

Creep and shrinkage

Creep coefficient and shrinkage strain · EN 1992-1-1 §3.1.4, Annex B · UK NA / PN-EN

Reference	NAE-RC-039 · 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

Creep coefficient $\phi(t, t_0)$ and the total shrinkage strain $\epsilon_{cs}(t)$ (drying and autogenous) of a concrete member at any age, from the cement class, the relative humidity, the notional size and the ages at loading and at the end of curing; the inputs of a deflection or restraint calculation (RC-033, RC-022).

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

Creep by Annex B.1: $\phi(t, t_0) = \phi_0 \beta_c(t, t_0)$ (B.1), $\phi_0 = \phi_{RH} \beta(f_{cm}) \beta(t_0)$ (B.2 – B.5), $\beta_c = [(t - t_0) / (\beta_H + t - t_0)]^{0.3}$ (B.7), β_H (B.8), $\alpha_1, \alpha_2, \alpha_3$ (B.8c), the cement class by adjusting t_0 (B.9, not less than 0.5 day); temperatures other than 20 °C (B.10) are not covered. Creep linear while the stress at loading $\sigma_c \leq 0.45 f_{ck}(t_0)$ (3.1.4(4)); above that the non-linear coefficient $\phi \exp(1.5 (\kappa \sigma - 0.45))$ (3.7) is used, $\kappa \sigma = \sigma_c / f_{ck}(t_0)$, $f_{ck}(t_0) = f_{cm}(t_0) - 8$ with $f_{cm}(t_0) = \beta_{cc}(t_0) f_{cm}$ (3.1.2(5), (3.1), (3.2)) for $t_0 < 28$ days. ϕ goes with the tangent modulus $E_c = 1.05 E_{cm}$ (Annex B). Shrinkage by 3.1.4(6): $\epsilon_{cs} = \epsilon_{cd} + \epsilon_{ca}$ (3.8), $\epsilon_{cd}(t) = \beta_{ds}(t, t_s) \kappa_h \epsilon_{cd,0}$ (3.9, 3.10, Table 3.3, linear between its values), $\epsilon_{cd,0}$ by (B.11, B.12), $\epsilon_{ca}(t) = \beta_{as}(t) \epsilon_{ca}(\infty)$ (3.11 – 3.13). Notional size $h_0 = 2 A_c / u$ (B.6): rectangle $b h / (b + h)$, slab drying on both faces h , on one face $2 h$. RH 40 – 100 %. Annex B is informative: the UK NA lets it be used, the PL NA keeps the recommended method (NA.9). The predicted creep has a coefficient of variation of about 20 % (B.1). Concrete classes up to C50/60. 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: Deflection calculations (creep and shrinkage).
 - The Concrete Centre, Concise Eurocode 2, 3 (materials).
 - CIRIA C766, Control of cracking caused by restrained deformation in concrete (shrinkage).
- 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 · concrete and member

Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
3.1.2(6)	Cement class		Class N (normal: CEM 32.5 R and 42.5 N)	
(B.6)	Section		Slab (both faces drying)	
	Rectangle: width b	b	300	mm
	Depth (slab: thickness)	h	250	mm
	Relative humidity of the surroundings (40 – 100)	RH	50	% Inside 50, outside 80

Inputs · ages

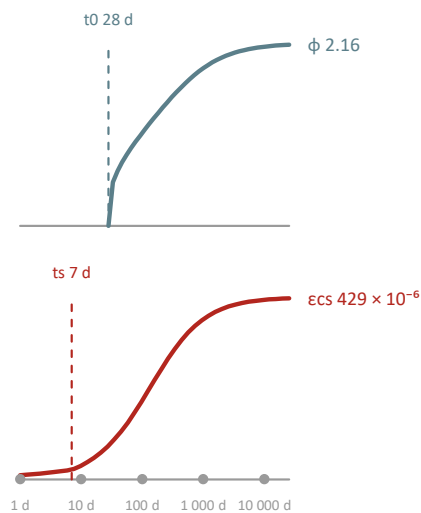
Days

	Age at loading	t_0	28.0	days
	Age at the end of curing (drying starts)	t_s	7.0	days
	Age considered (70 years = 25 550 days)	t	25550	days
3.1.4(4)	Compressive stress at loading (0 = not checked)	σ_c	0.0	MPa
	Inputs valid and consistent			OK

Results

Creep coefficient (B.1)	$\varphi(t, t_0)$	2.16	
Total shrinkage strain $\epsilon_{cd} + \epsilon_{ca}$ (3.8)	ϵ_{cs}	429	$\times 10^{-6}$
Drying / autogenous	$\epsilon_{cd} / \epsilon_{ca}$	374 / 55	$\times 10^{-6}$
Stress at loading $\sigma_c / f_{ck}(t_0)$ (3.1.4(4))	k_σ	0.00	not checked
Notional size $2 A_c / u$	h_0	250	mm
Effective modulus $E_{cm} / (1 + \phi)$ (7.20)	$E_{c,eff}$	10549	MPa

Development with time (log scale, days) · creep $\varphi(t, t_0)$ from loading at t_0 , shrinkage ϵ_{cs} from casting (drying from t_s)



Calculation · creep, Annex B.1

Table 3.1	Characteristic cylinder strength	f_{ck}	32	MPa
Table 3.1	Mean tensile strength	f_{ctm}	3.02	MPa
3.1.2	Mean strength $f_{ck} + 8$	f_{cm}	40	MPa
(B.8c)	$\alpha_1 = (35 / f_{cm})^{0.7}$	α_1	0.911	
(B.8c)	$\alpha_2 = (35 / f_{cm})^{0.2}$	α_2	0.974	
(B.8c)	$\alpha_3 = (35 / f_{cm})^{0.5}$	α_3	0.935	
(B.6)	Notional size $2 A_c / u$	h_0	250.0	mm
(B.3)	ϕ_{RH} ($f_{cm} > 35 \text{ MPa}$: with α_1, α_2)	ϕ_{RH}	1.677	
(B.4)	$\beta(f_{cm}) = 16.8 / \sqrt{f_{cm}}$	$\beta(f_{cm})$	2.656	
(B.9)	t_0 for the cement $t_0 (9 / (2 + t_0^{1.2}) + 1)^{\alpha} \geq 0.5$, $\alpha = -1, 0, 1$	$t_{0,adj}$	28.00	days
(B.5)	$\beta(t_0) = 1 / (0.1 + t_0^{0.20})$	$\beta(t_0)$	0.488	
(B.2)	Notional creep coefficient $\phi_{RH} \beta(f_{cm}) \beta(t_0)$	ϕ_0	2.176	
(B.8)	$\beta_H = 1.5 [1 + (0.012 RH)^{18}] h_0 + 250 \alpha_3 \leq 1500 \alpha_3$ ($\alpha_3 = 1$ if f_{cr})	β_H	609	
(B.7)	$\beta_c = [(t - t_0) / (\beta_H + t - t_0)]^{0.3}$	$\beta_{c(t, t_0)}$	0.993	
(B.1)	Linear creep coefficient $\phi_0 \beta_c$	ϕ_{lin}	2.161	
(3.2)	$\beta_{cc}(t_0) = \exp(s (1 - \sqrt{28 / t_0}))$, $s = 0.38, 0.25, 0.20$	$\beta_{cc(t_0)}$	1.000	
3.1.2(5)	$f_{ck}(t_0)$ ($f_{cm}(t_0) - 8$ before 28 days, f_{ck} after)	$f_{ck}(t_0)$	32.0	MPa
3.1.4(4)	$k_\sigma = \sigma_c / f_{ck}(t_0)$	k_σ	0.000	
(3.7)	Non-linear factor $\exp(1.5 (k_\sigma - 0.45))$ above 0.45		1.000	
(B.1), (3.7)	Creep coefficient	$\varphi(t, t_0)$	2.161	
Table 3.1	Mean modulus $22 (f_{cm} / 10)^{0.3}$	E_{cm}	33346	MPa
(7.20)	Effective modulus $E_{cm} / (1 + \phi)$	$E_{c,eff}$	10549	MPa

Calculation · shrinkage, 3.1.4(6) and Annex B.2

(B.12)	$\beta_{RH} = 1.55 [1 - (RH / 100)^3]$	β_{RH}	1.356
(B.11)	$\alpha_{ds1}, \alpha_{ds2}$ (S: 3, 0.13; N: 4, 0.12; R: 6, 0.11)	α_{ds1}	4
(B.11)		α_{ds2}	0.12
(B.11)	Basic drying shrinkage $0.85 (220 + 110 \alpha_{ds1}) \exp(-\alpha_{ds2} f_{cm} / 10^4)$	$\epsilon_{cd,0}$	0.000471
Table 3.3	k_h (1.0, 0.85, 0.75, 0.70 at $h_0 = 100, 200, 300, \geq 500$)	k_h	0.800
(3.10)	$\beta_{ds} = (t - t_s) / ((t - t_s) + 0.04 \sqrt{h_0^3})$	$\beta_{ds(t, t_s)}$	0.994
(3.9)	Drying shrinkage $\beta_{ds} k_h \epsilon_{cd,0}$	$\epsilon_{cd(t)}$	0.000374
(3.12)	$\epsilon_{ca}(\infty) = 2.5 (f_{ck} - 10) 10^{-6}$	$\epsilon_{ca}(\infty)$	0.000055
(3.13)	$\beta_{as} = 1 - \exp(-0.2 t^{0.5})$	$\beta_{as(t)}$	1.000
(3.11)	Autogenous shrinkage $\beta_{as} \epsilon_{ca}(\infty)$	$\epsilon_{ca(t)}$	0.000055
(3.8)	Total shrinkage strain $\epsilon_{cd} + \epsilon_{ca}$	$\epsilon_{cs(t)}$	0.000429

The strains are positive numbers (shortening). For a deflection calculation (RC-033) enter φ and ϵ_{cs} at the age considered; for early-age cracking (RC-022) the autogenous part at the age of interest.

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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