

Interface shear

Shear at the interface between concrete cast at different times · EN 1992-1-1 §6.2.5 · UK NA / PN-EN

Reference	NAE-RC-027 · 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

Check of the longitudinal shear at the joint between concrete cast at different times: a precast unit or slab with a structural topping, a beam cast in two lifts, or a construction joint. The design shear stress at the interface is compared with its resistance from adhesion, friction under the normal stress and the reinforcement crossing the joint, and the steel needed is given.

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

EN 1992-1-1 6.2.5 at one section. $v_{Edi} = \beta v_{Ed} / (z b_i)$ (6.24), with β the ratio of the longitudinal force in the new concrete to the total force in the compression or tension zone (1.0 is always safe), z the lever arm of the composite section, entered (0.9 d is the usual value for a reinforced section without axial force or prestress, 6.2.3(1); with either, z from a section analysis) and b_i the width of the joint. $v_{Rdi} = c f_{ctd} + \mu \sigma_n + \rho f_{yd}$ ($\mu \sin \alpha + \cos \alpha \leq 0.5 v_{fcd}$ (6.25), with c and μ for the surface from 6.2.5(2) (very smooth taken at the lowest c , 0.025), c halved for fatigue or dynamic loads (6.2.5(5)) and $c f_{ctd} = 0$ when on is tension; σ_n is the smallest normal stress across the joint from the other actions at the same time (compression positive, below 0.6 f_{cd}); $\rho = A_s / A_i$ from the legs crossing the joint; $45^\circ \leq \alpha \leq 90^\circ$, the steel inclined so that it is in tension under the shear. f_{ck} , f_{ctd} and v from the weaker of the two concretes. The steel must be anchored on both sides of the joint; a stepped distribution along the member (6.2.5(3), Figure 6.10) is left to the designer, who checks each zone at its own v_{Ed} . Surfaces, in brief: very smooth, cast against steel, plastic or specially prepared timber moulds; smooth, slipformed or extruded, or a free surface left untreated after vibration; rough, at least 3 mm roughness at about 40 mm spacing (raked, aggregate exposed or similar); indented, keys to Figure 6.9. Grouted joints between slab or wall elements (6.2.5(4)), the composite flexural design and the ordinary shear checks of the member (6.2.2, 6.2.3) are not covered here. f_{yk} 400 – 500 MPa.

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: Beams and Slabs (interface shear in composite construction).
- The Concrete Centre, Concise Eurocode 2, 7.2.6 (shear at the interface).
- The Concrete Centre, RC Spreadsheets v4 (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.

Website	naengineering.uk
Email	adrian@naengineering.uk
Phone	+48 505 844 422
LinkedIn	linkedin.com/company/naengineering

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
------	---------------------------

Project
Element
Date

Job no.
Made by
Checked

Inputs · joint and steel
Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C32/40	
3.2.2	Steel crossing the joint: characteristic yield strength (≤ 500 MPa)	f_{yk}	500	MPa
6.2.5(2)	Surface of the joint		Rough	
6.2.5(5)	Fatigue or dynamic loading (c halved)		No	
	Overall depth of the composite member	h	600	mm
	Depth of the second pour, from the top to the joint	h_t	150	mm
6.2.5(1)	Effective depth of the composite section	d	550	mm
6.2.5(1)	Lever arm of the composite section, verified	z	495	mm $\approx 0.9 d$: RC, no N or P
6.2.5(1)	Width of the joint	b_i	300	mm
	Steel across the joint: legs in each row (0 – 8)	n	2	
	Diameter	φ	10	mm
	Spacing of the rows along the member	s	200	mm
Figure 6.9	Angle of the steel to the joint ($45^\circ - 90^\circ$)	α	90	°

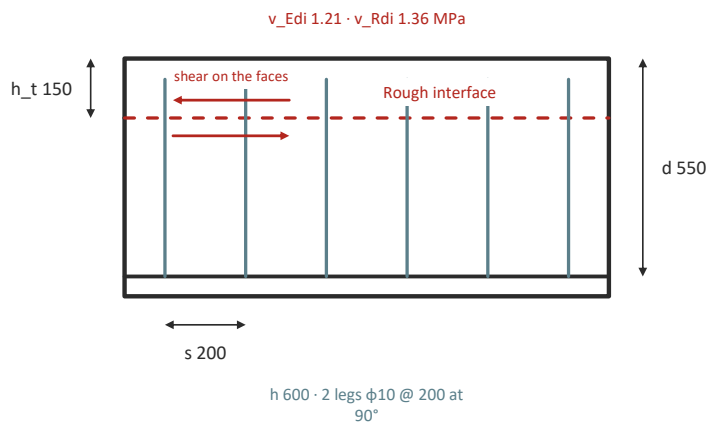
Inputs · design actions
Ultimate limit state, at the same section

	Shear force	V_{Ed}	180.0	kN
6.2.5(1)	Ratio of the force in the new concrete to the total (≤ 1)	β	1.00	
6.2.5(1)	Smallest normal stress across the joint (compression +, tension)	σ_n	0.00	MPa
Inputs valid and consistent				OK

Results

Interface v_{Edi} / v_{Rdi} (6.23)		0.89		OK
Upper limit $v_{Edi} / 0.5 v_{fcd}$ (6.25)		0.22		OK
Steel across the joint needed	$A_{s/s}$	638	mm ² /m	Yes
Steel provided	$A_{s/s}$	785	mm ² /m	
Design shear stress at the joint	v_{Edi}	1.21	MPa	
Resistance of the joint	v_{Rdi}	1.36	MPa	

Your joint, to scale · elevation of a length of the member: precast or first pour below, topping or second pour above, the interface (dashed) and the steel crossing it



Calculation · materials and surface

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
3.1.6(1)	Coefficient on compressive strength (shear)	α_{cc}	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
Table 3.1	Characteristic tensile strength (5 % fractile)	$f_{ctk,0.05}$	2.12	MPa
3.1.6(2)	Design tensile strength $\alpha_{ct} f_{ctk,0.05} / \gamma_c$	f_{ctd}	1.41	MPa
3.1.6(1)	Design compressive strength $\alpha_{cc} f_{ck} / \gamma_c$	f_{cd}	21.33	MPa
3.2.7	Design yield strength	f_{yd}	434.8	MPa
(6.6N)	Strength reduction factor $\nu = 0.6 (1 - f_{ck}/250)$	ν	0.523	
6.2.5(2)	Adhesion factor for the surface	c	0.400	
6.2.5(2)	Friction factor for the surface	μ	0.70	
6.2.5(1), (5)	c used: halved for fatigue or dynamic loads, 0 under tension	c	0.400	

Calculation · interface

6.2.5(1)	Lever arm of the composite section, entered	z	495	mm
(6.24)	Design shear stress $\beta v_{Ed} / (z b_i)$	v_{Edi}	1.212	MPa
(6.25)	Without steel $c f_{ctd} + \mu \sigma_n$	v_c	0.564	MPa
6.2.5(1)	Steel ratio $\rho = n \pi \phi^2 / 4 / (b_i s)$	ρ	0.00262	
(6.25)	Steel term $\rho f_{yd} (\mu \sin \alpha + \cos \alpha)$	v_s	0.797	MPa
(6.25)	Upper limit $0.5 v_{fcd}$	$v_{Rdi,max}$	5.581	MPa
(6.25)	Resistance $\min(v_c + v_s; 0.5 v_{fcd})$	v_{Rdi}	1.361	MPa
(6.23)	$v_{Edi} \leq v_{Rdi}$		1.212	MPa

OK

(6.25)	Steel needed $\max(0; v_{Edi} - v_c) b_i / (f_{yd} (\mu \sin \alpha + \cos \alpha))$	$A_{s/s}$	638	mm ² /m
	Steel provided $n \pi \phi^2 / 4 \cdot 1000 / s$	$A_{s/s}$	785	mm ² /m

The steel needed holds only while $v_{Edi} \leq 0.5 v_{fcd}$; above that limit no amount of steel helps and the joint (or the section) must change. Anchor the steel on both sides of the joint (8.4); links of the vertical shear design that cross the joint may be counted. The drawing is an elevation of the member over a few spacings, the steel drawn leaning to show α only.

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 $v_{Rd,c}$. 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