Combined footing

Rectangular footing under two columns · EN 1992-1-1 §6.1, §6.2, §6.4.4, §9.3 · UK NA / PN-EN

Reference	NAE-RC-028 · 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
Issued	29 October 2026

What it does

Rectangular reinforced concrete footing carrying two columns on its long axis: characteristic bearing pressure (uniform or trapezoidal) against an allowable value, the net design pressure and the shear and bending moment along the footing, bottom and top longitudinal bars, transverse bars under each column, beam shear at d from the column faces, punching at both columns and bar spacing. The footing can be centred on the resultant of the column loads.

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

Rigid footing on uniform ground: the soil pressure varies linearly along L and is uniform across B. Two columns on the long axis carrying axial loads only (no column moments, no horizontal forces). Full contact is required: if the resultant of the characteristic loads (columns, footing and backfill) lies more than L/6 from the centre, the base loses contact; this is outside the scope: the sheet reports FAIL and shows no Results (the calculation below them is then for diagnosis only). The same L/6 limit on the design column loads alone, whose net pressure is used for the members, is a conservative scope limit (the uniform weight of footing and backfill keeps the gross pressure positive a little further). Geotechnical design to EN 1997-1 is not covered: the bearing check compares the characteristic gross pressure with an allowable pressure from the geotechnical engineer; bearing resistance, settlement and sliding are not checked. ULS: the footing and the backfill (taken over the whole plan area) are uniform loads carried by an equal uniform part of the pressure, so they cause no bending or shear; the footing is designed as a beam along L for the net pressure of the factored column loads (EN 1990 (6.10) with your γG and γQ), the column loads acting at the column centres. Bottom bars are designed for the largest sagging moment at a column face, top bars for the largest hogging moment between the inner faces (at zero shear), both over the whole width B, rectangular stress block without redistribution (5.5(4)), z ≤ 0.95 d, no compression steel (K ≤ K'), As,min to 9.2.1.1 on both faces. Beam shear (6.2.2) at d from each column face over the width B, without the av/2d reduction for loads near a support (conservative); outside the columns with the bottom bars, between them with the smaller of the top and bottom resistances, since either face may be in tension there and |V| falls from the faces towards the point of zero shear; the strut limit 0.5 B d ν fcd is checked at the faces (6.2.2(6)). Transverse bending: each column load is spread uniformly across B and carried by a strip of width cx + d each side (less where the end of the footing or half the clear gap is closer), moment at the column face (a conventional simplification, not derived from a plate analysis); the same bars, which run along the whole footing, are also checked for the bending per metre at the highest net pressure. One-way shear across B is checked per metre of length at the highest net pressure, and near the columns the punching perimeters carry the actual column loads. Punching (6.4.4(2)): stress at the column face against vRd,max, and closed control perimeters at a = 0.1d to 2d that stay inside the footing and short of half the clear gap to the other column, less the net pressure inside (6.48), vRd = vRd,c 2d/a (6.50); the largest ratio over a ≤ min(2d; a_max) is found exactly (stationary point), not on a grid. The shear is multiplied by a factor β that you choose; the sheet does not derive it: 1.0 corresponds to (6.51) with no moment in the column, 6.4.3(6) gives 1.15 for internal columns of braced structures with similar spans, and a column near the end of the footing, with unequal shears on its two sides, or a perimeter running to an edge may call for a higher value such as the 1.4 of an edge column (6.4.3(6)); one β applies to every perimeter. Perimeters running to the near end, to a long side and to that corner (6.4.2(4), Figure 6.15) are also searched up to 2d, each with the net reaction inside it, and the largest ratio of all governs. At the face u0 is the column perimeter, or the edge or corner value of 6.4.5(3) when the face is within d of the end or a side. Perimeters reaching half way to the other column or to both sides are not checked and the sheet warns. No shear or punching reinforcement. Bar spacing: clear gap to 8.2(2), largest spacing to 9.3.1.1(3) for areas of maximum moment and concentrated loads, applied to all three layers (recommended value 2h ≤ 250 mm). Anchorage at the ends (9.8.2.2), crack widths, starter bars and the concrete grade for durability are not covered. Concrete classes up to C50/60, fyk 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: Foundations.
- The Institution of Structural Engineers, Manual for the design of concrete building structures to Eurocode 2 (foundations).

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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Revision history

v1.0	29 Oct 2026 · First issue

Project		Job no.	
Element		Made by	
Date		Checked	

Inputs · footing and bars

Shaded cells only

	National Annex		**UK NA (BS EN)**		
Table 3.1	Concrete strength class		**C30/37**		
3.2.2	Reinforcement characteristic yield strength (400 – 500 MPa)	f_{yk}	**500**	MPa	
	Footing length (x, along the column line)	L	**7200**	mm	
	Footing width (y)	B	**3200**	mm	
	Footing depth	h	**750**	mm	
4.4.1.3(4)	Nominal cover to the bottom bars (≥ 40 on blinding)	c_{nom}	**50**	mm	75 if cast on soil
4.4.1	Nominal cover to the top bars	c_{top}	**50**	mm	
8.2(2)	Maximum aggregate size	d_g	**20**	mm	
	Bottom bars along L (lower layer), diameter	φ_{bl}	**16**	mm	
	Bottom bars along L, centres	s_{bl}	**150**	mm	
	Bottom bars across B (upper layer), diameter	φ_{bt}	**16**	mm	
	Bottom bars across B, centres	s_{bt}	**125**	mm	
	Top bars along L, diameter	φ_{tl}	**16**	mm	
	Top bars along L, centres	s_{tl}	**175**	mm	

Inputs · columns and loads

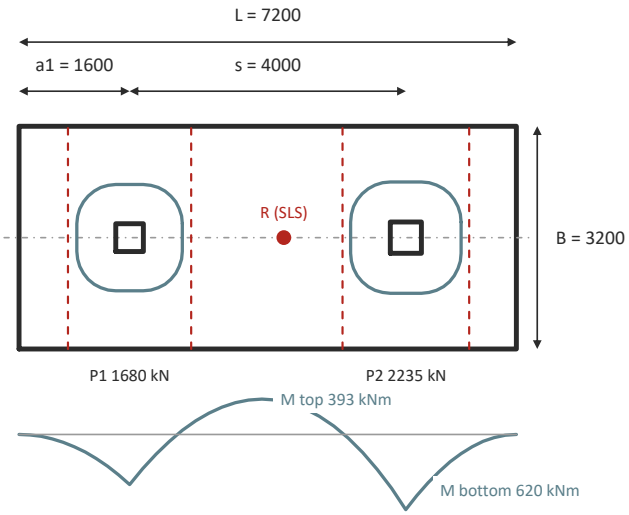
Characteristic loads at the top of the footing

	Centre the footing on the resultant of the column loads		**No**		Yes: a1 is calculated
	Left end to the centre of column 1 (if not centred)	a_1	**1600**	mm	
	Column 1 to column 2, centre to centre	s	**4000**	mm	
	Column 1: dimension along L	c_{x1}	**400**	mm	
	Column 1: dimension across	c_{y1}	**400**	mm	
	Column 1: load, permanent	G_{k1}	**800**	kN	
	Column 1: load, variable	Q_{k1}	**400**	kN	
	Column 2: dimension along L	c_{x2}	**450**	mm	
	Column 2: dimension across	c_{y2}	**450**	mm	
	Column 2: load, permanent	G_{k2}	**1100**	kN	
	Column 2: load, variable	Q_{k2}	**500**	kN	
EN 1990 A1.2(B)	Partial factor, permanent	γ_G	**1.35**		
EN 1990 A1.2(B)	Partial factor, variable	γ_Q	**1.50**		
6.4.3(6)	Punching: factor β on the shear (≥ 1.0)	β	**1.15**		Your choice; see the About sheet
	Depth of backfill over the footing	D_s	**500**	mm	
	Unit weight of backfill	γ_{soil}	**18.0**	kN/m³	
	Allowable gross bearing pressure	q_{allow}	**200**	kPa	From the ground investigation
	Inputs valid and consistent				**OK**

Results

Scope: e / (L/6), SLS gross and ULS net	**0.24**	OK
Bearing, characteristic q_max / q_allow	**0.89**	OK
Bottom bars along L (sagging at the faces)	**0.78**	OK
Top bars along L (hogging between the columns)	**0.91**	OK
Bars across B: strips, per metre, shear across B	**0.82**	OK
Beam shear (at d: VRd,c; at the faces: VRd,max)	**0.81**	OK
Punching at column 1 vEd / vRd (face, perimeters)	**0.51**	OK
Punching at column 2 vEd / vRd (face, perimeters)	**0.64**	OK
Detailing (largest spacing, clear gap)	**0.70**	OK

Your footing in plan, to scale · punching perimeters at the governing a (blue) · shear sections at d (dashed) · ULS bending moment below, on the tension side



SLS pressure 120 / 178 kPa

Calculation · layout and bearing (characteristic)

Column loads N1,k = Gk1 + Qk1	$N_{1,k}$	1200.0	kN	
N2,k = Gk2 + Qk2	$N_{2,k}$	1600.0	kN	
Column 1 centre a1, or if centred L/2 − N2,k s / (N1,k + N2,k)	x_1	1600	mm	
Column 2 centre x1 + s	x_2	5600	mm	
Clear gap between the columns s − (cx1 + cx2)/2	g	3575	mm	
Self weight of the footing 25 kN/m³ · L B h	W_f	432.0	kN	
Backfill over the whole plan area γsoil L B Ds	W_s	207.4	kN	
Total vertical load at the base N1,k + N2,k + Wf + Ws	N_k	3439.4	kN	
Eccentricity Σ Ni,k (xi − L/2) / Nk (+ towards the right end)	e_k	233	mm	
Its size	$\|e_k\|$	233	mm	
Full contact |e_k| ≤ L/6 (beyond: outside the scope)	$L/6$	1200	mm	OK
Pressure at the left end Nk/(B L) (1 − 6 ek/L)	$q_{k,left}$	120.3	kPa	
Pressure at the right end Nk/(B L) (1 + 6 ek/L)	$q_{k,right}$	178.2	kPa	
Largest pressure	$q_{k,max}$	**178.2**	kPa	
Largest pressure against the allowable (full contact)	q_{allow}	200	kPa	OK

Calculation · ULS net pressure and actions along L

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 / γc	$C_{Rd,c}$	0.120		NDP sheet
6.4.5(3)	Factor on v fcd for vRd,max		0.50		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 column loads P1 = γG Gk1 + γQ Qk1	P_1	1680.0	kN	
EN 1990 (6.10)	P2 = γG Gk2 + γQ Qk2	P_2	2235.0	kN	
	Total P = P1 + P2	P	3915.0	kN	
	Eccentricity of P Σ Pi (xi − L/2) / P	e_d	284	mm	
	ULS net-pressure model applies |e_d| ≤ L/6	$L/6$	1200	mm	**OK**

Footing and backfill weigh the same everywhere and are carried by an equal uniform part of the soil pressure: they cause no bending or shear. Below, the footing is a beam along L loaded by the column loads and the net upward line load w(x) = wa + wb x, x in metres from the left end; M > 0 is tension in the bottom.

	Net line load at the left end (P/L)(1 − 6 ed/L)	w_a	415.3	kN/m
	Its gradient 12 P ed / L³	w_b	35.69	kN/m²
	Net pressure at the left end wa / B	$q_{d,left}$	129.8	kPa
	Net pressure at the right end (wa + wb L) / B	$q_{d,right}$	210.1	kPa
	Check: upward force (qd,left + qd,right)/2 · B L = P	ΣR	3915.0	kN
	Moment at the outer face of column 1	M	423.3	kNm
	Moment at the inner face of column 1	M	371.4	kNm
	Moment at the inner face of column 2	M	580.4	kNm
	Moment at the outer face of column 2	M	620.0	kNm
	Largest sagging moment at a face (bottom bars)	$M_{Ed,bot}$	**620.0**	kNm
	Zero shear between the inner faces wa x + wb x²/2 = P1	x_0	3.515	m
	Largest hogging moment between the inner faces (top bars)	$M_{Ed,top}$	**-393.5**	kNm
	Effective depth, bottom bars along L h − c − ϕbl/2	d_{bl}	692	mm
	Effective depth, bottom bars across h − c − ϕbl − ϕbt/2	d_{bt}	676	mm
	Effective depth, top bars h − c_top − ϕtl/2	d_{tl}	692	mm

x (m)	Section	V (kN)	M (kNm)
0.000	Left end	0.0	0.0
1.400	Column 1, outer face	616.4	423.3
0.708	Shear section at d outside column 1	303.0	106.2
1.600	Column 1 centre, just left	710.1	555.9
1.600	Column 1 centre, just right	-969.9	555.9
1.800	Column 1, inner face	-874.7	371.4
2.492	Shear section at d inside column 1	-534.3	-117.1
3.515	Largest hogging (zero shear or a face)	0.0	-393.5
4.683	Shear section at d inside column 2	656.1	-15.0
5.375	Column 2, inner face	1067.6	580.4
5.600	Column 2 centre, just left	1205.1	836.1
5.600	Column 2 centre, just right	-1029.9	836.1
5.825	Column 2, outer face	-890.6	620.0
6.517	Shear section at d outside column 2	-450.8	154.9
7.200	Right end	0.0	0.0

Shear just right of a section unless marked left. Inside the column outline the diagram treats each column load as a point load at its centre; the design moments are taken at the faces. The right end shows the closure: V = 0 and M = 0.

Calculation · bending (rectangular block, no redistribution)

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 min((1 − k1)/k2; ξy)	$x_{u/d}$	0.600	
3.1.7(3)	Limiting K (αcc/γc) 0.8 ξ (1 − 0.4 ξ)	K'	0.207	
(9.1N)	Minimum ratio max(0.26 fctm/fyk; 0.0013)	ρ_{min}	0.00151	

	Strip under column 1 cx1 + min(d; to end) + min(d; g/2)	b_{e1}	1752	mm	
	Strip under column 2 cx2 + min(d; g/2) + min(d; to end)	b_{e2}	1802	mm	
	Transverse moment, column 1 (P1/B)((B − cy1)/2)²/2	M_{t1}	514.5	kNm	
	Transverse moment per metre qd,max ((B − min cy)/2)²/2	m_{ty}	205.9	kNm/m	
	Transverse moment, column 2 (P2/B)((B − cy2)/2)²/2	M_{t2}	660.2	kNm	
	K, bottom bars along L, width B M / (b d² fck)	K_{bl}	0.013		
	Lever arm d (1 − 0.4 ξ) ≤ 0.95 d	z	657	mm	N/A: K > K', outside scope
	Required M / (fyd z)	$A_{s,req}$	2169	mm²	
(9.1N)	Minimum ρmin b d	$A_{s,min}$	3335	mm²	
	Provided π ϕ²/4 · b / s	$A_{s,prov}$	4289	mm²	
6.1, 9.2.1.1	Bottom bars: K ≤ K' and As,prov ≥ max(As,req; As,min)		4289	mm²	**OK**
	K, top bars along L, width B M / (b d² fck)	K_{tl}	0.009		
	Lever arm d (1 − 0.4 ξ) ≤ 0.95 d	z	657	mm	N/A: K > K', outside scope
	Required M / (fyd z)	$A_{s,req}$	1377	mm²	
(9.1N)	Minimum ρmin b d	$A_{s,min}$	3335	mm²	
	Provided π ϕ²/4 · b / s	$A_{s,prov}$	3677	mm²	
6.1, 9.2.1.1	Top bars: K ≤ K' and As,prov ≥ max(As,req; As,min)		3677	mm²	**OK**
	K, bars across, strip under column 1 M / (b d² fck)	K_{t1}	0.021		
	Lever arm d (1 − 0.4 ξ) ≤ 0.95 d	z	642	mm	N/A: K > K', outside scope
	Required M / (fyd z)	$A_{s,req}$	1843	mm²	
(9.1N)	Minimum ρmin b d	$A_{s,min}$	1784	mm²	
	Provided π ϕ²/4 · b / s	$A_{s,prov}$	2818	mm²	
	K, bars across, strip under column 2 M / (b d² fck)	K_{t2}	0.027		
	Lever arm d (1 − 0.4 ξ) ≤ 0.95 d	z	642	mm	N/A: K > K', outside scope
	Required M / (fyd z)	$A_{s,req}$	2365	mm²	
(9.1N)	Minimum ρmin b d	$A_{s,min}$	1835	mm²	
	Provided π ϕ²/4 · b / s	$A_{s,prov}$	2899	mm²	
	K, bars across, per metre of length M / (b d² fck)	K_{ty}	0.015		
	Lever arm d (1 − 0.4 ξ) ≤ 0.95 d	z	642	mm	N/A: K > K', outside scope
	Required M / (fyd z)	$A_{s,req}$	737	mm²	
(9.1N)	Minimum ρmin b d	$A_{s,min}$	1018	mm²	
	Provided π ϕ²/4 · b / s	$A_{s,prov}$	1608	mm²	
6.2.2(1)	Ratio of the bars across As/(s d)	ρ_{bt}	0.0024		
	One-way shear across B per metre qd,max ((B − min cy)/2 − dbt	$v_{Ed,y}$	152.1	kN/m	
(6.2)	Resistance per metre vRd,c dbt	$V_{Rd,c,y}$	248.6	kN/m	
6.1, 6.2.2	Bars across: strips, per metre; one-way shear across B		152.1	kN/m	**OK**

Calculation · beam shear at d from the column faces, 6.2.2

6.2.2(1)	Ratio, bottom bars along L ≤ 0.02 in (6.2)	ρ_{bl}	0.0019		
6.2.2(1)	Ratio, top bars along L	ρ_{tl}	0.0017		
(6.2)	Resistance, bottom in tension max(CRd,c k (100ρ fck)^⅓; vmin)	$V_{Rd,c,b}$	809.4	kN	
(6.2)	Resistance, top in tension	$V_{Rd,c,t}$	809.4	kN	
	Shear at d outside column 1	V_1	303.0	kN	
	its resistance (outside: bottom bars; between: the smaller)	$V_{Rd,1}$	809.4	kN	
	Shear at d inside column 1 (≤ mid-gap)	V_2	534.3	kN	
	its resistance (outside: bottom bars; between: the smaller)	$V_{Rd,2}$	809.4	kN	
	Shear at d inside column 2 (≥ mid-gap)	V_3	656.1	kN	
	its resistance (outside: bottom bars; between: the smaller)	$V_{Rd,3}$	809.4	kN	
	Shear at d outside column 2	V_4	450.8	kN	
	its resistance (outside: bottom bars; between: the smaller)	$V_{Rd,4}$	809.4	kN	
	Largest VEd / VRd,c		**0.811**		
	Largest shear at a column face	$V_{Ed,face}$	1067.6	kN	
6.2.2(6)	Strut limit at the face 0.5 B d v fcd, d = min(dbl; dtl)	$V_{Rd,max}$	11692.0	kN	
(6.2)	Beam shear VEd ≤ VRd,c at the four sections, ≤ VRd,max at the faces		0.81		**OK**

Calculation · punching at the columns, 6.4.4(2)

	Mean effective depth (dbl + dbt)/2	d	684	mm	
6.4.4(1)	Mean ratio √(ρbl ρbt) ≤ 0.02	ρ_l	0.0021		
(6.50)	Basic resistance max(CRd,c k (100ρ fck)^⅓; vmin)	$v_{Rd,c}$	0.367	MPa	
(6.6N)	Strength reduction factor 0.6(1 − fck/250)	v	0.528		
6.4.5(3)	Maximum punching stress vmax √ αcc fck / γc	$v_{Rd,max}$	5.280	MPa	
	Column 1: net pressure at its centre (wa + wb x1) / B	q_1	147.6	kPa	
	Column 1: largest a inside min(face to end; (B − cy)/2; gap/2)	$a_{max,1}$	1400	mm	
6.4.5(3)	Column 1: u0 (edge or corner value if within d of an edge)	u_{01}	1600	mm	
(6.53)	Column 1: stress at the face β P1 / (u0 d) ≤ vRd,max	$v_{Ed,01}$	1.765	MPa	OK
	Column 2: net pressure at its centre (wa + wb x2) / B	q_2	192.2	kPa	
	Column 2: largest a inside min(face to end; (B − cy)/2; gap/2)	$a_{max,2}$	1375	mm	
6.4.5(3)	Column 2: u0 (edge or corner value if within d of an edge)	u_{02}	1800	mm	
(6.53)	Column 2: stress at the face β P2 / (u0 d) ≤ vRd,max	$v_{Ed,02}$	2.088	MPa	OK

a (mm)	vRd = vRd,c 2d/a (MPa)	VEd,red,1 (kN)	vEd/vRd, 1	VEd,red,2	vEd/vRd, 2
68	7.332	1638	**0.19**	2170	**0.22**
137	3.666	1615	**0.30**	2137	**0.37**
205	2.444	1588	**0.38**	2100	**0.47**
274	1.833	1557	**0.43**	2056	**0.54**
342	1.466	1521	**0.47**	2007	**0.58**
410	1.222	1481	**0.49**	1952	**0.61**
479	1.047	1437	**0.50**	1892	**0.63**
547	0.917	1388	**0.51**	1826	**0.64**
616	0.815	1335	**0.50**	1754	**0.64**
684	0.733	1278	**0.50**	1677	**0.63**
752	0.667	1216	**0.48**	1594	**0.62**
821	0.611	1150	**0.47**	1505	**0.60**
889	0.564	1080	**0.45**	1411	**0.57**
958	0.524	1005	**0.42**	1311	**0.54**
1026	0.489	926	**0.40**	1205	**0.50**
1094	0.458	842	**0.36**	1094	**0.46**
1163	0.431	755	**0.33**	977	**0.42**
1231	0.407	663	**0.29**	855	**0.37**
1300	0.386	566	**0.25**	726	**0.32**
1368	0.367	465	**0.21**	593	**0.26**
1368	0.367	465	**0.21**	593	**0.26**
1368	0.367	465	**0.21**	593	**0.26**

Closed control perimeters u = 2(cx + cy) + 2πa at a = 0.1d … 2d from the column face, and one at each column's limit a_max; a perimeter is used only where it stays inside the footing and short of half the clear gap (rows marked –). VEd,red = P − qd A (6.48), with A = cx cy + 2a(cx + cy) + πa² and the net pressure at the column centre (exact for a linear pressure on a symmetric area); vEd = β VEd,red / (u d). The table shows the ratio along a; the check below uses its exact maximum, and also the perimeters running to the near end, to a long side and to that corner (6.4.2(4)), each up to 2d where it fits. Perimeters reaching half way to the other column or to both sides are not checked (warning).

6.4.4(2)	Column 1, closed: a of the largest ratio (exact)	a_1	564	mm	
(6.50)	Column 1, closed: largest ratio β VEd,red/(u d)/(vRd,c 2d/a)		0.506		
6.4.2(4)	Column 1, to the end: a of the largest ratio	a_{e1}	724	mm	
6.4.2(4)	Column 1, to the end: u = cy + πa + 2(e + cx), largest ratio		0.404		
6.4.2(4)	Column 1, to a side: a of the largest ratio	a_{sd1}	716	mm	
6.4.2(4)	Column 1, to a side: u = cx + πa + 2(e_s + cy), largest ratio		0.396		
6.4.2(4)	Column 1, to the corner: a of the largest ratio	a_{cn1}	771	mm	
6.4.2(4)	Column 1, to the corner: u = e + cx + e_s + cy + πa/2, largest ratio		0.402		
6.4.4(2)	Column 2, closed: a of the largest ratio (exact)	a_2	575	mm	
(6.50)	Column 2, closed: largest ratio β VEd,red/(u d)/(vRd,c 2d/a)		0.640		
6.4.2(4)	Column 2, to the end: a of the largest ratio	a_{e2}	711	mm	
6.4.2(4)	Column 2, to the end: u = cy + πa + 2(e + cx), largest ratio		0.506		
6.4.2(4)	Column 2, to a side: a of the largest ratio	a_{sd2}	717	mm	
6.4.2(4)	Column 2, to a side: u = cx + πa + 2(e_s + cy), largest ratio		0.513		
6.4.2(4)	Column 2, to the corner: a of the largest ratio	a_{cn2}	770	mm	
6.4.2(4)	Column 2, to the corner: u = e + cx + e_s + cy + πa/2, largest ratio		0.500		

6.4.4	Punching at column 1				OK
6.4.4	Punching at column 2				OK

Calculation · detailing

8.2(2)	Smallest clear gap, bottom along L max(ϕ; dg + 5; 20)	$a_{min,bl}$	25	mm	
8.2(2)	Smallest clear gap, bottom across max(ϕ; dg + 5; 20)	$a_{min,bt}$	25	mm	
8.2(2)	Smallest clear gap, top along L max(ϕ; dg + 5; 20)	$a_{min,tl}$	25	mm	
9.3.1.1(3)	Largest spacing (maximum moment) min(2h; 250)	s_{max}	250	mm	
8.2, 9.3.1.1	All three layers: clear gap ≥ a_min, spacing ≤ s_max		109	mm	OK

Anchor the bottom bars beyond the column faces and at the ends to 9.8.2.2, provide starter bars to the columns, and check the crack widths where the exposure needs it. A combined footing normally carries a top mat between the columns; As,min is applied to the top bars throughout.

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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 γc	2.4.2.4(1)	**1.5**	**1.4**	Persistent & transient. UK NA: recommended; PL: NA.2, Table NA.2
Partial factor, reinforcement γs	2.4.2.4(1)	**1.15**	**1.15**	UK NA: recommended; PL: NA.2, Table NA.2
αcc (compression in flexure / axial)	3.1.6(1)	**0.85**	**1**	UK NA: 0.85; PL: recommended (NA.9)
αcc (shear and punching)	3.1.6(1)	**1**	**1**	UK NA: 1.0 for other phenomena; PL: recommended (NA.9)
αct (design tensile strength)	3.1.6(2)	**1**	**1**	Recommended value in both annexes
CRd,c numerator (CRd,c = value / γc)	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
vRd,max factor (vRd,max = factor · ν · fcd)	6.4.5(3)	**0.5**	**0.4**	UK NA: 0.5 ν fcd; PL: recommended value (NA.9), 0.4 ν fcd since EN 1992-1-1 AC:2010 (PN-EN 1992-1-1:200
kmax (vEd ≤ kmax · vRd,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
ϕlarge (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 ≤ cot θ ≤ 2.0
k1 (x/d limit, δ ≥ k1 + k2 xu/d)	5.5(4)	**0.4**	**0.44**	UK NA for fyk ≤ 500 MPa; PL: recommended (NA.9)
k2 (x/d limit, εcu2 = 0.0035)	5.5(4)	**1**	**1.25**	UK NA: 0.6 + 0.0014/εcu2; PL: 1.25(0.6 + 0.0014/εcu2)
Upper limit on the (310/σs) factor (0 = none)	7.4.2(2)	**1.5**	**0**	UK NA Table NA.5 Note 5: (310/σs) or (500/fyk)(As,prov/As,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
ϕmin (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