

One-way slab

Solid slabs spanning one way · EN 1992-1-1 §6.1, §6.2, §7.4, §9.3 · UK NA / PN-EN

Reference	NAE-RC-012 · 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)
National Annex	Selectable: UK NA to BS EN 1992-1-1 or Polish NA to PN-EN 1992-1-1
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What it does

Design of a 1 m strip of a solid slab spanning one way: design moments and shears for a simply supported, continuous or cantilever span, bottom and top reinforcement, shear without links at both supports, deflection by the span to depth ratio and the detailing rules for slabs.

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 solid slab, 1 m strip. Simply supported and cantilever spans from statics; continuous spans from the coefficients of Concise Eurocode 2 Table 15.2 (TCC How to: Slabs, Table 3), which include 20 % redistribution ($\delta = 0.8, 5.5$) and apply only where the bays exceed 30 m², $Q_k \leq 1.25 G_k$, $q_k \leq 5 \text{ kN/m}^2$, the load is substantially uniform and there are at least three spans with the shortest ≥ 0.85 the longest: the load ratios are checked and the rest must be confirmed with the input provided, otherwise every coefficient result fails. The coefficient method is a UK simplification of a redistributed linear analysis (5.5); its use under the PL annex is the designer's decision. For redistributed supports the x/d of the bars provided is checked against the 5.5(4) limit. Rectangular stress block, no compression reinforcement. Shear without links (6.2.2) at both supports with the bars in tension there, assumed anchored beyond the section (bottom bars at an end support to 9.3.1.2(1)). Deflection by (7.16) with K of Table 7.4N, the $(A_{s,prov} / A_{s,req})(500 / f_{yk})$ factor (UK: ≤ 1.5) and the 7/l factor for spans over 7 m with brittle partitions (7.4.2(2)); not assessed where the bending check fails. At a simple support top bars for 25 % of the span moment are checked (9.3.1.2(2)). Concrete classes up to C50/60, $f_{yk} \leq 500 \text{ MPa}$. Crack widths, fire and punching are separate checks. The second-generation EN 1992-1-1:2023 is not yet implemented.

Further reading and independent cross-check

- The Concrete Centre, How to design concrete structures using Eurocode 2: Slabs.
 - The Concrete Centre, Concise Eurocode 2, Table 15.2.
 - The Concrete Centre, RC Spreadsheets v4, TCC31 One-way slabs (licensed product) can be used as an independent cross-check.
- NA Engineering is not affiliated with The Concrete Centre or CIRIA; their publications are referenced for information only.

About NA Engineering

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Disclaimer

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Revision history

v1.0	29 Oct 2026 · First issue
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Project
Element
Date

Job no.
Made by
Checked

Inputs · slab

Shaded cells only

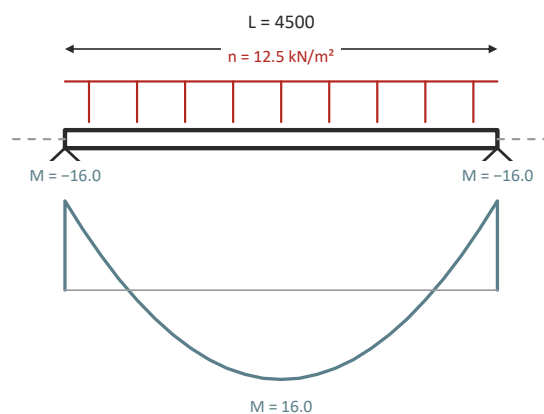
	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
3.2.2	Reinforcement characteristic yield strength (≤ 500 MPa)	f_{yk}	500	MPa
8.2(2)	Maximum aggregate size	d_g	20	mm
	Span type		Interior span	Continuous: Concise EC2 Table 15.2
	Table 15.2 conditions met (bays > 30 m ² , ≥ 3 similar spans, uniform load)		Yes	Continuous spans only
5.3.2.2	Effective span	l	4500	mm
	Slab thickness	h	200	mm
4.4.1	Nominal cover	c_{nom}	25	mm
	Bottom bars (span): diameter	φ_b	12	mm
	Bottom bars: spacing	s_b	200	mm
	Top bars (supports): diameter	φ_t	12	mm
	Top bars: spacing	s_t	175	mm
	Distribution bars: diameter	φ_d	10	mm
	Distribution bars: spacing	s_d	300	mm

Inputs · loads

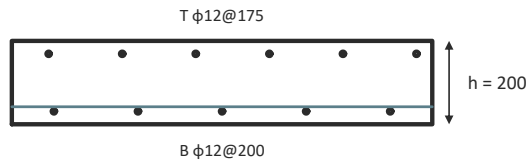
Characteristic, per m²

	Permanent load in addition to the self weight	g_k	1.50	kN/m ²
	Variable load	q_k	2.50	kN/m ²
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 slab strip, to scale · elevation, load and design moments (schematic envelope: sagging below, hogging above)



1 m strip, to scale · main bars (span bottom, support top) and distribution bars on the main tension face



Results

Span bending $A_{s,req} / A_{s,prov}$	0.47		OK
Support bending $A_{s,req} / A_{s,prov}$ (simple support: 25 % of the span b)	0.41		OK
Shear without links $V_{Ed} / V_{Rd,c}$ (worse support)	0.30		OK
Deflection actual $l/d \div$ limiting l/d	0.44		OK
Detailing (distribution bars, clear gaps, $A_{s,max}$)	262	mm ² /m	OK
Table 15.2 conditions (continuous spans) Q_k / G_k	0.38		OK

If the Table 15.2 conditions are not met, every result based on the coefficients fails: analyse the slab (e.g. continuous beam analysis) instead.

Calculation · loads and actions (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 $0.18 / \gamma_c$	$C_{Rd,c}$	0.120	NDP sheet
5.5(4)	Coefficient for x/d limit	k_1	0.40	NDP sheet
5.5(4)	Coefficient for x/d limit	k_2	1.00	NDP sheet
7.4.2(2)	Upper limit on the stress / area factor		1.50	NDP sheet
7.4.2(2)	$L/d \leq 40K$ 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 $\alpha_{cc} f_{ck} / \gamma_c$	f_{cd}	18.13	MPa
3.2.7	Design yield strength	f_{yd}	434.8	MPa
	Self weight 25 h	g_{sw}	5.00	kN/m ²
EN 1990 (6.10)	Design load $\gamma_G (g_k + g_{sw}) + \gamma_Q q_k$	n	12.53	kN/m ²
	Total load on the span $F = n l$	F	56.4	kN/m
Table 15.2	Span moment (coefficient $\times F l$)	M_{span}	16.0	kNm/m
Table 15.2	Left support moment (hogging; cantilever: at the root)	M_{left}	16.0	kNm/m
Table 15.2	Right support moment (hogging)	M_{right}	16.0	kNm/m
Table 15.2	Shear at the left support	V_{left}	28.2	kN/m
Table 15.2	Shear at the right support	V_{right}	28.2	kN/m

Calculation · bending

5.5(4)	Redistribution ratio implied (1.0, or 0.8 for Table 15.2)	δ	0.80	
5.5(4)	Limiting neutral axis depth $\min((\delta - k_1)/k_2; \epsilon_{cu}/(\epsilon_{cu} + \epsilon_{yd}))$	$x_{u/d}$	0.400	
3.1.7(3)	Limiting K (α_{cc}/γ_c) $0.8\xi (1 - 0.4\xi)$	K'	0.152	
	Effective depth, bottom bars $h - c - \phi_b/2$	d_b	169	mm
	Effective depth, top bars $h - c - \phi_t/2$	d_t	169	mm
9.2.1.1(3)	Maximum reinforcement $0.04 A_c$	$A_{s,max}$	8000	mm ² /m
	Span (bottom): $K = M / (b d^2 f_{ck})$	K	0.017	
3.1.7(3)	Span (bottom): lever arm $d (1 - 0.4\xi) \leq 0.95 d$	z	161	mm
	Span (bottom): A_s required $M / (f_{yd} z)$	$A_{s,req}$	229	mm ² /m
(9.1N)	Span (bottom): $A_{s,min} \max(0.26 f_{ctm}/f_{yk}; 0.0013) b d$	$A_{s,min}$	266	mm ² /m

	Span (bottom): As provided $1000 \pi \phi^2 / (4 s)$	$A_{s,prov}$	565	mm ² /m	
5.5(4)	Span (bottom): x/d of the bars provided $A_s f_{yd} / (0.8 b f_{cd} d)$	x/d	0.100		
	Support (top): $K = M / (b d^2 f_{ck})$	K	0.017		
3.1.7(3)	Support (top): lever arm $d (1 - 0.4 \xi) \leq 0.95 d$	z	161	mm	
	Support (top): As required $M / (f_{yd} z)$	$A_{s,req}$	229	mm ² /m	
(9.1N)	Support (top): As,min $\max(0.26 f_{ctm}/f_{yk}; 0.0013) b d$	$A_{s,min}$	266	mm ² /m	
	Support (top): As provided $1000 \pi \phi^2 / (4 s)$	$A_{s,prov}$	646	mm ² /m	
5.5(4)	Support (top): x/d of the bars provided $A_s f_{yd} / (0.8 b f_{cd} d)$	x/d	0.115		
	Span: $A_{s,prov} \geq \max(A_{s,req}; A_{s,min})$ (coefficients applicable)	A_s	565	mm ² /m	OK
5.5(4), 9.3.1.2(2)	Support: $A_{s,prov} \geq \max(A_{s,req}; A_{s,min})$, $x/d \leq$ limit; simple supp	A_s	646	mm ² /m	OK

Calculation · shear and deflection

6.2.2(1)	Left support: pl of the bars in tension there	ρ_l	0.0038		
(6.2)	Left support: $V_{Rd,c}$	$V_{Rd,c}$	94.6	kN/m	
6.2.2(1)	Right support: pl of the bars in tension there	ρ_l	0.0038		
(6.2)	Right support: $V_{Rd,c}$	$V_{Rd,c}$	94.6	kN/m	
(6.2)	Shear utilisation $\max(V_{Ed} / V_{Rd,c})$ of the two supports		0.30		
7.4.2	Tension bars for deflection $A_{s,req} / (b d)$ (span; cantilever: sup	ρ	0.00157		N/A: bending fails
(7.16)	Reference ratio $\rho_0 = \sqrt{f_{ck}} \cdot 10^{-3}$	ρ_0	0.00566		
Table 7.4N	K for the structural system	K	1.5		
(7.16)	Basic span to depth ratio	l/d	176.0		
7.4.2(2)	Steel stress factor $(A_{s,prov} / A_{s,req})(500 / f_{yk})$ (UK ≤ 1.5)	F_3	1.500		
7.4.2(2)	Long span factor $7 / l$ ($l > 7$ m, brittle partitions)	F_2	1.000		
7.4.2	Limiting span to depth ratio (UK NA: $\leq 40 K$)	l/d_{lim}	60.0		
	Actual span to depth ratio	l/d	26.6		
7.4.2	Deflection $l/d \leq$ limit (with every bending check passing)	l/d	26.6		OK

Calculation · detailing (9.3)

9.3.1.1(3)	Maximum spacing of main bars at maximum moments $\min(2h;$	s_{max}	250	mm	
9.3.1.1(3)	Maximum spacing of secondary bars at maximum moments $\min$	$s_{max,d}$	400	mm	
8.2(2)	Minimum clear gap, main bars $\max(\phi; d_g + 5; 20)$	a_{min}	25	mm	
8.2(2)	Minimum clear gap, distribution bars $\max(\phi; d_g + 5; 20)$	$a_{min,d}$	25	mm	
	Main bars for the distribution rule (span; cantilever: top)	$A_{s,main}$	565	mm ² /m	
	Distribution bars provided	$A_{s,d}$	262	mm ² /m	
9.3.1.1(2)	Distribution bars $\geq 20\%$ of the main bars	$A_{s,d}$	262	mm ² /m	OK
9.3.1.1(3)	Main bar spacing at maximum moments $\leq s_{max}$	s	200	mm	OK
9.3.1.1(3)	Distribution bar spacing $\leq s_{max,d}$	s_d	300	mm	OK
8.2(2)	Clear gaps of main and distribution bars	a	163	mm	OK
9.2.1.1(3)	Main reinforcement $\leq A_{s,max}$	A_s	646	mm ² /m	OK

Curtail and anchor the support bars for the design moments (9.2.1.3); 9.3.1.2(2) gives only the nominal top steel at a simple support (25 % of the span moment, extending at least 0.2 of the span). At an end support at least half the span bottom bars should continue and be anchored (9.3.1.2(1)).

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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 γ_c	2.4.2.4(1)	1.5	1.4	Persistent & transient. UK NA: recommended; PL: NA.2, Table NA.2
Partial factor, reinforcement γ_s	2.4.2.4(1)	1.15	1.15	UK NA: recommended; PL: NA.2, Table NA.2
α_{cc} (compression in flexure / axial)	3.1.6(1)	0.85	1	UK NA: 0.85; PL: recommended (NA.9)
α_{cc} (shear and punching)	3.1.6(1)	1	1	UK NA: 1.0 for other phenomena; PL: recommended (NA.9)
α_{ct} (design tensile strength)	3.1.6(2)	1	1	Recommended value in both annexes
CRd,c numerator (CRd,c = value / γ_c)	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
$v_{Rd,max}$ factor ($v_{Rd,max} = \text{factor} \cdot v \cdot f_{cd}$)	6.4.5(3)	0.5	0.4	UK NA: 0.5 v fcd; PL: recommended value (NA.9), 0.4 v fcd since EN 1992-1-1 AC:2010 (PN-EN 1992-1-1:2008)
kmax ($v_{Ed} \leq k_{max} \cdot v_{Rd,c}$ 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
ϕ_{large} (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, $1 \leq \cot \theta \leq 2.0$
k1 (x/d limit, $\delta \geq k_1 + k_2 x_u/d$)	5.5(4)	0.4	0.44	UK NA for $f_{yk} \leq 500$ MPa; PL: recommended (NA.9)
k2 (x/d limit, $\epsilon_{cu2} = 0.0035$)	5.5(4)	1	1.25	UK NA: $0.6 + 0.0014/\epsilon_{cu2}$; PL: $1.25(0.6 + 0.0014/\epsilon_{cu2})$
Upper limit on the (310/ σ_s) factor (0 = none)	7.4.2(2)	1.5	0	UK NA Table NA.5 Note 5: (310/ σ_s) or (500/ f_{yk})($A_{s,prov}/A_{s,req}$) ≤ 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
ϕ_{min} (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