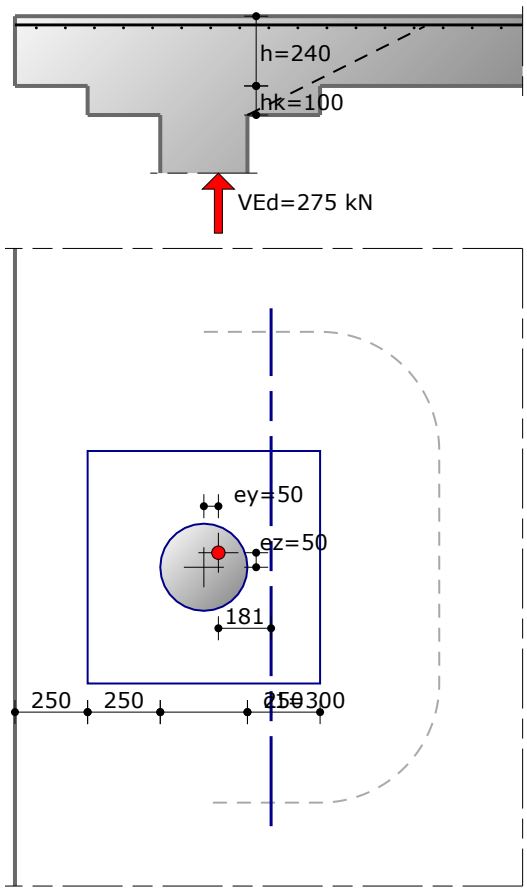
GENERAL

File : ....Struct4U\website\voorbeeld uitdraai\XConstructVoorbeeldenDutch.xcst

Consequence class : CC2

PUNCHING: Punch

INPUT DATA



Concrete grade	C30/37	
Steel grade	B500B	
Longitudinal reinf. y	10-100	
Longitudinal reinf. z	10-100	
First layer	Longitudinal reinf. y	
Cover c	25 mm	
Angel shear reinforcement	90 degrees	
V_{Ed}	275 kN	
Eccentricity	e_y = 50 mm	e_z = 50 mm
q_{Ed}	0 kN/m ^{2}	

CALCULATION according to Eurocode 2

Applied standards: : NEN-EN 1992-1-1+C1:2011/NB:2016+A1:2020 nl

6.4.3 Punching shear calculation

$$d_{eff} = \frac{d_y + d_z}{2} = \frac{210 + 200}{2} = 205 \text{ mm} \quad ...(6.32)$$

$$\nu = 0{,}6 \left[1 - \frac{f_{ck}}{250} \right] = 0{,}6 \times \left[1 - \frac{30}{250} \right] = 0{,}528 \quad ...(6.6N)$$

$$v_{Rd,max} = 0{,}4 \ \nu \ f_{cd} = 0{,}4 \times 0{,}528 \times 20 = 4{,}22 \text{ MPa}$$

$$c_1 / (2 c_2) = 800 / (2 \times 800) = 0{,}5 \qquad k = 0{,}45 \quad ...(T\ 6.1)$$

$$W_1 = 2{,}365 \text{ m}^2 \quad ...(6.40)$$

$$\beta = \frac{u_1}{u_{1*}} + k \frac{u_1}{W_1} e_{par} = \frac{3845}{2888} + 0{,}45 \times \frac{3845}{2{,}365 \times 10^6} \times 50 = 1{,}37 \quad ...(6.44)$$

$$u_0 = \pi \ D = \pi \times 300 = 942 \text{ mm}$$

$$v_{Ed} = \beta \ \frac{V_{Ed}}{u_0 \ d} = 1{,}37 \times \frac{275 \times 10^3}{942 \times 305} = 1{,}31 \text{ MPa} < v_{Rd,max} = 4{,}22 \text{ MPa} \quad ...(6.53)$$

$$k = 1 + \sqrt{\frac{200}{d}} = 1 + \sqrt{\frac{200}{205}} = 1{,}988 \leq 2{,}0$$

$$\rho_{ly} = A_{sly} / (b_w \ d_y) = 785 / (1000 \times 210) = 0{,}00374$$

$$\rho_{lz} = A_{slz} / (b_w \ d_z) = 785 / (1000 \times 200) = 0{,}00393$$

$$\rho_l = \sqrt{\rho_{ly} \ \rho_{lz}} = \sqrt{0{,}004 \times 0{,}004} = 0{,}0037 < 0{,}02$$

$$v_{Rd,c1} = C_{Rd,c} \ k \ (100 \ \rho_l \ f_{ck})^{1/3} + k_1 \ \sigma_{cp} = \quad ...(6.47)$$

$$= 0{,}12 \times 1{,}988 \times (100 \times 0{,}004 \times 30)^{1/3} + 0{,}15 \times 0 = 0{,}54 \text{ MPa}$$

$$v_{min} = 0{,}035 \ k^{3/2} \ f_{ck}^{1/2} = 0{,}035 \times 1{,}988^{3/2} \times 30^{1/2} = 0{,}54 \text{ MPa} \quad ...(6.3N)$$

$$v_{Rd,c2} = v_{min} + k_1 \ \sigma_{cp} = 0{,}537 + 0{,}15 \times 0 = 0{,}54 \text{ MPa}$$

$$u_1 = 3845 \text{ mm} \qquad u_{1*} = 2888 \text{ mm} \qquad A_1 = 2{,}08 \text{ m}^2$$

$$V_{Ed} = V_{Ed} - A_1 \ q_{Ed} = 275 - 2{,}08 \times 0{,}00 = 275 \text{ kN}$$

$$v_{Ed} = \beta \ \frac{V_{Ed}}{u_1 \ d} = 1{,}37 \times \frac{275 \times 10^3}{3845 \times 205} = 0{,}48 \text{ MPa} < v_{Rd,c} = 0{,}54 \text{ MPa}$$

Punching shear reinforcement is not necessary