

1 Demo01

Calculation factors

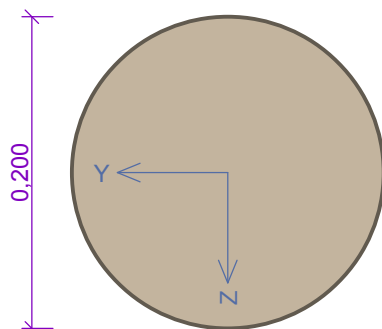
According to standard CSN EN 1992-1-1.

2 Column A7

2.1 Input data

Member type: column
Environment: X0

Section



Materials

Concrete : C 30/37

$f_{ck} = 30,0$ MPa; $f_{ctm} = 2,9$ MPa; $E_{cm} = 32000,0$ MPa

Longitudinal steel : 10505 (R) ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Transverse steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Internal forces - design (ULS)

no.	Load name	N_{Ed} [kN]	V_{Edz} [kN]	M_{Edy} [kNm]	QP coef. [-]
1	Load 1	-345,00	0,00	-5,00	1,000
2	Load 2	-270,00	0,00	5,00	1,000

Internal forces - characteristic (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 3	-150,00	10,00

Internal forces - quasi-permanent (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 4	-150,00	10,00

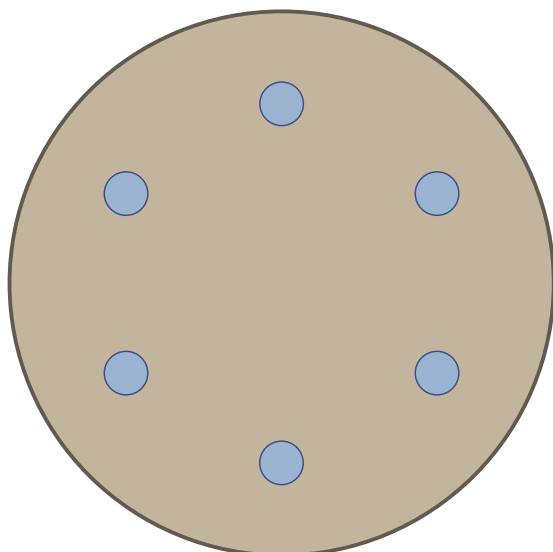
Buckling

Length [m]	Buckling coef. [-]	Buckling length [m]
3,00	0,50	1,50

Section reinforcement

Circle:6pc × profile 16,0, cover 26,0 mm

6x16,00 cov. 26,0



Reinforcement in compression not considered.

Shear area

Stirrups

Profile: 6,0 mm; Distance: 0,20 m; Legs: 2

Minimum cover

Structural class: S4

$$c_{min} = \max(c_{min,b}; c_{min,dur}; 10) = \max(16; 10; 10) = 16 \text{ mm}$$

$$c_{nom} = c_{min} + \Delta c_{dev} = 16 + 10 = 26 \text{ mm}$$

2.2 Results

Check of min and max reinforcement level

Column (total reinforcement):

$$\rho_s = 0,0384 \geq \rho_{s,min} = 0,00253 \Rightarrow \text{PASS}$$

$$\rho_s = 0,0384 \leq \rho_{s,max} = 0,04 \Rightarrow \text{PASS}$$

Check stirrup principles

$$\text{Min stirrup diameter } d = 6,00 \text{ mm} \Rightarrow \text{PASS}$$

$$\text{Max stirrup spacing } s_{cl,max} = 0,20 \text{ m} \Rightarrow \text{PASS}$$

Check of ultimate limit state

no.	Name	N_{Ed} [kN]	N_{Rd} [kN]	V_{Edz} [kN]	V_{Rdz} [kN]	M_{0Edy} [kNm]	M_{Edy} [kNm]	M_{Rdy} [kNm]	Check
1	Load 1	-345,00	-481,04	0,00	0,00	-7,59	-8,72	-13,84	Pass
2	Load 2	-270,00	-499,28	0,00	0,00	7,02	7,85	15,97	Pass

Ultimate limit state (bent-up bar, shear) PASS

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 3	19,96	69,74	Pass



no.	Name	σ_c [MPa]	σ_r [MPa]	Check
	Limit values $k_1 \times f_{ck} / k_3 \times f_{yk}$		400,00	

Crack width restriction limit state

no.	Name	$\Delta\epsilon$ [-]	s_{rmax} [m]	w [mm]	Check
1	Load 4	209.10 ⁻⁶	0,143	0,030	Pass
	Max allowed width w_{max}			0,400	

Serviceability limit state PASS

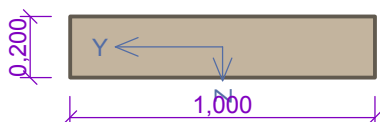
Overall check - Section PASS

3 Slab 0.2m

3.1 Input data

Member type: beam
Environment: X0

Section



Materials

Concrete : C 25/30

$f_{ck} = 25,0$ MPa; $f_{ctm} = 2,6$ MPa; $E_{cm} = 30500,0$ MPa

Longitudinal steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Transverse steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Internal forces - design (ULS)

no.	Load name	N_{Ed} [kN]	V_{Edz} [kN]	M_{Edy} [kNm]	QP coef. [-]
1	Load 1	0,00	45,00	38,00	1,000

Internal forces - characteristic (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 2	0,00	35,00

Internal forces - quasi-permanent (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 3	0,00	35,00

Section reinforcement

Count	Profile [mm]	Cover [mm]	Position
10	10,0	30,0	bottom reinforcement



10x10,0-cov.30,0

Reinforcement in compression not considered.

Shear area

Section without shear reinforcement.

Minimum cover

Structural class: S4

$$c_{min} = \max(c_{min,b}; c_{min,dur}; 10) = \max(10; 10; 10) = 10 \text{ mm}$$

$$c_{nom} = c_{min} + \Delta c_{dev} = 10 + 10 = 20 \text{ mm}$$

3.2 Results

Check of min and max reinforcement level

Beam (reinforcement in tension - min, total reinforcement - max):

$$\rho_{s,t} = 0,00476 \geq \rho_{s,min} = 0,00135 \Rightarrow \text{PASS}$$

$$\rho_s = 0,00393 \leq \rho_{s,max} = 0,04 \Rightarrow \text{PASS}$$

Check of ultimate limit state

no.	Name	N_{Ed} [kN]	N_{Rd} [kN]	V_{Edz} [kN]	V_{Rdz} [kN]	M_{Edy} [kNm]	M_{Rdy} [kNm]	Check
1	Load 1	0,00	0,00	45,00	90,41	38,00	54,10	Pass

Ultimate limit state (bent-up bar, shear) PASS

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 2	12,66	291,35	Pass
Limit values $k_1 \times f_{ck} / k_3 \times f_{yk}$			400,00	

Crack width restriction limit state



no.	Name	$\Delta\varepsilon$ [-]	s_{rmax} [m]	w [mm]	Check
1	Load 3	$874 \cdot 10^{-6}$	0,291	0,255	Pass
Max allowed width w_{max}				0,400	

Serviceability limit state **PASS**

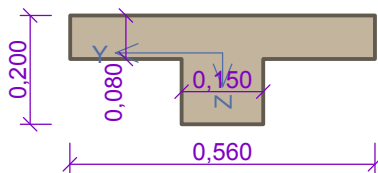
Overall check - Section **PASS**

4 Beam

4.1 Input data

Member type: beam
Environment: X0

Section



Materials

Concrete : C 25/30

$f_{ck} = 25,0$ MPa; $f_{ctm} = 2,6$ MPa; $E_{cm} = 30500,0$ MPa

Longitudinal steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Transverse steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Internal forces - design (ULS)

no.	Load name	N_{Ed} [kN]	V_{Edz} [kN]	M_{Edy} [kNm]	QP coef. [-]
1	Load 1	0,00	0,00	24,00	1,000

Internal forces - characteristic (SLS)

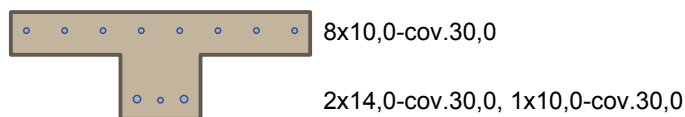
no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 2	0,00	20,00

Internal forces - quasi-permanent (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 3	0,00	20,00

Section reinforcement

Count	Profile [mm]	Cover [mm]	Position
8	10,0	30,0	upper reinforcement
2	14,0	30,0	bottom reinforcement
1	10,0	30,0	bottom reinforcement



Reinforcement in compression not considered.

Shear area

Section without shear reinforcement.

Minimum cover

Structural class: S4

$$c_{min} = \max(c_{min,b}; c_{min,dur}; 10) = \max(14; 10; 10) = 14 \text{ mm}$$

$$c_{nom} = c_{min} + \Delta c_{dev} = 14 + 10 = 24 \text{ mm}$$

4.2 Results

Check of min and max reinforcement level

Beam (reinforcement in tension - min, total reinforcement - max):

$$\rho_{s,t} = 0,0158 \geq \rho_{s,min} = 0,00135 \Rightarrow \text{PASS}$$

$$\rho_s = 0,0162 \leq \rho_{s,max} = 0,04 \Rightarrow \text{PASS}$$

Check of ultimate limit state

no.	Name	N_{Ed} [kN]	N_{Rd} [kN]	V_{Edz} [kN]	V_{Rdz} [kN]	M_{Edy} [kNm]	M_{Rdy} [kNm]	Check
1	Load 1	0,00	0,00	0,00	0,00	24,00	27,20	Pass

Ultimate limit state (bent-up bar, shear) PASS

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 2	13,90	344,01	Pass
Limit values $k_1 \times f_{ck} / k_3 \times f_{yk}$			400,00	

Crack width restriction limit state

no.	Name	$\Delta\varepsilon$ [-]	s_{rmax} [m]	w [mm]	Check
1	Load 3	0,00148	0,168	0,249	Pass
Max allowed width w_{max}				0,400	

Serviceability limit state **PASS**

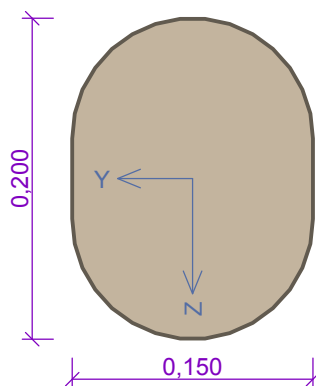
Overall check - Section **PASS**

5 Column Oval

5.1 Input data

Member type: column
Environment: X0

Section



Materials

Concrete : C 25/30

$f_{ck} = 25,0$ MPa; $f_{ctm} = 2,6$ MPa; $E_{cm} = 30500,0$ MPa

Longitudinal steel : B500 (cust.) ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Transverse steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Internal forces - design (ULS)

no.	Load name	N_{Ed} [kN]	V_{Edz} [kN]	M_{Edy} [kNm]	QP coef. [-]
1	Load 1	-180,82	0,00	3,28	1,000

Internal forces - characteristic (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 2	-150,00	3,00

Internal forces - quasi-permanent (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]
1	Load 3	-150,00	3,00

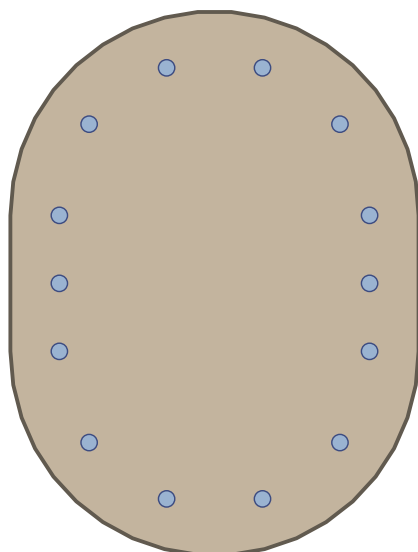
Buckling

Length [m]	Buckling coef. [-]	Buckling length [m]
2,00	1,00	2,00

Section reinforcement

Oval: 4pc $\times$ profile 6,0 in arc, 3pc $\times$ profile 6,0 on even edge, cover 15,0 mm

4x6,00, 3x6,00 cov. 15,0



Reinforcement in compression not considered.

Shear area

Section without shear reinforcement.

Minimum cover

Structural class: S4

$$c_{min} = \max(c_{min,b}; c_{min,dur}; 10) = \max(6; 10; 10) = 10 \text{ mm}$$

$$c_{nom} = c_{min} + \Delta c_{dev} = 10 + 10 = 20 \text{ mm}$$

5.2 Results

Check of min and max reinforcement level

Column (total reinforcement):

$$\rho_s = 0,0157 \geq \rho_{s,min} = 0,002 \Rightarrow \text{PASS}$$

$$\rho_s = 0,0157 \leq \rho_{s,max} = 0,04 \Rightarrow \text{PASS}$$

Check of ultimate limit state

no.	Name	N_{Ed} [kN]	N_{Rd} [kN]	V_{Edz} [kN]	V_{Rdz} [kN]	M_{0Edy} [kNm]	M_{Edy} [kNm]	M_{Rdy} [kNm]	Check
1	Load 1	-180,82	-327,42	0,00	0,00	4,18	5,65	10,85	Pass

Ultimate limit state (bent-up bar, shear) PASS

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 2	12,00	-1,23	Pass
Limit values $k_1 \times f_{ck} / k_3 \times f_{yk}$			400,00	

Crack width restriction limit state



no.	Name	$\Delta\epsilon$ [-]	s_{rmax} [m]	w [mm]	Check
1	Load 3	-	-	0,000	Pass
Max allowed width w_{max}				0,400	

Serviceability limit state **PASS**

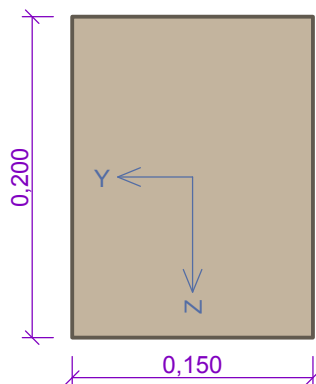
Overall check - Section **PASS**

6 Beam B3

6.1 Input data

Member type: beam
Environment: XC2
Length: 8,00m

Section



Materials

Concrete : C 25/30

$f_{ck} = 25,0$ MPa; $f_{ctm} = 2,6$ MPa; $E_{cm} = 30500,0$ MPa

Longitudinal steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

Transverse steel : B500 ($f_{yk} = 500,0$ MPa; $E = 200000,0$ MPa)

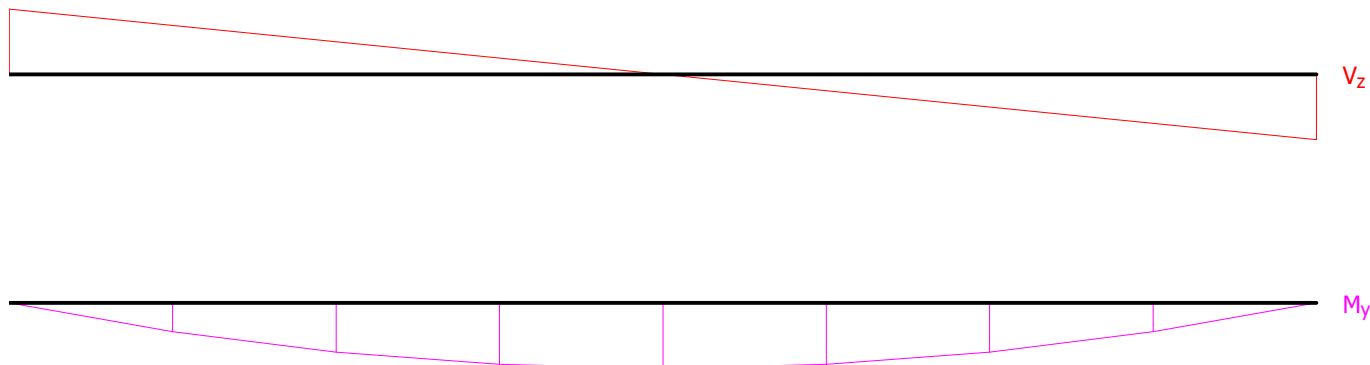
Internal forces

LOAD 1 - DESIGN (ULS)			
Position [m]	N_{Ed} [kN]	V_{Edz} [kN]	M_{Edy} [kNm]
0,00	0,00	-40,00	0,00
1,00	-	-	10,50
2,00	-	-	18,00
3,00	-	-	22,50
4,00	-	-	24,00
5,00	-	-	22,50
6,00	-	-	18,00
7,00	-	-	10,50
8,00	0,00	40,00	0,00

Load 1 - design (ULS)



N



Reinforcement

Sector no.: 1, (0,00m - 1,00m)

Count	Profile [mm]	Cover [mm]	Position
2	6,0	15,0	upper reinforcement
2	10,0	15,0	bottom reinforcement

Sector no.: 2, (1,00m - 2,50m)

Count	Profile [mm]	Cover [mm]	Position
2	6,0	15,0	upper reinforcement
4	10,0	15,0	bottom reinforcement

Sector no.: 3, (2,50m - 5,50m)

Count	Profile [mm]	Cover [mm]	Position
2	6,0	15,0	upper reinforcement
5	10,0	15,0	bottom reinforcement

Sector no.: 4, (5,50m - 7,00m)

Count	Profile [mm]	Cover [mm]	Position
2	6,0	15,0	upper reinforcement
4	10,0	15,0	bottom reinforcement

Sector no.: 5, (7,00m - 8,00m)

Count	Profile [mm]	Cover [mm]	Position
2	6,0	15,0	upper reinforcement
2	10,0	15,0	bottom reinforcement

Reinforcement in compression not considered.

Shear area

Sector no.: 1, (0,00m - 2,00m)

Stirrups

Profile: 4,0 mm; Distance: 0,10 m; Legs: 2

Sector no.: 2, (2,00m - 6,00m)

Stirrups

Profile: 4,0 mm; Distance: 0,12 m; Legs: 2

Sector no.: 3, (6,00m - 8,00m)



Stirrups

Profile: 4,0 mm; Distance: 0,10 m; Legs: 2

Minimum cover

Structural class: S4

$$c_{\min} = \max(c_{\min,b}; c_{\min,dur}; 10) = \max(10; 25; 10) = 25 \text{ mm}$$

$$c_{\text{nom}} = c_{\min} + \Delta c_{\text{dev}} = 25 + 10 = 35 \text{ mm}$$

6.2 Results

Ultimate limit state (ULS) is checked

Maximal utilization: 97,1%; Load 1; X=2,500m.

Count of entered cross-sections on member: 1

Member PASSES