

Fire resistance

Tabulated data · EN 1992-1-2 §5 · beams, slabs, columns · UK NA / PN-EN

Reference	NAE-RC-014 · 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) · BS EN 1992-1-2:2004 / PN-EN 1992-1-2:2008, Section 5 (tabulated data)
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

Fire resistance of reinforced concrete members by the tabulated data of EN 1992-1-2: minimum width or thickness and axis distance of the bars for simply supported and continuous beams, one- and two-way slabs and flat slabs, and the fire resistance of columns by method A, expression (5.7).

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

Standard fire exposure, normal weight concrete with siliceous aggregate, reinforced (not prestressed) members, detailing to EN 1992-1-1. Beams: rectangular, exposed on three sides, bars in one bottom layer, axis distance $a = c + \phi_w + \phi/2$ to the bottom and the sides, linear interpolation between the columns of Tables 5.5 and 5.6 (5.2(12)), corner bars $a_{sd} = a + 10$ mm where b is not above column 4 (5.5) or 3 (5.6), linear interpolation to 5.2(12). Table 5.6 applies only where the redistribution at normal temperature is $\leq 15\%$ and, from R90, the top bars over the supports follow (5.11) (5.6.3); otherwise the beam is checked as simply supported. Flat slabs: with redistribution $> 15\%$ the one-way axis distance of Table 5.8 applies (5.7.4(1)); from REI 90, 20 % of the top bars must run continuously over the span in the column strips (5.7.4(2)), or the result fails. The bars must fit across the width. Table 5.5 follows EN 1992-1-2:2004 (as in Concise Eurocode 2 Table 4.6); the PN-EN 1992-1-2:2008 print shows 45 mm at R60, $b = 120$ / $a = 45$ at R90 and 70 mm at R240 / $b = 350$, taken as misprints. Slabs: thickness h_s and axis distance $a = c + \phi/2$ of the lower layer (Tables 5.8, 5.9); two-way values need support on all four edges. Columns: method A, expression (5.7) (5.3.2(4)) for braced structures, heated on more than one side, valid for $2 \leq l_0, fi \leq 6$ m (2 m used below 2 m), first-order eccentricity $e \leq 0.15 b$ (recommended e_{max} , kept by both annexes), $A_s \leq 0.04 A_c$, $25 \leq a \leq 80$ mm, $h \leq 1.5 b$, $200 \leq b' \leq 450$ mm, an even number of bars. National annexes: BS EN 1992-1-2 UK NA and PN-EN 1992-1-2:2008 NA as printed (later amendments not reviewed). Spalling (4.5), the web thickness of I-beams and walls are outside the scope.

Further reading and independent cross-check

- EN 1992-1-2, Section 5.
- The Concrete Centre, Concise Eurocode 2, Section 4.6.
- The Concrete Centre, How to design concrete structures using Eurocode 2: Fire resistance.

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Revision history

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

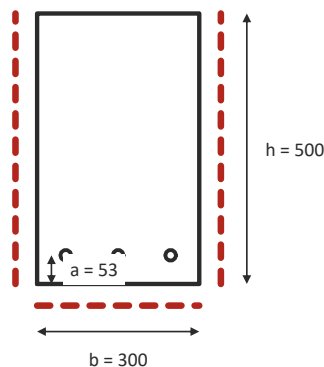
Job no.
Made by
Checked

Inputs · member
Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
3.2.2	Reinforcement characteristic yield strength (columns)	f_{yk}	500	MPa
	Member		Beam – simply supported	
	Required standard fire resistance (minutes)	R	90	min
	Width b (beams, columns: smaller side)	b	300	mm
	Depth h (beam depth, slab thickness, column larger side)	h	500	mm
4.4.1	Nominal cover to the links (slabs: to the bars)	c_{nom}	35	mm
	Link diameter (0 for slabs)	φ_w	8	mm
	Main bar diameter	φ	20	mm
	Number of main bars (beam bottom layer; column total, even,)	n	3	
8.2(2)	Maximum aggregate size	d_g	20	mm
5.6.3, 5.7.4	Continuous members: redistribution at normal temperature $\leq 15\%$		Yes	
5.6.3(3), 5.7.4(2)	Continuous members: top bars detailed for fire (5.11) / 20 % continuous		Yes	From R90 / REI 90

Inputs · columns only
Method A, 5.3.2

	Load level in fire $\mu_{fi} = N_{Ed,fi} / N_{Rd}$ (0.7 if not calculated)	μ_{fi}	0.70	
	Effective length in fire	$l_{0,fi}$	3.00	m
	First-order eccentricity in fire $M_{0Ed,fi} / N_{0Ed,fi}$	e	20	mm
	Inputs valid and consistent			OK

Your section, to scale · fire-exposed faces (red) · axis distance a

Results

Axis distance a provided / a required		1.06	OK
Width or thickness provided / minimum		2.00	OK
Column fire resistance R from (5.7) (minutes)	R	—	min
			n/a

Continuous beams fall back to Table 5.5 unless both continuity conditions are confirmed; flat slabs fail from REI 90 without the continuous top bars.

Calculation · axis distance

Fig. 5.2	Axis distance provided $c + \phi w + \phi/2$ (slabs: $c + \phi/2$)	a	53	mm	
Tables 5.5, 5.6	Beams: minimum width for the rating (column 2)	b_{min}	150	mm	
	Beams: table used		5.5 simply supported		
5.2(12)	Beams: axis distance for b, interpolated between the columns	a	40.0	mm	
5.6.1(8)	Beams: corner bars $a_{sd} = a + 10$ where $b \leq \text{column 4 (5.5)} / 3$	a_{sd}	50.0	mm	
Tables 5.8, 5.9	Slabs: minimum thickness h_s	$h_{s,min}$	—	mm	
Tables 5.8, 5.9	Slabs: minimum axis distance	a	—	mm	
	Required axis distance for this member	a_{req}	50.0	mm	
	Width or thickness provided / minimum		300 / 150	mm	
5.6, 5.7	Axis distance $a \geq a_{req}$ (bars fit; flat slabs: continuity)	a	53	mm	OK
5.6, 5.7	Width $b \geq b_{min}$ (slabs: $h_s \geq h_{s,min}$)		300	mm	OK

Calculation · columns, method A (5.3.2)

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
Table 3.1	Characteristic cylinder strength	f_{ck}	32	MPa	
Table 3.1	Mean tensile strength	f_{ctm}	3.02	MPa	
	Reinforcement $n \pi \phi^2 / 4$	A_s	942	mm ²	
	Mechanical reinforcement ratio $A_s f_{yd} / (A_c f_{cd})$	ω	0.151		
(5.7)	$R_{\eta fi} = 83 (1 - \mu_{fi} (1 + \omega) / (0.85/\alpha_{cc} + \omega))$	$R_{\eta fi}$	24.9		
(5.7)	$R_a = 1.6 (a - 30)$	R_a	36.8		
(5.7)	$R_l = 9.6 (5 - l_{0,fi}), l_{0,fi} \geq 2 \text{ m}$	R_l	19.2		
(5.7)	$b' = 2 A_c / (b + h); R_b = 0.09 b'$	R_b	33.8		
(5.7)	$R_n = 0$ for 4 bars, 12 for more	R_n	0		
(5.7)	$R = 120 ((R_{\eta fi} + R_a + R_l + R_b + R_n) / 120)^{1.8}$	R	111	min	
5.3.2(4)	Limits of (5.7): $25 \leq a \leq 80, l_{0,fi} \leq 6 \text{ m}, h \leq 1.5 b, 200 \leq b' \leq 450, e \leq 0.15 b, A_s \leq$		375	mm	OK
8.2(2)	Bars fit across b (clear gap $\geq \max(\phi; dg + 5; 20)$)	a	77	mm	OK

Columns: $\mu_{fi} = NEd_{fi} / NR_d$ may be taken as 0.7 where not calculated (5.3.2(3)). The value of e_{max} is the recommended 0.15 b; check the National Annex for another value. Beyond the method's limits use method B (Table 5.2b) or Annex C.

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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