

Anchorage & lap lengths

Reinforced concrete · EN 1992-1-1 §8.4 and §8.7 · UK NA / PN-EN

Reference	NAE-RC-001 · 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
Issued	29 October 2026

What it does

Design anchorage length l_{bd} and lap length l_0 of straight ribbed bars in tension and in compression, for one bar size in detail and as a ready-to-use table for all bar sizes from 8 to 40 mm.

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

Straight ribbed bars (B500) only; no bends, hooks or welded transverse bars ($\alpha_1 = \alpha_3 = \alpha_4 = \alpha_5 = 1.0$, which is conservative). Bond conditions per EN 1992-1-1 Fig. 8.2 are chosen by the user. c_d is taken as $\min(a/2; c)$ for straight bars. Bundled bars, mechanical couplers and lightweight concrete are outside the scope. Concrete classes up to C50/60.

The sheet gives lengths only. Transverse reinforcement at laps (8.7.4) and the rules for large bars (8.8) must be checked separately; the sheet flags when they apply.

The second-generation EN 1992-1-1:2023 is not yet implemented; the UK and Polish annexes to the 2004 edition remain in use during the co-existence period.

Further reading and independent cross-check

- The Concrete Centre, How to design concrete structures using Eurocode 2: Detailing.
- The Concrete Centre, RC Spreadsheets v4, TCC101 Detailing data (licensed product) can be used as an independent cross-check.
- IStructE, Manual for the design of concrete building structures to Eurocode 2.

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About NA Engineering

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Disclaimer

This spreadsheet is provided free of charge, as is, for use by competent engineers. It does not replace engineering judgement. The user is responsible for the input, for checking that the method suits the element being designed and for verifying the results. NA Engineering accepts no liability for any loss arising from its use. Sheets are password-protected and the workbook structure is locked so that the formulas and the NA Engineering details cannot be changed; only the shaded input cells can be edited.

Revision history

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

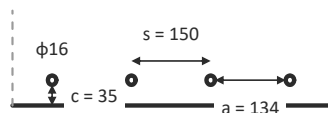
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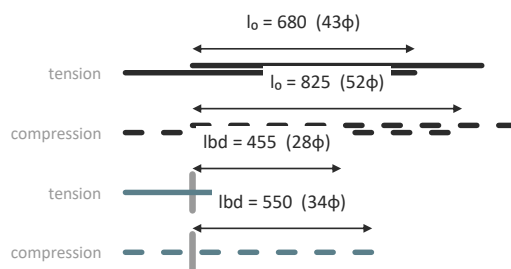
Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
3.2.2	Reinforcement characteristic yield strength	f_{yk}	500	MPa
	Bar diameter (detailed result)	φ	16	mm
Fig. 8.2	Bond condition		Good	Poor: top bars in deep pours
	Bar stress ratio σ_{sd} / f_{yd}		1.00	1.00 = fully stressed bar
4.4.1	Nominal cover to the lapped bars	c	35	mm
	Bar centres	s	150	mm
Table 8.3	Proportion of bars lapped in one section	ρ_1	100	%
	Inputs valid and consistent			OK

Your bars, to scale · section at the lap



Lengths for this bar, to the same scale · laps (dark), anchorage (blue), compression dashed



Results

Rounded up to 5 mm

Anchorage length, tension	l_{bd}	455	mm	28 ϕ
Lap length, tension	l_o	680	mm	43 ϕ
Anchorage length, compression	l_{bd}	550	mm	34 ϕ

Lap length, compression	l_0	825	mm	52 ϕ
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Detailing checks

Not covered by the lengths above

8.7.4.1(3)	Transverse reinforcement at tension laps ($\phi \geq 20$ and $> 25\%$ lapped)	OK
8.7.4.2	Compression laps: one transverse bar outside each lap end	! Detail
8.8	Large bars ($\phi > \phi_{\text{large}}$ from the National Annex)	OK

Calculation

	Clear gap between bars $s - \phi$		134	mm	OK
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(2)	Coefficient on tensile strength	α_{ct}	1.00		NDP sheet
8.8(1)	Large bar threshold	ϕ_{large}	40	mm	NDP sheet
Table 3.1	Characteristic cylinder strength	f_{ck}	32	MPa	
Table 3.1	Mean tensile strength	f_{ctm}	3.02	MPa	
Table 3.1	Characteristic tensile strength (5 % fractile)	$f_{ctk,0.05}$	2.12	MPa	
3.1.6(2), 8.4.2(2)	Design tensile strength ($f_{ctk,0.05}$ not above C60/75 value)	f_{ctd}	1.41	MPa	
3.2.7	Design yield strength	f_{yd}	434.8	MPa	
8.4.2(2)	Bond condition coefficient	η_1	1.00		
8.4.2(2)	Bar size coefficient	η_2	1.00		
(8.2)	Ultimate bond stress	f_{bd}	3.18	MPa	
8.4.3(2)	Design stress in the bar	σ_{sd}	434.8	MPa	
(8.3)	Basic required anchorage length	$l_{b,rqd}$	548	mm	
Table 8.2	Cover / spacing dimension $\min(a/2; c)$	c_d	35	mm	
Table 8.2	Effect of concrete cover (tension)	α_2	0.822		
(8.10)	Effect of proportion of lapped bars	α_6	1.500		
$\alpha_1 = \alpha_3 = \alpha_4 = \alpha_5 = 1.0$: straight bars, no credit taken for transverse reinforcement or transverse pressure (conservative).					
(8.6)	Minimum anchorage length, tension	$l_{b,min}$	164	mm	
(8.4)	Design anchorage length, tension	l_{bd}	450	mm	
(8.11)	Minimum lap length	$l_{0,min}$	246	mm	
(8.10)	Design lap length, tension	l_0	675	mm	
(8.7)	Minimum anchorage length, compression	$l_{b,min}$	329	mm	
Table 8.2	Design anchorage length, compression ($\alpha_1 \dots \alpha_5 = 1$)	l_{bd}	548	mm	
(8.10)	Design lap length, compression	l_0	822	mm	

All bar sizes

Same inputs, mm, rounded up to 5 mm

ϕ (mm)	$l_{b,rqd}$	l_{bd} tension	l_0 tension	l_{bd} compr.	l_0 compr.
8	275	195	290	275	415
10	345	240	360	345	515
12	415	295	440	415	620
16	550	455	680	550	825
20	685	610	915	685	1030
25	860	805	1210	860	1285
32	1100	1085	1625	1100	1645
40	1490	1490	2235	1490	2235

Table values use the cover, bar centres, bond condition, stress ratio and lapped proportion entered above. Where the clear gap between bars is small, α_2 tends to 1.0. Lengths only: transverse reinforcement at laps (8.7.4) and large-bar rules (8.8) apply as for the detailed bar above; shaded sizes exceed ϕ_{large} (8.8).

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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