m = \beta\, n\, l_x^2$, $v = \beta v\, n\, l_x$

Panel	moment	1.00	1.10	1.20	1.30	1.40	1.50	1.75	2.00	βsy
1 Interior panel	negative	0.031	0.037	0.042	0.046	0.050	0.053	0.059	0.063	0.032
	positive	0.024	0.028	0.032	0.035	0.037	0.040	0.044	0.048	0.024
2 One short edge discontinuous	negative	0.039	0.044	0.048	0.052	0.055	0.058	0.063	0.067	0.037
	positive	0.029	0.033	0.036	0.039	0.041	0.043	0.047	0.050	0.028
3 One long edge discontinuous	negative	0.039	0.049	0.056	0.062	0.068	0.073	0.082	0.089	0.037
	positive	0.030	0.036	0.042	0.047	0.051	0.055	0.062	0.067	0.028
4 Two adjacent edges discontinuous	negative	0.047	0.056	0.063	0.069	0.074	0.078	0.087	0.093	0.045
	positive	0.036	0.042	0.047	0.051	0.055	0.059	0.065	0.070	0.034
5 Two short edges discontinuous	negative	0.046	0.050	0.054	0.057	0.060	0.062	0.067	0.070	–
	positive	0.034	0.038	0.040	0.043	0.045	0.047	0.050	0.053	0.034
6 Two long edges discontinuous	negative	–	–	–	–	–	–	–	–	0.045
	positive	0.034	0.046	0.056	0.065	0.072	0.078	0.091	0.100	0.034
7 Three edges discontinuous – one long continuous	negative	0.057	0.065	0.071	0.076	0.081	0.084	0.092	0.098	–
	positive	0.043	0.048	0.053	0.057	0.060	0.063	0.069	0.074	0.044
8 Three edges discontinuous – one short continuous	negative	–	–	–	–	–	–	–	–	0.058
	positive	0.042	0.054	0.063	0.071	0.078	0.084	0.096	0.105	0.044
9 Four edges discontinuous	negative	–	–	–	–	–	–	–	–	–
	positive	0.055	0.065	0.074	0.081	0.087	0.092	0.103	0.111	0.056

Shear coefficients βv (Table 3.15)

1 Interior panel	βvx continuou	0.33	0.36	0.39	0.41	0.43	0.45	0.48	0.50
	βvx discontinu	–	–	–	–	–	–	–	–
	βvy continuou	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
	βvy discontinu	–	–	–	–	–	–	–	–
2 One short edge discontinuous	βvx continuou	0.36	0.39	0.42	0.44	0.45	0.47	0.50	0.52
	βvx discontinu	–	–	–	–	–	–	–	–
	βvy continuou	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	βvy discontinu	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
3 One long edge discontinuous	βvx continuou	0.36	0.40	0.44	0.47	0.49	0.51	0.55	0.59
	βvx discontinu	0.24	0.27	0.29	0.31	0.32	0.34	0.36	0.38
	βvy continuou	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	βvy discontinu	–	–	–	–	–	–	–	–
4 Two adjacent edges discontinuous	βvx continuou	0.40	0.44	0.47	0.50	0.52	0.54	0.57	0.60
	βvx discontinu	0.26	0.29	0.31	0.33	0.34	0.35	0.38	0.40
	βvy continuou	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	βvy discontinu	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
5 Two short edges discontinuous	βvx continuou	0.40	0.43	0.45	0.47	0.48	0.49	0.52	0.54
	βvx discontinu	–	–	–	–	–	–	–	–
	βvy continuou	–	–	–	–	–	–	–	–
	βvy discontinu	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
6 Two long edges discontinuous	βvx continuou	–	–	–	–	–	–	–	–
	βvx discontinu	0.26	0.30	0.33	0.36	0.38	0.40	0.44	0.47
	βvy continuou	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	βvy discontinu	–	–	–	–	–	–	–	–
7 Three edges discontinuous – one long continuous	βvx continuou	0.45	0.48	0.51	0.53	0.55	0.57	0.60	0.63
	βvx discontinu	0.30	0.32	0.34	0.35	0.36	0.37	0.39	0.41
	βvy continuou	–	–	–	–	–	–	–	–
	βvy discontinu	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
8 Three edges discontinuous – one short continuous	βvx continuou	–	–	–	–	–	–	–	–
	βvx discontinu	0.29	0.33	0.36	0.38	0.40	0.42	0.45	0.48
	βvy continuou	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
	βvy discontinu	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
9 Four edges discontinuous	βvx continuou	–	–	–	–	–	–	–	–
	βvx discontinu	0.33	0.36	0.39	0.41	0.43	0.45	0.48	0.50
	βvy continuou	–	–	–	–	–	–	–	–
	βvy discontinu	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33

Coefficients apply to panels with corners prevented from lifting and torsion reinforcement at the corners, under uniform load, with $1 \le l_y / l_x \le 2$; '–' means no such edge.

Nationally Determined Parameters

Values used by the Calculation sheet for the selected National Annex. Sources: UK NA to BS EN 1992-1-1:2004, Table NA.1; PN-EN 1992-1-1:2008, Załącznik krajowy NA. Edit only if your project specifies different values.

Parameter	Clause	UK NA	PL NA	Notes
Partial factor, concrete γc	2.4.2.4(1)	**1.5**	**1.4**	Persistent & transient. UK NA: recommended; PL: NA.2, Table NA.2
Partial factor, reinforcement γs	2.4.2.4(1)	**1.15**	**1.15**	UK NA: recommended; PL: NA.2, Table NA.2
αcc (compression in flexure / axial)	3.1.6(1)	**0.85**	**1**	UK NA: 0.85; PL: recommended (NA.9)
αcc (shear and punching)	3.1.6(1)	**1**	**1**	UK NA: 1.0 for other phenomena; PL: recommended (NA.9)
αct (design tensile strength)	3.1.6(2)	**1**	**1**	Recommended value in both annexes
CRd,c numerator (CRd,c = value / γc)	6.2.2(1), 6.4.4(1)	**0.18**	**0.18**	Recommended value in both annexes
k1 (axial stress term, punching)	6.4.4(1)	**0.1**	**0.1**	Recommended value in both annexes
vRd,max factor (vRd,max = factor · ν · fcd)	6.4.5(3)	**0.5**	**0.4**	UK NA: 0.5 ν fcd; PL: recommended value (NA.9), 0.4 ν fcd since EN 1992-1-1 AC:2010 (PN-EN 1992-1-1:200
kmax (vEd ≤ kmax · vRd,c at u1)	6.4.5	**2**	**1.5**	UK NA 6.4.5(3): 2 vRd,c. PL: no limit in PN-EN 1992-1-1:2008; 1.5 (A1:2014 recommendation) applied conse
ϕlarge (large bar threshold, mm)	8.8(1)	**40**	**32**	UK NA: 40 mm; PL: 32 mm recommended (NA.9)
cot θ upper limit (variable strut)	6.2.3(2)	**2.5**	**2**	UK NA: 2.5 (1.25 with axial tension); PL: NA.4, 1 ≤ cot θ ≤ 2.0
k1 (x/d limit, δ ≥ k1 + k2 xu/d)	5.5(4)	**0.4**	**0.44**	UK NA for fyk ≤ 500 MPa; PL: recommended (NA.9)
k2 (x/d limit, εcu2 = 0.0035)	5.5(4)	**1**	**1.25**	UK NA: 0.6 + 0.0014/εcu2; PL: 1.25(0.6 + 0.0014/εcu2)
Upper limit on the (310/σs) factor (0 = none)	7.4.2(2)	**1.5**	**0**	UK NA Table NA.5 Note 5: (310/σs) or (500/fyk)(As,prov/As,req) ≤ 1.5; PL: none
L/d not to exceed 40 K (1 = applies)	7.4.2(2)	**1**	**0**	UK NA Table NA.5 Note 6; not in EN text
ϕmin (longitudinal bars in columns, mm)	9.5.2(1)	**12**	**6**	UK NA: 12 mm; PL: NA.6, 6 mm
k3 (crack spacing)	7.3.4(3)	**3.4**	**3.4**	Recommended value in both annexes
k4 (crack spacing)	7.3.4(3)	**0.425**	**0.425**	Recommended value in both annexes