

Crack width

Flexural cracking · EN 1992-1-1 §7.3 · UK NA / PN-EN

Reference	NAE-RC-003 · 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

Calculated crack width w_k of a rectangular reinforced concrete section in bending under the quasi-permanent moment, with the minimum reinforcement check for crack control and the steel stress limit of 7.2(5).

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

Rectangular section, one layer of tension bars of one size, pure bending (no axial force). Cracked elastic analysis with the effective modulus $E_{c,eff} = E_{cm} / (1 + \phi)$. Cracking from restrained early-age thermal and shrinkage strains is not covered; use CIRIA C766 for that. Concrete classes up to C50/60.

The second-generation EN 1992-1-1:2023 is not yet implemented.

Further reading and independent cross-check

- CIRIA C766, Control of cracking caused by restrained deformation in concrete (2018), for early-age and restraint cracking.
 - The Concrete Centre, How to design concrete structures using Eurocode 2: Serviceability.
 - The Concrete Centre, RC Spreadsheets v4, TCC14 Crack Width (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

NA Engineering is a structural engineering consultancy delivering structural design, reinforced concrete modelling and detailing, and steel detailing for residential, commercial, infrastructure, energy and refurbishment projects. We share tools like this one because good engineering should be transparent: every formula here is visible and referenced. If you need a design, a check or a full detailing package, talk to us.

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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

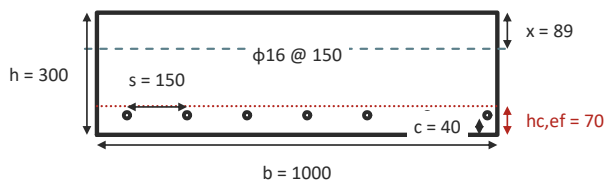
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Project
Element
Date

Job no.
Made by
Checked

Inputs
Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
	Section width	b	1000	mm
	Section depth	h	300	mm
	Cover to the tension bars	c	40	mm
	Bar diameter	ϕ	16	mm
	Bar centres	s	150	mm
	Quasi-permanent bending moment	M_{qp}	55.0	kNm For crack width
7.2(5)	Characteristic bending moment	M_k	75.0	kNm For steel stress limit
Annex B	Creep coefficient	$\varphi(\infty, t_0)$	2.00	
7.3.4(2)	Load duration		Long-term	
7.3.1(5)	Limiting crack width (project requirement)	w_{max}	0.30	mm Table 7.1N / UK NA Table NA.4
	Reinforcement characteristic yield strength	f_{yk}	500	MPa
	Inputs valid and consistent			OK

Your section, to scale · bars at spacing s · neutral axis and $h_{c,ef}$ (dashed)

Results

Calculated crack width	w_k	0.159	mm	OK
Steel stress, characteristic $\leq 0.8 f_{yk}$	$\sigma_{s,k}$	252	MPa	OK
Minimum reinforcement $A_s / A_{s,min}$		3.69		OK

Calculation

	Clear gap between bars $s - \phi$	134	mm	OK
	Bars inside the section $h - c - \phi$	244	mm	OK
7.3.4(3)	Crack spacing coefficient	k_3	3.40	NDP sheet
7.3.4(3)	Crack spacing coefficient	k_4	0.425	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	Secant modulus of elasticity	E_{cm}	33346	MPa
3.2.7(4)	Modulus of elasticity of reinforcement	E_s	200000	MPa

	Effective depth $h - c - \phi/2$	d	252	mm	
	Tension reinforcement $\pi \phi^2 / 4 \cdot b / s$	A_s	1340	mm ²	
	Reinforcement ratio	ρ	0.0053		
7.4.3(5)	Effective modulus $E_{cm} / (1 + \phi)$	$E_{c,eff}$	11115	MPa	
	Modular ratio (long-term)	$\alpha_{e,eff}$	17.99		
	Neutral axis depth, cracked elastic section	x	88.7	mm	
	Steel stress $M / (A_s (d - x/3))$	σ_s	184.5	MPa	
7.3.2(3)	Effective tension depth $\min(2.5(h-d); (h-x)/3; h/2)$	$h_{c,ef}$	70.4	mm	
(7.10)	Effective reinforcement ratio	$\rho_{p,eff}$	0.0190		
7.3.4(2)	Load duration factor	k_t	0.4		
7.3.4(2)	Modular ratio E_s / E_{cm}	α_e	6.00		
(7.9)	Mean strain difference	$\epsilon_{sm} - \epsilon_{cm}$	0.000568		
7.3.4(3)	Spacing limit for (7.11) $5(c + \phi/2)$		240	mm	
(7.11), (7.14)	Maximum crack spacing ($k_1 = 0.8, k_2 = 0.5$)	$s_{r,max}$	279	mm	
(7.8)	Crack width	w_k	0.159	mm	OK
7.3.2(2)	Size coefficient (1.0 at $h \leq 300$, 0.65 at $h \geq 800$)	k	1.000		
(7.1)	Minimum reinforcement $k_c k_{fct,eff} A_{ct} / f_{yk} (k_c = 0.4)$	$A_{s,min}$	363	mm ²	
7.2(5)	Steel stress, characteristic $M_k / (A_s (d - x/3))$	$\sigma_{s,k}$	251.6	MPa	Long-term x: conservative
7.2(5)	Steel stress limit $0.8 f_{yk}$	$\sigma_{s,k}$	400	MPa	OK

$f_{ct,eff}$ is taken as f_{ctm} (cracking expected after 28 days). For early-age cracking use a lower $f_{ct,eff}$ and see CIRIA C766.

Prepared with NA Engineering calculation tools · naengineering.uk · adrian@naengineering.uk. Free for use by competent engineers; see the About sheet for scope and disclaimer.

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