



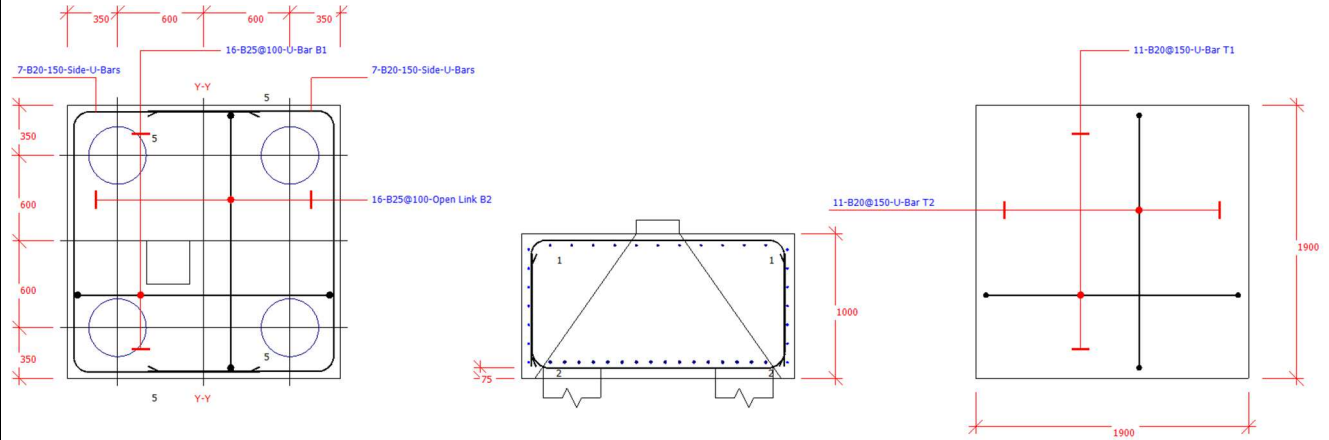
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Job ref : Job Ref
Sheet : Sheet Ref / 2 -
Made By :
Date : 421 June 2015/ Version 2018.07
Checked :
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MASTERRC - PILE CAP DESIGN



Summary of Design Data

Design to	EC 2: 2004 - Using UK values
Working vertical load per pile	800kN
Pile dia., cap o/a depth, overhang:	400mm, 1000mm, 150mm
Pile spacing, centre to centre:	3.00 • dia. (1200mm)
Column size:	300mm. (x-x) x 300mm. (y-y)
Concrete grade:	C32/40
Concrete cover to reinforcement:	Bottom: 75mm., sides and top: 50mm.
Overall plan dimensions:	Width (x-x): 1900mm. Length (y-y): 1900mm.
Column Offsets:	ex = -250 mm. ey = -150 mm.

Forces

Axial Loads (kN)	Dead 950, Imposed 750
Moments Mxx (kN.m)	Dead 25, Imposed 27, Accomp. Imposed 10 +ve causes compression on top
Moments Mxx (kN.m) + Col. Ecc ey	Dead -118, Imposed -86, Accomp. Imposed 10
Moments Myy (kN.m)	Dead 2, Imposed 10, Accomp. Imposed 5 +ve causes compression on left
Moments Myy (kN.m) + Col. Ecc ex	Dead 240, Imposed 198, Accomp. Imposed 5

Calculations

No. of piles	Using user defined value in presence of moment	4
Pile loads - Axial	Uniformly distributed from Column Axial Load	
Load per pile (service)	$(950 + 750 + 0 + 87) / 4$	447kN
Load per pile (Ultimate)	$((950+86.6) \cdot 1.35 + 750 \cdot 1.50 + 0 \cdot 1.05) / 4 = 2524 / 4$	631kN
Load per pile (Ultimate Net)	$(950 \cdot 1.35 + 750 \cdot 1.50 + 0 \cdot 1.05) / 4 = 2408 / 4$	602kN
Moment xx (Service)	-118 + -86 + 10	-193kN.m
Moment yy (Service)	240 + 198 + 5	442kN.m
Factored Moment xx (Ultimate)	-118 \cdot 1.35 + -86 \cdot 1.50 + 10 \cdot 1.05	-276kN
Factored Moment xx (Ultimate)	240 \cdot 1.35 + 198 \cdot 1.50 + 5 \cdot 1.05	625kN
Pile loads - Axial + Moment (kN)	Pile coordinates relative to pile cap centre	

	X (mm)	Y (mm)	Service	Ultimate	Ultimate Net	
Pile 1	-600	600	551	776	747	
Pile 2	600	600	182	256	227	
Pile 3	-600	-600	712	1007	978	
Pile 4	600	-600	343	468	457	
Max Values			712	1007	978	
Max Load per pile (service)	Including moments				712kN	OK

Y-Y Axis: Layer B1

Reinf% = 100As/BD As = 16B25@100 = 7856 => $100 \cdot 7856 / (1900 \cdot 1000)$ 0.41% OK

Strut & Tie Analogy

Truss Ften = $2 \cdot F_{ult} / (24 \cdot d) \cdot (3l^2 - a^2)$ $2 \cdot 1483 / (24 \cdot 1700 \cdot 913) \cdot (3 \cdot 1700^2 - 300^2)$ 683 kN
 As = $F_{ten} / (0.87 \cdot f_y)$ $683.4 / (0.87 \cdot 500)$ 1571 mm² OK

Beam Shear on Y-Y plane

$F_v = \Sigma$ Ultimate pile load for 2 piles in shear zone 1783 kN OK
 Reduced $V_{app} = V_{app} \cdot \beta_{enhance}$ $741.3 \cdot 0.318$ 235.724 6.2.2.6
 $V_{app} / \max(V_{Rd,c,a}, V_{Rd,c,b})$ $235.7 / \max(744.6, 610.4)$ 0.317 OK
 $V_{Rd,max} = 0.5 \cdot B_w \cdot d \cdot v \cdot f_{cd}$ $0.5 \cdot 1900 \cdot 912.0 \cdot 0.523 \cdot 18$ 8219.8 kN OK

X-X Axis: Layer B2

Reinf% = 100As/BD As = 16B25@100 = 7856 => $100 \cdot 7856 / (1900 \cdot 1000)$ 0.41% OK



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Strut & Tie Analogy

$$F_{ten} = F_{ult} \cdot 2 / (24 \cdot d) \cdot (3l^2 - b^2) \quad 2 \cdot 2063 / (24 \cdot 1500 \cdot 888) \cdot (3 \cdot 1500^2 - 300^2) \quad 860 \text{ kN}$$

$$A_s = F_{ten} / (0.87 \cdot f_y) \quad 860.2 / (0.87 \cdot 500) \quad 2470 \text{ mm}^2 \quad \text{OK}$$

Beam Shear on X-X plane

$$F_v = \Sigma \text{Ultimate pile load for 2 piles in shear zone} \quad 1492 \text{ kN} \quad \text{OK}$$

$$\text{Reduced } V_{app} = V_{app} \cdot \beta_{enhance} \quad 1492.3 \cdot 0.250 \quad 373.078 \quad 6.2.2.6$$

$$V_{app} / \max(V_{Rd,C,a}, V_{Rd,C,b}) \quad 373.1 / \max(734.6, 598.2) \quad 0.508 \quad \text{OK}$$

$$V_{Rd,max} = 0.5 \cdot B_w \cdot d \cdot v \cdot f_{cd} \quad 0.5 \cdot 1900 \cdot 888.0 \cdot 0.523 \cdot 18 \quad 8003.5 \text{ kN} \quad \text{OK}$$

Punching Shear

Column Head

$$F_v = \Sigma \text{Ultimate pile load for 4 piles in shear zone} \quad 4024 \text{ kN}$$

$$- (1.35 \times 86.64) \text{ selfweight} \quad 2407 \text{ kN}$$

$$V_{Rd,max} = 0.5 \cdot B_w \cdot d \cdot v \cdot f_{cd} \quad 0.5 \cdot 1200 \cdot 912.0 \cdot 0.523 \cdot 18 \quad 5191.5 \text{ kN} \quad \text{OK}$$

Shear perimeter at 2 d_{eff}
Perimeter Crosses Piles. Perimeter limit to 1/5 int piles

$$F_v = \Sigma \text{Ultimate pile load for 4 piles in shear zone} \quad 4024.0 \cdot 0.322 \quad 1296.622 \quad 6.2.2.6$$

$$\text{Reduced } V_{app} = V_{app} \cdot \beta_{enhance} \quad 1296.6 / \max(1455.8, 1221.3) \quad 0.891 \quad \text{OK}$$

$$V_{app} / \max(V_{Rd,C,a}, V_{Rd,C,b})$$

Truss Concrete Compression

F_c , Vertical Compression Check Using maximum ultimate pile load 1006.0 kN

$$F_{cap} = \pi \cdot \text{dia}^2 / 4 \cdot 0.85 \cdot v' \cdot f_{cd} \quad 125664 \cdot 0.85 \cdot 0.52 \cdot 18.1 \quad 1013.4 \text{ kN} \quad \text{OK}$$

Anti-Crack Steel

Top Nominal Steel $20@ 150 \text{ mm} = 2094 \text{ mm}^2/\text{m}$ 0.209%

Spacing [3.12.5.4] $20^2 \cdot 500 / \text{Min}(1000, 500)$ 400 OK

Side Steel $20@ 150 \text{ mm} = 2094 \text{ mm}^2/\text{m}$ 0.11%

Spacing [3.12.5.4] $20^2 \cdot 500 / \text{Min}(1900, 500)$ 400 OK

Friction Pile Spacing

Circular piles Spacing $\geq 3\Phi$ $3 \cdot 400 = 1200 \text{ mm}$ $\text{actual} = 1200 \text{ mm}$ OK

see BS 8004 Clause 7.3.4.2