CENTRUM PILE LTD
CENTRUM PRECAST CONCRETE PILE
SIZE 200 SQUARE Calculations

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SHEAR CAPACITY OF CENTRUM PILES
DESIGN IN ACCORDANCE WITH EC 2

Design Parameters

Pile	Pile depth	$h := 200 \cdot mm$	
	Pile width	$b_w := 200 \cdot mm$	
	cover	$c_b := 30 \cdot mm$	
Tension (Bottom) Reinforcement			
Number of bars (minimum)	$n_b := 2$	Bar diameters	$\phi_b := 12 \cdot mm$
Shear Links			
Number of legs	$n_v := 2$	Link diameter	$\phi_v := 5 \cdot mm$
Spacing of links	$s_v := 120 \cdot mm$		

Material Parameters

concrete characteristic cylinder strength	$f_{ck} := 50 \cdot \frac{N}{mm^2}$
steel reinforcement characteristic strength	$f_{yk} := 500 \cdot \frac{N}{mm^2}$
shear steel reinforcement characteristic strength	$f_{ywk} := 500 \cdot \frac{N}{mm^2}$
Rebar Modulus	$E := 200000 \cdot \frac{N}{mm^2}$

Table 2.1N partial factors for materials at the ultimate limit state

EN 13369:2004 C.2 modified material factors	steel	$\gamma_s := 1.10$
	concrete	$\gamma_c := 1.40$

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Effective depth $d_b := h - c_b - \frac{\phi_b}{2}$ $d_b = 164 \cdot mm$

Main Rebar Area $As_b := n_b \cdot \pi \cdot \frac{\phi_b^2}{4}$ $As_b = 226.2 \cdot mm^2$

Shear Rebar Area $A_{sw} := n_v \cdot \pi \cdot \frac{\phi_v^2}{4}$ $A_{sw} = 39.3 \cdot mm^2$

nominal lever arm value $z := 0.9 \cdot d_b$

for non-prestressed structures $\alpha_{cw} := 1$

6.6 N $v_1 := 0.6 \cdot \left(1 - \frac{f_{ck}}{250 \cdot \frac{N}{mm^2}}\right)$ $v_1 = 0.5$

angle between shear reinforcement and member axis $\alpha := 90 \cdot deg$

$f_{cd} := \frac{f_{ck}}{\gamma_c}$ $f_{cd} = 35.7 \cdot \frac{N}{mm^2}$

$\theta_{min} := acot(2.5)$ $\theta_{min} = 21.8 \cdot deg$

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Concrete Capacity

$$V_{Rd.min.22} := \frac{\alpha_{cw} \cdot b_w \cdot z \cdot \upsilon_1 \cdot f_{cd}}{\left(\cot\left(\theta_{min}\right) + \tan\left(\theta_{min}\right)\right)} \qquad V_{Rd.min.22} = 174.5 \cdot kN$$

Shear link Capacity

$$V_{Rd.s1} := \frac{A_{sw}}{s_v} \cdot z \cdot \frac{f_{ywk}}{\gamma_s} \cdot \cot\left(\theta_{min}\right) \qquad V_{Rd.s1} = 54.9 \cdot kN$$

Shear Capacity

$$V_{Rd} := \min\left(V_{Rd.min.22}, V_{Rd.s1}\right) \qquad V_{Rd} = 54.9 \cdot kN$$

Additional longitudinal bars

$$\Delta F_{td1} := 0.5 \cdot V_{Rd} \cdot \left(\cot\left(\theta_{min}\right) - \cot(\alpha)\right) \qquad \Delta F_{td1} = 68.6 \cdot kN$$

$$As_{td1} := \frac{\Delta F_{td1}}{\frac{f_{yk}}{\gamma_s}} \qquad As_{td1} = 150.9 \cdot mm^2$$

Area of main reinforcement $\qquad As_b = 226.2 \cdot mm^2$

Additional reinforcement needs to be at least equal to area of reinforcement provided

Additional_reinforcement = "satisfactory"