

Strip footing

Reinforced concrete strip footing under a wall · EN 1992-1-1 §6.2, §9.3, §9.8 · UK NA / PN-EN

Reference	NAE-RC-030 · 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) · EN 1990 load combination by the user
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

Reinforced strip footing under a long concrete or masonry wall, per metre run: gross bearing pressure against an allowable value, transverse bending and one-way shear of the projections, the bottom transverse bars and the longitudinal distribution bars, with the wall anywhere on the footing and a moment across the footing.

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

Long footing of uniform section under a uniform wall load (plane strain, per metre run). Rigid footing, linear soil pressure, no tension at the base (partial contact when $e > B/6$); eccentricities above $B/3$ need special precautions (EN 1997-1 6.5.4) and are not covered: the sheet reports FAIL. Bearing is checked with characteristic loads against an allowable gross pressure from the geotechnical engineer; EN 1997-1 bearing resistance, sliding and settlement are not covered. Structural checks take the design contact pressure from the wall loads, footing and backfill (γG on the weights), less the downward load of footing and backfill. Bending at the face of a concrete wall, and a quarter of the wall thickness inside the face of a masonry wall (halfway between the centre and the face of the wall, the critical section of ACI 318-11 15.4.2(b) / ACI 318-19 13.2.7.1, EN 1992-1-1 giving none; one-way shear then at d from that section, as ACI 318-19 13.2.7.2 measures it). A masonry wall is taken to deliver its load without moment (the moment inputs must be zero; the wall may be off centre); its load spreads over the wall thickness in bearing on the footing. Under the wall only the contact pressure counts, the footing weight there being ignored for the sagging moment (conservative); the hogging search uses the same load model on both projections and under the wall. A hogging moment is reported as top tension, top bars are not designed. One-way shear at d from the bending section without the $av/2d$ reduction (conservative), and the unreduced shear at the face against $0.5 v_{fcd} b d$ (6.2.1(8), v from (6.6N)), no shear reinforcement. Longitudinal bars: at least 20 % of the transverse steel (9.3.1.1(2)); footings over soft spots, changes of ground or with point loads on the wall need a longitudinal design, not covered. Bar spacing to 8.2 and 9.3.1.1(3) for the region of maximum moment (one spacing throughout): transverse $\leq \min(2h; 250)$, longitudinal $\leq \min(3h; 400)$; the cover c applies to the top of the cage as well. Cover for durability, crack control, uplift and the choice of the governing combination (one combination per run, favourable permanent actions with their own factor) are for the designer. 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: Foundations.
- IStructE, Manual for the design of concrete building structures to Eurocode 2 (foundations).
- The Concrete Centre, RC Spreadsheets v4 (licensed product) can be used as an independent cross-check.

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About NA Engineering

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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 · geometry

Shaded cells only

	National Annex		UK NA (BS EN)	
Table 3.1	Concrete strength class		C30/37	
3.2.2	Reinforcement characteristic yield strength (≤ 500 MPa)	f_{yk}	500	MPa
	Footing width	B	1200	mm
	Footing depth	h	400	mm
	Wall		Concrete	masonry: section $t/4$ inside
	Wall thickness	t	250	mm
	Wall offset from the footing centre (+ / -)	o	0	mm 0 = central wall
4.4.1.3(4)	Nominal cover to the bottom bars (≥ 40 on blinding)	c_{nom}	50	mm 75 if cast on soil
8.2(2)	Maximum aggregate size	d_g	20	mm
	Transverse bottom bars (lower layer), diameter	ϕ_t	12	mm
	Transverse bars, centres	s_t	200	mm
	Longitudinal bars (upper layer), diameter	ϕ_l	10	mm
	Longitudinal bars, centres	s_l	200	mm

Inputs · loads and ground

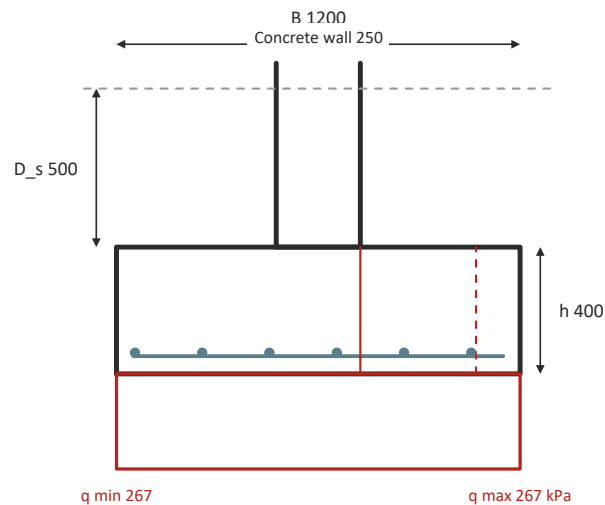
Wall loads per metre run, at the top of the footing

	Wall load, permanent	G_k	150.0	kN/m
	Wall load, variable	Q_k	60.0	kN/m
	Moment across the footing, permanent (+ = pressure up at +x)	$M_{G,k}$	0.0	kNm/m
	Moment across the footing, variable	$M_{Q,k}$	0.0	kNm/m
EN 1990 A1.2(B)	Partial factor, permanent	γ_G	1.35	
EN 1990 A1.2(B)	Partial factor, variable	γ_Q	1.50	
	Depth of backfill over the footing	D_s	500	mm
	Unit weight of backfill	γ_{soil}	18.0	kN/m ³
	Allowable gross bearing pressure	q_{allow}	200	kPa From the ground investigation
	Inputs valid and consistent			OK

Results

Bearing pressure, characteristic q / q_{allow}	q_{max}	0.96		OK
Eccentricity, characteristic e / B	e	0.000		OK
Bending, transverse bars $A_{s,req} / A_{s,prov}$		0.92		OK
Top face: hogging moment	M_{top}	0.0	kNm/m	OK
Shear $\max(V_{Ed} / V_{Rd,c} \text{ at } d; V_{face} / 0.5 v_{fcd} b d)$		0.20		OK
Longitudinal bars need / provided		0.29		OK
Bar spacing (largest of the four ratios)		0.80		OK

Your strip footing, to scale · cross-section with the wall, the bars, the sections for bending (solid) and shear at d (dashed), and the ULS contact pressure below (ordinates not to scale)



Calculation · bearing (characteristic, per metre)

Self weight of footing $25 \text{ kN/m}^3 \cdot B \cdot h$	W_f	12.00	kN/m	
Backfill over the footing $\gamma_{soil} (B - t) D_s$	W_s	8.55	kN/m	
Moment of the backfill (none over the wall) $-\gamma_{soil} t D_s o$	M_{ws}	0.000	kNm/m	
Total vertical load at the base $G_k + Q_k + W_f + W_s$	N_k	230.6	kN/m	
Moment about the base centre $M_{G,k} + M_{Q,k} + (G_k + Q_k) o + M$	M_k	0.00	kNm/m	
Eccentricity $ M_k / N_k$	e_k	0	mm	
Maximum pressure $(e \leq B/6: N/B (1 + 6e/B); \text{ else } 2N / (3(B/2 - e)))$	q_{max}	192.1	kPa	
Maximum pressure against the allowable	q_{allow}	200	kPa	OK

Calculation · ULS contact pressure

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
3.1.6(1)	Coefficient on compressive strength (shear)	α_{cc}	1.00	NDP sheet
6.2.2(1), 6.4.4(1)	Coefficient $0.18 / \gamma_c$	$C_{Rd,c}$	0.120	NDP sheet
5.5(4)	Coefficient for x/d limit	k_1	0.40	NDP sheet
5.5(4)	Coefficient for x/d limit	k_2	1.00	NDP sheet
Table 3.1	Characteristic cylinder strength	f_{ck}	30	MPa
Table 3.1	Mean tensile strength	f_{ctm}	2.90	MPa
EN 1990 (6.10)	Design wall load $\gamma_G G_k + \gamma_Q Q_k$	N_{Ed}	292.5	kN/m
EN 1990 (6.10)	Design moment $\gamma_G M_{G,k} + \gamma_Q M_{Q,k}$	M_{Ed}	0.00	kNm/m
	Downward load of footing and backfill $\gamma_G (25 h + \gamma_{soil} D_s)$	w_d	25.65	kPa

	Total design load at the base $N_{Ed} + \gamma G (W_f + W_s)$	N_t	320.2	kN/m	
	Moment about the base centre $M_{Ed} + N_{Ed} o + \gamma G M_{ws}$	M_t	0.00	kNm/m	
	Eccentricity $ M_t / N_t$	e_d	0	mm	
EN 1997-1 6.5.4	Design eccentricity $e \leq B/3$ (beyond: special precautions, not covered)	$B/3$	400	mm	OK
Below, x is measured from the base centre in metres towards the more heavily loaded edge; a wall offset against the moment is mirrored accordingly. Footing and backfill (factored by γG) are included in the contact pressure and subtracted again as the downward load w on the projections.					
	Wall centre o, towards the heavier edge	x_w	0.000	m	
	Width in contact (B, or $3(B/2 - e)$)	B_c	1.200	m	N/A: $e > B/3$, not covered
	Maximum design pressure (gross)	$q_{Ed,max}$	266.9	kPa	
	Pressure gradient	q_b	0.0	kPa/m	
	Pressure at the base centre (linear)	q_o	266.9	kPa	
	Start of contact $x_0 = B/2 - B_c$	x_0	-0.600	m	
	Minimum design pressure (gross)	$q_{Ed,min}$	266.9	kPa	

Calculation · bending of the projections

	Effective depth, transverse bars $h - c - \phi_t/2$	d	344	mm	
	Wall faces, heavier and lighter side	$x_{f,R}$	0.125	m	
		$x_{f,L}$	-0.125	m	
	Section inside the wall face (masonry $t/4$, concrete 0)	a_w	0	mm	
	Bending section, heavier side	x_R	0.125	m	
	Bending section, lighter side	x_L	-0.125	m	
	Moment, heavier side $\int q (x - x_R) dx - w$ over the projection bearing	M_R	27.21	kNm/m	
	Moment, lighter side $\int q (x_L - x) dx - w$ beyond the face	M_L	27.21	kNm/m	
	Design moment, bottom bars	$M_{Ed,t}$	27.21	kNm/m	
	Zero shear beyond the light wall face (hogging extremum)	x_s	-0.600	m	
	Moment there (negative = top tension)	M_s	0.00	kNm/m	
	Zero shear under the wall, between its face and the section	$x_{s,w}$	-0.554	m	
	Moment there	$M_{s,w}$	0.00	kNm/m	
	Heavier side: zero shear under the wall $L/2 - u$, $pR u - qb u^2/2$	$x_{h,w}$	0.554	m	
	Moment there	$M_{h,w}$	0.00	kNm/m	
9.8.2.1(3)	Largest hogging moment (top tension, negative)	M_{top}	0.00	kNm/m	
3.2.7	Design yield strength	f_{yd}	434.8	MPa	
3.2.7	Neutral axis depth at first yield	ξ_y	0.617		
5.5(4)	Limiting neutral axis depth, no redistribution $\min((1 - k_1)/k_2; \xi_1)$	$x_{u/d}$	0.600		
3.1.7(3)	Limiting K (α_{cc}/γ_c) $0.8 \xi (1 - 0.4 \xi)$	K'	0.207		
	K $M_{Ed,t} / (b d^2 f_{ck})$, $b = 1000$	K	0.008		
	Lever arm $\leq 0.95 d$	z	327	mm	N/A: $K > K'$
	Required $M_{Ed,t} / (f_{yd} z)$	$A_{s,req}$	192	mm ² /m	
(9.1N)	Minimum $\max(0.26 f_{ctm}/f_{yk}; 0.0013) b d$	$A_{s,min}$	518	mm ² /m	
	Provided $\pi \phi_t^2/4 \cdot 1000 / s_t$	$A_{s,prov}$	565	mm ² /m	
3.1.7, 9.2.1.1	Transverse bars: $K \leq K'$, provided $\geq \max(\text{required}; \text{minimum})$		565	mm ² /m	OK

Calculation · one-way shear and the longitudinal bars

	Shear at d from the bending section, heavier side	V_R	31.6	kN/m	
	Shear at d from the bending section, lighter side	V_L	31.6	kN/m	
	Design shear	V_{Ed}	31.6	kN/m	
6.2.2(1)	Reinforcement ratio $A_{s,prov} / (b d) \leq 0.02$	ρ_l	0.0016		
(6.2)	Resistance $\max(CR_{d,c} k (100 \rho f_{ck})^{1/3}; v_{min}) b d$	$V_{Rd,c}$	154.3	kN/m	
6.2.1(8)	Unreduced shear at the wall faces $\max(V_{f,R} ; V_{f,L})$	V_{face}	114.6	kN/m	
6.2.1(8), (6.6N)	Its limit $0.5 b d v f_{cd}$, $v = 0.6 (1 - f_{ck}/250)$	V_{max}	1816.3	kN/m	
(6.2), 6.2.1(8)	$V_{Ed} \leq V_{Rd,c}$ at d; $V_{face} \leq 0.5 b d v f_{cd}$		31.6	kN/m	OK
9.3.1.1(2)	Longitudinal bars needed $0.2 A_{s,prov} \cdot B / 1000$	$A_{s,l}$	136	mm ²	
	Provided across the width $\pi \phi_l^2/4 \cdot n$, $n = (B - 2c - \phi_l)/s_l + 1$	$A_{s,l,prov}$	471	mm ²	
9.3.1.1(2)	Longitudinal: provided $\geq$ needed		471	mm ²	OK
8.2(2)	Minimum clear gap between bars $\max(\phi; dg + 5; 20)$	a_{min}	25	mm	
9.3.1.1(3)	Largest spacing, transverse (maximum moment) $\min(2h; 250)$	$s_{max,t}$	250	mm	

9.3.1.1(3)	Largest spacing, longitudinal (maximum moment) $\min(3h; 400)$	$s_{max,l}$	400	mm	
8.2, 9.3.1.1(3)	Clear gaps $\geq a_{min}$, spacings $\leq s_{max}$		200	mm	OK

Anchor the transverse bars beyond the bending section to 9.8.2.2 (a bend or hook at the ends of short projections) and provide starter bars for a concrete wall. The longitudinal bars are a minimum for robustness; design them as a beam where the ground or the wall load varies along the footing.

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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