PAD FOOTING V5.12 — Engineering Building & Infrastructure Pty Ltd

Pad:	**(Pad Footing PF01) 1200mm long x 1200mm wide, 700mm deep, f'c = 120MPa**	
	Bearing = 48928kPa < 212850kPa	**OK (0.23)**
Reinf't:	**N50-100 cts (BLL), 35-N50/m [29 cts] (BUL) (BLL bars in L dir.) , 100mm cover**	
Capacity:	**M*L = 3360.1kNm/m < øMu.L = 4288.8kNm/m, M*W = 6425.1kNm/m < øMu.W = 9092.5kNm/m**	**OK (0.78,0.71)**
	V*L = 0.0kN/m < øVuc.L = 370.3kN/m, V*W = 0.0kN/m > øVuc.W = 365.5kN/m	**OK (0.00,0.00)**
	VP* = 2010kN < øVp = 6296kN	**OK (0.32)**
Column:	**800mm long x 450mm wide, P* = 94508kN**	

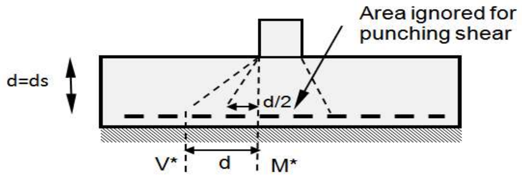
Geometry

(Designing at asup from column centreline) — Two-way slab footing

Concrete strength (f'c) =	120	MPa	Column length (CL) =	800	mm
Pad length (L) =	1200	mm	Column width (CW, CW=0 for Circle) =	450	mm
Pad width (W) =	1200	mm	Column area reduction =	1.41	m²
Pad depth (D) =	700	mm			
Design moment at column face =	N	(Y)es,(N)o	Outstand in L direction =	200	mm
Use asup (=0.7) =	Y	(Y)es,(N)o	Outstand in W direction =	375	mm
Method =	E	(E)lastic/(P)lastic	Pad Area =	1.44	m²

Loading

Dead load (Pdl) =	70000	kN (Excluding footing S.Wt)
Live load (Pll) =	450	kN
Eccentricity (EccL) =	0	mm
Eccentricity (EccW) =	0	mm
S.Wt. density (ρ) =	6.0	kN/m³
S.Wt. = ρ*L*W*D =	6.0	kN
P* = 1.35*(Pdl+SWt) =	94508	kN



(Bearing elastically determined)

Allowable bearing pressure =	212850	kPa	OK (0.23)		
Max. bearing pressure (Bp) =	48928	kPa	Ultimate B.P.(Bp*) =	65631	kPa
			P*/Rt =	1.3414	

Reinforcement

Unreinforced =	N	(Y)es, (N)o	Bottom reinf't layers =	1	
Extreme bottom bars in =	L	(W), (L) dir	Ductility class =	A	(N)ormal,(L)ow,(A)uto
Cover to bottom layer of reinf't =	100	mm	Ductility class =	N	(N)ormal,(L)ow

BLL (in L dir.) =	**N50-100 cts (BLL)**		**BUL (in W dir.) =**	**35-N50/m [29 cts] (BUL)**	
Bar size =	50	mm	Bar size =	50	mm
Bar cts/No. per m =	100	mm	Bar cts/No. per m =	35	No/m
Steel Strength (fsy) =	500	MPa	Steel Strength (fsy) =	500	MPa
Area steel (Ast) =	19635	mm²/m	Area steel (Ast) =	68722	mm²/m
Depth to steel (ds) =	575	No	Depth to steel (ds) =	525	No
Ast.min = 0.19*(D/ds)²*f'ct.f/fsy*ds =	2128	mm²/m	Ast.min =	2331	mm²/m

Bending (Reinforced) - Cl 8.1 (Applicable)

alpha (α2 = 0.85-0.0015*f'c) =	0.670	(0.67 ≤ α2)	Eq 8.1.3(1)		
gamma (γ = 0.97-0.0025*f'c) =	0.670	(0.67 ≤ γ)	Eq 8.1.3(2)		
Strength factor (øbl = 1.24-13*kuo/12) =	0.85		øbw =	0.85	(0.65 ≤ ø ≤ 0.85) Table 2.2.2 for N Class
Moment (ML*) =	3360.1	kNm/m	MW* =	6425.1	kNm/m
Ast Req'd =	14960	mm²/m	Ast Req'd =	36830	mm²/m
øMuo.L =	4288.8	kNm/m	øMuo.W =	9092.5	kNm/m
	OK (0.78)			OK (0.71)	

Bending (Unreinforced) - Cl 20.4.2 (Not applicable)

Plain concrete (ø.ur) =	0.6	Table 2.2.2(g)			
øMuo.ur.L = (ø=0.6)*f'ct.f*Z =	277.7	kNm/m	øMuo.ur.W =	277.7	kNm/m
	No Good (12.10)			No Good (23.14)	

Punching shear (Reinforced) - Cl 9.3 (Applicable)

Pad load (P*) =	94508 kN	dom =	525 mm	
Column load reduction =	92498 kN	Perim. (u) =	4600 mm	
Punching shear (Vp*) =	2010 kN	βh =	1.8	Cl 9.3.1.4
		fcv =	3.72 MPa	Cl 9.3.3
øVp = (ø=0.7)*u*dom*f'cv =	6296.3 kN	OK (0.32)		

Punching shear (Unreinforced) - Cl 20.4.3 (Not applicable)

Punching shear (Vp*) =	2010 kN	
øVp.ur1 = (ø=0.6)*0.1*u*(D-50)*(1+2/βh)*√f'c =	4176.1 kN	
øVp.ur2 = (ø=0.6)*0.2*u*(D-50)*√f'c =	3930.5 kN	
øVp.ur = min(øVp.ur1,øVp.ur2) =	3930.5 kN	OK (0.51)

Strength of slab in one-way shear (Reinforced) - Cl 8.2 (Applicable)

Use Simplified method =	N (Y)es,(N)o	
Max. nominal aggregate size (dg) =	16 mm	(General method)
Lightweight concrete =	N (Y)es,(N)o	(General method)

	Length		Width	
1-way shear (VL*) =	0.0 kN/m	VW* =	0.0 kN/m	
ML* =	0.0 kNm/m	MW* =	0.0 kNm/m	
ds =	575 mm	ds =	525 mm	
Effective shear depth dv = max(0.72*D,0.9*ds) =	518 mm	dv =	504 mm	Cl 8.2.1.9
Total flange (W) =	1200 mm	L =	1200 mm	
Effective flange (bv) =	1000 mm	bv =	1000 mm	
Simple method for kv & θv - Cl 8.2.4.3				
kvo = 200/(1000+1.3*dv) =	0.120	kvo =	0.121	
kv = min(kvox, 0.15) =	0.120	kv =	0.121	Eq 8.2.4.3(1)
Angle of inclination of concrete comp. strut (θv) =	36.0 °	θv =	36.0 °	
General method for kv & θv - Cl 8.2.4.2				
Tensile area of concrete (Act) =	350000 mm^2/m	Act =	350000 mm^2/m	
Ast =	19635 mm^2/m	Ast =	68722 mm^2/m	
Shear only εx1 ≤ $3000x10^{-6}$ =	0.0 $x10^{-6}$	εx1 =	0.0 $x10^{-6}$	Eq 8.2.4.2.2(1)
Shear only $-200x10^{-6}$ ≤ εx2 (where εx1 < 0) ≤ 0 =	0.0 $x10^{-6}$	εx2 =	0.0 $x10^{-6}$	Eq 8.2.4.2.2(2)
Long. mid-depth concrete strain (εx) =	0.0 $x10^{-6}$	εx =	0.0 $x10^{-6}$	
kdg = 2.0 =	2.000	kdg =	2.000	Eq 8.2.4.2(4)
kv = (0.4/(1+1500*εx))*(1300/(1000+kdg*dv)) =	0.256	kv =	0.259	Eq 8.2.4.2(2)
Angle (θv) = (29+7000*εx) =	29.0 °	θv =	29.0 °	Eq 8.2.4.2(1)
Adopted kv & θv - General method - Cl 8.2.4.2				
kv =	0.256	kv =	0.259	
Angle of inclination of concrete compression strut (θv) =	29.0 °	θv =	29.0 °	
Concrete contribution to shear stength - Cl 8.2.4.1				
Capacity reduction factor (ø) =	0.70	ø =	0.70	Table 2.2.2(e)
kv =	0.256	kv =	0.259	
Effective flange (bv) =	1000 mm/m	bv =	1000 mm/m	
Effective shear depth (dv) =	518 mm	dv =	504 mm	
min(√f'c,8.0) =	8.00 MPa	Limited from 10.95MPa - Cl 8.2.4.1		
Vuc = kv*bv*dv*min(√f'c, 8.0) =	1057.9 kN/m	Vuc =	1044.1 kN/m	Cl 8.2.4.1
D ≥ 650mm, ks =	0.50			
ks*øVuc.L =	370.3 kN/m	ks*øVuc.W =	365.5 kN/m	Eq 8.2.1.6(1)
	OK (0.00)		OK (0.00)	

Strength of slab in one-way shear (Unreinforced) - Cl 20.4.3 (Not applicable)

1-way shear (VL*) =	0.0 kN/m	VW* =	0.0 kN/m
øVu.ur.L = (ø=0.6)*0.15*b*(D-50)*$f'c^{1/3}$ =	288.5 kN/m	øVu.ur.W =	288.5 kN/m
	OK (0.00)		OK (0.00)

Total weight (Rt = Pdl + S.Wt + Pll) = 70456.0 kN

Bearing Pressure - Elastic

Bearing pressure B.P. (Rt/[W*L]) = 48927.8 kPa

	Width			Length	
Eccentricity (Ecc.x) =	0	mm	Eccentricity (Ecc.y) =	0	mm
yx = (W/2 - Ecc.x) =	600	mm	yy = (L/2 - Ecc.y) =	600	mm

Bearing pressure (1/A) =	48927.8 kPa	Bearing Distance (1-2) =	1200 mm
Bearing pressure (2/F) =	48927.8 kPa	Bearing Distance (2-3) =	1200 mm
Bearing pressure (3/K) =	48927.8 kPa	Bearing Distance (3-4) =	1200 mm
Bearing pressure (4/P) =	48927.8 kPa	Bearing Distance (4-1) =	1200 mm

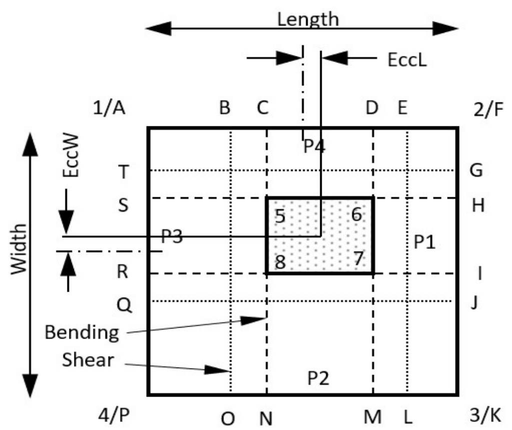
Minimum bearing pressure (q.min) = 48927.8 kPa
Maximum bearing pressure (q.max) = 48927.8 kPa OK (0.23)

Bearing Pressure - Plastic (Not applicable)

	Width			Length	
Eccentricity (Ecc.x) =	0	mm	Eccentricity (Ecc.y) =	0	mm
Effective width (2*yw) =	1200	mm	Effective length (2*yl) =	1200	mm

Maximum bearing pressure (q.max) = 48927.8 kPa OK (0.23)

Calculations



	Working kPa	Ultimate kPa		Working kPa	Ultimate kPa
1/A	48927.8	65630.7	3/K	48927.8	65630.7
B	48927.8	65630.7	L	48927.8	65630.7
C	48927.8	65630.7	M	48927.8	65630.7
D	48927.8	65630.7	N	48927.8	65630.7
E	48927.8	65630.7	O	48927.8	65630.7
2/F	48927.8	65630.7	4/P	48927.8	65630.7
G	48927.8	65630.7	Q	48927.8	65630.7
H	48927.8	65630.7	R	48927.8	65630.7
I	48927.8	65630.7	S	48927.8	65630.7
J	48927.8	65630.7	T	48927.8	65630.7

Design Bending (Moment and shear reduced by 0.9 * Self-weight)

Dist 1/A - C (L) + Lext = 320 mm
Dist D - 2/F (L) + Wext = 320 mm
Dist 1/A - S (W) = 442.5 mm
Dist R - 4/P (W) = 442.5 mm

	Area	Ave BP kPa	Area m²	Shear kN	Ecc m	Moment kNm	
P1	DFKM	65630.7	0.38	25200.7	0.160	4032.1	L Dir
P2	RIKP	65630.7	0.53	34847.9	0.221	7710.1	W Dir
P3	ACNP	65630.7	0.38	25200.7	0.160	4032.1	L Dir
P4	AFHS	65630.7	0.53	34847.9	0.221	7710.1	W Dir

L Direction (ML*) = 3360.1 kNm/m
W Direction (MW*) = 6425.1 kNm/m

Design Shear (Moment and shear reduced by 0.9 * Self-weight)

Depth dv (W) = 504 mm
Depth dv (L) = 504 mm

VDist 1/A - B (L) = 0 mm
VDist E - 2/F (L) = 0 mm
VDist 1/A - T (W) = 0 mm
VDist Q - 4/P (W) = 0 mm

	Area	Ave BP kPa	Area m²	Shear kN	Ecc m	Moment kNm	
P1	EFKL	0.0	0.00	0.0	0.000	0.0	L Dir
P2	QJKP	0.0	0.00	0.0	0.000	0.0	W Dir
P3	ABOP	0.0	0.00	0.0	0.000	0.0	L Dir
P4	AFGT	0.0	0.00	0.0	0.000	0.0	W Dir

L Direction (VL*) = 0.0 kN/m
W Direction (VW*) = 0.0 kN/m
L Direction (ML*) = 0.0 kNm/m
W Direction (MW*) = 0.0 kNm/m

PAD FOOTING V5.12 Engineering Building & Infrastructure Pty Ltd

Pad:	**(Pad Footing PF01) 1200mm long x 1200mm wide x 700mm deep**	
Uplift:	**Pup* = 100kN < øPdown = 63023kN**	**OK (0.00)**
Down:	**Pdown + S.Wt = 70025kN, Bearing = 48629kPa < 212850kPa**	**OK (0.23)**

Geometry

Pad length (L) = 1200 mm
Pad width (W) = 1200 mm
Pad depth (D) = 700 mm

Concrete density (ρc) = 25.0 kN/m³
Soil density (ρs) = 18.0 kN/m³

Slab thickness (th) = 150 mm
Soil thickness = 0 mm

Allowable bearing pressure = 212850 kPa

Loadings

Ultimate uplift load (Pup*) = 100.0 kN

Working downward load (Pdown) = 70000.0 kN
Pad self weight (S.Wt. = ρc*L*W*D) = 25.2 kN
Pdown + S.Wt = 70025.2 kN

Max. bearing pressure (Bp = (Pdown + S.Wt)/(L*W)) = 48629 kPa OK (0.23)

Uplift resistance

Overlap = 0 mm footing under the slab in L Direction, -ve for more options

Area of slab for uplift (Au) = 0.00 m²

Vertical load Pdown = 70000.0 kN
Pad self weight S.Wt. = ρc*L*W*D = 25.2 kN
Slab self weight Wt. (Au*ρc*th) = 0.0 kN
Soil self weight Wt. = 0.0 kN
ΣPdown = 70025.2 kN

øΣPdown = 0.9*ΣPdown = 63022.7 kN

Ratio = Pup* / øΣPdown = OK (0.00)