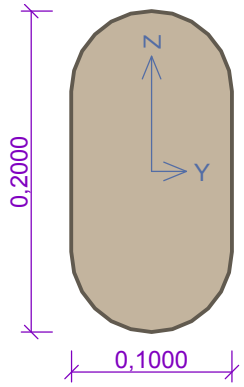
Demo01

Calculation factors

According to standard CSN EN 1992-1-1.

Geometry

Column cross-section:



Cross-section dimension	
cross-section height	h = 0,2000 m
cross-section width	b = 0,1000 m

Slab thickness h_s = 0,250 m
Column type - internal

Materials

Concrete: C 20/25, Longitudinal reinforcement: B500, Stirrups: B500

Concrete C 20/25

Strength in compression of concrete	$f_{c,k}$	=	20,0	MPa
Strength in tension of concrete	$f_{c,t}$	=	2,2	MPa
Concrete Young modulus	$E_{c,m}$	=	29000,0	MPa

Longitudinal reinforcement B500

Steel strength	$f_{t,k}$	=	500,0	MPa
Steel Young modulus	E	=	200000,0	MPa

Longitudinal reinforcement B500

Steel strength	$f_{t,k}$	=	500,0	MPa
Steel Young modulus	E	=	200000,0	MPa

Load

Shear force	V_{Ed}	=	300,00	kN
Bending moment in direction x	$M_{Ed,x}$	=	0,00	kNm
Bending moment in direction y	$M_{Ed,y}$	=	0,00	kNm
Axial force in slab	$N_{Ed,x}$	=	0,00	kN acting on width 1,000m
Axial force in slab	$N_{Ed,y}$	=	0,00	kN acting on width 1,000m

Reinforcement

Slab reinforcement in direction of axis x: 10,0 × ∅12,0mm/m, cover 30,0 mm
Slab reinforcement in direction of axis y: 10,0 × ∅12,0mm/m, cover 42,0 mm

Shear area

Shear reinforcement not set

Critical circumference table

column distance [m]	circumference [m]	v_{Ed} [MPa]	v_{Rd} [MPa]	Result
0	0,514	2,805	3,68	Pass
0,416	3,128	0,461	0,527	Pass

Detailed check

Effective slab thickness:
$d_x = h - c_x - 0,5 \times \phi_s = 0,25 - 0,03 - 0,5 \times 0,012 = 0,214$ m
$d_y = h - c_y - 0,5 \times \phi_s = 0,25 - 0,042 - 0,5 \times 0,012 = 0,202$ m
$d = 0,5 \times (d_x + d_y) = 0,5 \times (0,214 + 0,202) = 0,208$ m

Factor β:
$\beta = 1$

Maximum resistance on column cirumference $v_{Rd,max}$:
$\nu = 0,6 \times (1 - f_{ck} / 250) = 0,6 \times (1 - 20 / 250) = 0,552$
$v_{Rd,max} = 0,5 \times \nu \times f_{cd} = 0,5 \times 0,552 \times 13,33 = 3,68$ MPa

Shear stress on column cirumference $v_{Ed,max}$:
$v_{Ed,max} = \beta \times V_{Ed} / (u_0 \times d) = 1 \times 300 / (0,514 \times 0,208) = 2,805$ MPa

$v_{Ed,max} \leq v_{Rd,max} \Rightarrow$ Pass

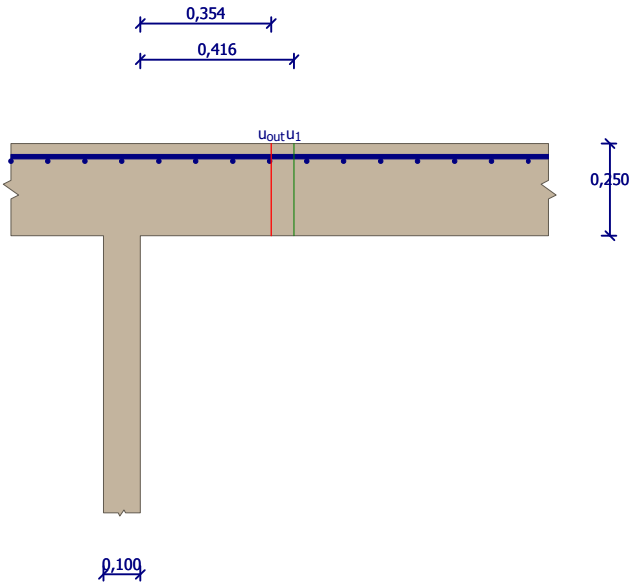
Concerete resistance $v_{Rd,c}$:
$C_{Rd,c} = 0,18 / \gamma_C = 0,18 / 1,5 = 0,12$
$k = \min(1 + \sqrt{(200 / d)}; 2) = \min(1 + \sqrt{(200 / 0,208)}; 2) = 1,981$
$A_{sx} = 2,5 \times \pi \times \phi_s^2 = 2,5 \times 3,142 \times 0,012^2 = 0,00113$ m^2
$\rho_{lx} = A_{sx} / (1 \times d) = 0,00113 / (1 \times 0,208) = 0,00544$
$A_{sy} = 2,5 \times \pi \times \phi_s^2 = 2,5 \times 3,142 \times 0,012^2 = 0,00113$ m^2
$\rho_{ly} = A_{sy} / (1 \times d) = 0,00113 / (1 \times 0,208) = 0,00544$
$\rho_l = \sqrt{(\rho_{lx} \times \rho_{ly})} = \sqrt{(0,00544 \times 0,00544)} = 0,00544$
$v_{min} = 0,035 \times k^{1,5} \times \sqrt{f_{ck}} = 0,035 \times 1,981^{1,5} \times \sqrt{20} = 0,436$ MPa
$v_{Rd,c} = \max(C_{Rd,c} \times k \times \sqrt[3]{(100 \times \rho_l \times f_{ck})}; v_{min}) = \max(0,12 \times 1,981 \times \sqrt[3]{(100 \times 0,00544 \times 20)}; 0,436) = 0,527$ MPa

Length of check cirumference, which meets the condition $v_{Rd,c} \geq v_{Ed}$:
$u_{out} = \beta \times V_{Ed} / (v_{Rd,c} \times d) = 1 \times 300 / (0,527 \times 0,208) = 2,739$ m
this cirumference lies at distance 0,354 m from the column edge

Check of cirumference no. 1 at distance 0,416 m from the column edge
Shear stress from load
$v_{Ed} = \beta \times V_{Ed} / (u_0 \times d) = 1 \times 300 / (3,128 \times 0,208) = 0,461$ MPa

Slab resistance in punching passes

Front view



Top view