

1 Demo01

Calculation factors

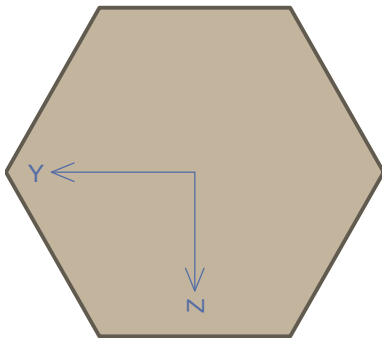
According to standard CSN EN 1992-1-1.

2 Column 3

2.1 Input data

Member type: column
Environment: X0

Section



BETON, OBEČNÝ POLYGON - POLYGON

Polygon points coordinates (number of points 6)

Point No. 1 [Y: -0,058 m, Z: 0,100 m]
Point No. 2 [Y: 0,058 m, Z: 0,100 m]
Point No. 3 [Y: 0,115 m, Z: 0,000 m]
Point No. 4 [Y: 0,058 m, Z: -0,100 m]
Point No. 5 [Y: -0,058 m, Z: -0,100 m]
Point No. 6 [Y: -0,115 m, Z: 0,000 m]

Materials

Concrete : C 30/37

$f_{ck} = 30,0$ MPa; $f_{ctm} = 2,9$ MPa; $E_{cm} = 32000,0$ 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]	V_{Edy} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]	QP coef. [-]
1	Load 1	-400,00	0,00	0,00	2,33	5,46	0,00	1,000
2	Load 2	-400,00	0,00	0,00	-2,40	-5,78	0,00	1,000

Internal forces - characteristic (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 3	350,00	2,00	0,00	0,00

Internal forces - quasi-permanent (SLS)

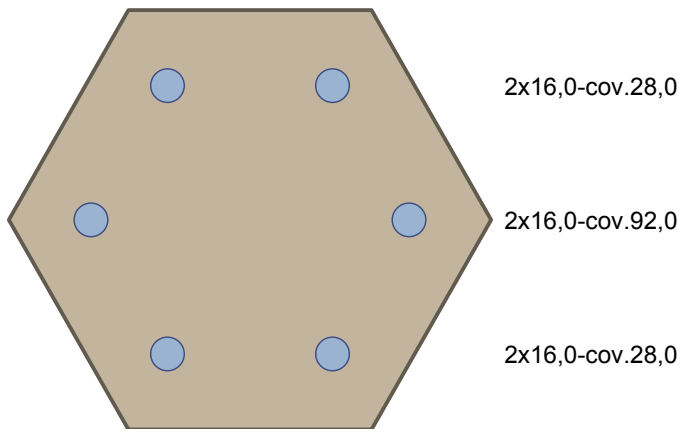
no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 4	-350,00	2,00	0,00	0,00

Buckling

Length [m]	Buckling coef. [-]	Buckling length [m]	Perpendicular to axis
2,00	1,00	2,00	Y
2,00	1,00	2,00	Z

Section reinforcement

Count	Profile [mm]	Cover [mm]	Position
2	16,0	28,0	upper reinforcement
2	16,0	92,0	upper reinforcement
2	16,0	28,0	bottom reinforcement



Reinforcement in compression not considered.

Shear area

Stirrups

Profile: 6,0 mm; Distance: 0,20 m; Vertical legs: 2; Horiz. legs: 2

Minimum cover

Structural class: S4

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

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

2.2 Results

Check of min and max reinforcement level

Column (total reinforcement):

$$\rho_s = 0,0349 \geq \rho_{s,\min} = 0,00266 \Rightarrow \text{PASS}$$

$$\rho_s = 0,0349 \leq \rho_{s,\max} = 0,04 \Rightarrow \text{PASS}$$

Check stirrup principles

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

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

Check of ultimate limit state

no.	Name	N_{Ed} N_{Rd} [kN]	V_{Edz} V_{Rdz} [kN]	V_{Edy} V_{Rdy} [kN]	M_{0Edy} [kNm]	M_{Edy} M_{Rdy} [kNm]	M_{0Edz} [kNm]	M_{Edz} M_{Rdz} [kNm]	T_{Ed} T_{Rd} [kNm]	Check
1	Load 1	-400,00	0,00	0,00	3,14	3,96	7,36	9,13	0,00	Pass
		-692,00	0,00	0,00	-	6,22	-	14,33	0,00	
2	Load 2	-400,00	0,00	0,00	-3,17	-3,99	-7,63	-9,46	0,00	Pass
		-692,00	0,00	0,00	-	-6,07	-	-14,38	0,00	

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

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 3	-	328,98	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 4	-	-	0,000	Pass
Max allowed width w_{max}				0,400	

Serviceability limit state **PASS**

Overall check - Section **PASS**

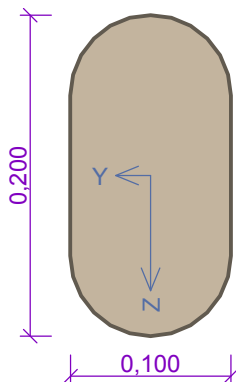
3 Column 7

3.1 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 ($f_{yk} = 500,0$ 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]	V_{Edy} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]	QP coef. [-]
1	Load 1	-100,00	0,00	0,00	3,76	2,04	0,00	1,000

no.	Load name	N_{Ed} [kN]	V_{Edz} [kN]	V_{Edy} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]	QP coef. [-]
2	Load 2	-100,00	0,00	0,00	-2,80	-1,86	0,00	1,000

Internal forces - characteristic (SLS)

no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 3	-80,00	2,00	-2,00	0,00

Internal forces - quasi-permanent (SLS)

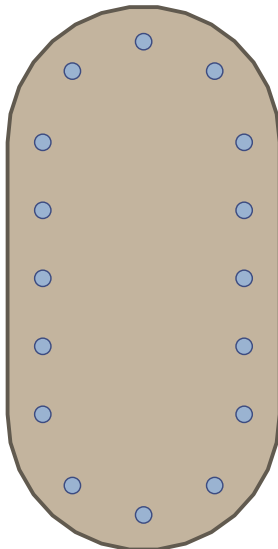
no.	Load name	N_{Ed} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 4	-80,00	2,00	-2,00	0,00

Buckling

Length [m]	Buckling coef. [-]	Buckling length [m]	Perpendicular to axis
2,00	1,00	2,00	Z

Section reinforcement

Oval: 3pc × profile 6,0 in arc, 5pc × profile 6,0 on even edge, cover 10,0 mm
3x6,00, 5x6,00 cov. 10,0



Reinforcement in compression not considered.

Shear area

Section without shear reinforcement.

Minimum cover

Structural class: S4

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

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

3.2 Results

Check of min and max reinforcement level

Column (total reinforcement):



$$\rho_s = 0,0253 \geq \rho_{s,\min} = 0,002 \Rightarrow \text{PASS}$$

$$\rho_s = 0,0253 \leq \rho_{s,\max} = 0,04 \Rightarrow \text{PASS}$$

Check of ultimate limit state

no.	Name	N_{Ed} N_{Rd} [kN]	V_{Edz} V_{Rdz} [kN]	V_{Edy} V_{Rdy} [kN]	M_{0Edy} [kNm]	M_{Edy} M_{Rdy} [kNm]	M_{0Edz} [kNm]	M_{Edz} M_{Rdz} [kNm]	T_{Ed} T_{Rd} [kNm]	Check
1	Load 1	-100,00	0,00	0,00	4,20	4,20	2,28	3,67	0,00	Pass
		-297,46	0,00	0,00	-	4,69	-	4,10	0,00	
2	Load 2	-100,00	0,00	0,00	-3,22	-3,22	-2,14	-3,44	0,00	Pass
		-297,46	0,00	0,00	-	-4,03	-	-4,32	0,00	

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

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 3	20,79	97,33	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 4	$318 \cdot 10^{-6}$	0,053	0,017	Pass
Max allowed width w_{max}				0,400	

Serviceability limit state **PASS**

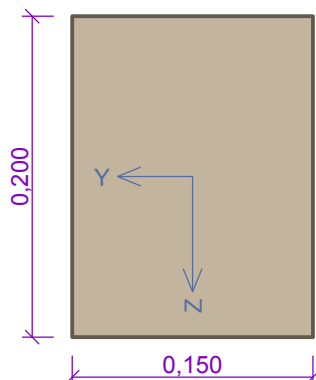
Overall check - Section **PASS**

4 Beam

4.1 Input data

Member type: beam
Environment: X0

Section



Materials

Concrete : C 25/30 (cust.)

$f_{ck} = 25,0$ 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]	V_{Ely} [kN]	M_{Ely} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]	QP coef. [-]
1	Load 1	0,00	32,00	0,00	12,00	0,00	0,00	1,000

Internal forces - characteristic (SLS)

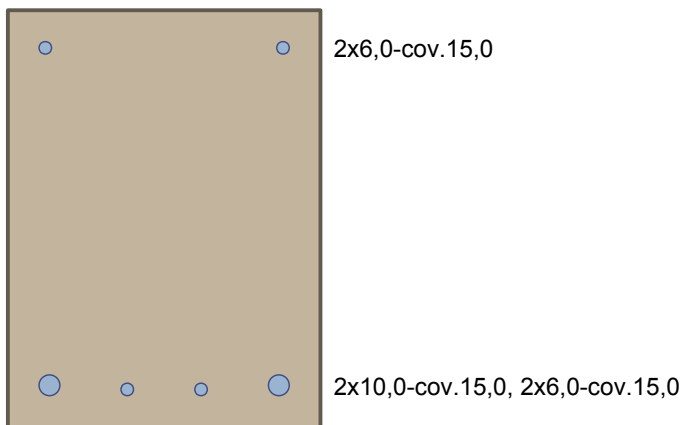
no.	Load name	N_{Ed} [kN]	M_{Ely} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 2	0,00	10,00	0,00	0,00

Internal forces - quasi-permanent (SLS)

no.	Load name	N_{Ed} [kN]	M_{Ely} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
1	Load 3	0,00	10,00	0,00	0,00

Section reinforcement

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



Reinforcement in compression not considered.

Shear area

Stirrups

Profile: 4,0 mm; Distance: 0,12 m; Vertical legs: 2; Horiz. legs: 2

Minimum cover

Structural class: S4

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

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

4.2 Results

Check of min and max reinforcement level

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

$$\rho_{s,t} = 0,00789 \geq \rho_{s,\min} = 0,00135 \Rightarrow \text{PASS}$$

$$\rho_s = 0,00901 \leq \rho_{s,\max} = 0,04 \Rightarrow \text{PASS}$$

Shear reinforcement ratio

$$\rho_{w,\min} = 800 \cdot 10^{-6} \leq \rho_w = 0,0014 \Rightarrow \text{PASS}$$

$$\text{Max stirrup spacing } s_{l,\max} = 0,14 \text{ m} \Rightarrow \text{PASS}$$

$$\text{Max stirrup legs spacing } s_{t,\max} = 0,14 \text{ m}$$

Check of ultimate limit state

no.	Name	N_{Ed} N_{Rd} [kN]	V_{Edz} V_{Rdz} [kN]	V_{Edy} V_{Rdy} [kN]	M_{Edy} M_{Rdy} [kNm]	M_{Edz} M_{Rdz} [kNm]	T_{Ed} T_{Rd} [kNm]	Check
1	Load 1	0,00	32,00	0,00	12,00	0,00	0,00	Pass
		0,00	36,69	0,00	15,17	0,00	0,00	

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

Check of serviceability limit state

Stress restriction limit state

no.	Name	σ_c [MPa]	σ_r [MPa]	Check
1	Load 2	15,82	287,98	Pass
Limit values $k_1 \times f_{ck} / k_3 \times f_{yk}$			400,00	

Crack width restriction limit state

no.	Name	$\Delta\epsilon$ [-]	$s_{r\max}$ [m]	w [mm]	Check
1	Load 3	0,00121	0,100	0,122	Pass
Max allowed width w_{\max}				0,400	

Serviceability limit state PASS

Overall check - Section PASS

5 Beam 1

5.1 Input data

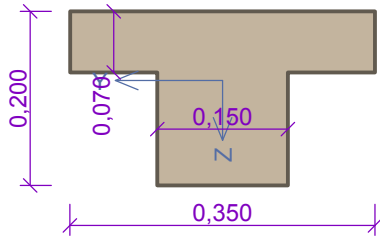
Member type: beam

Environment: XC2

Length: 8,00m

Section

Materials



Concrete : C 30/37

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

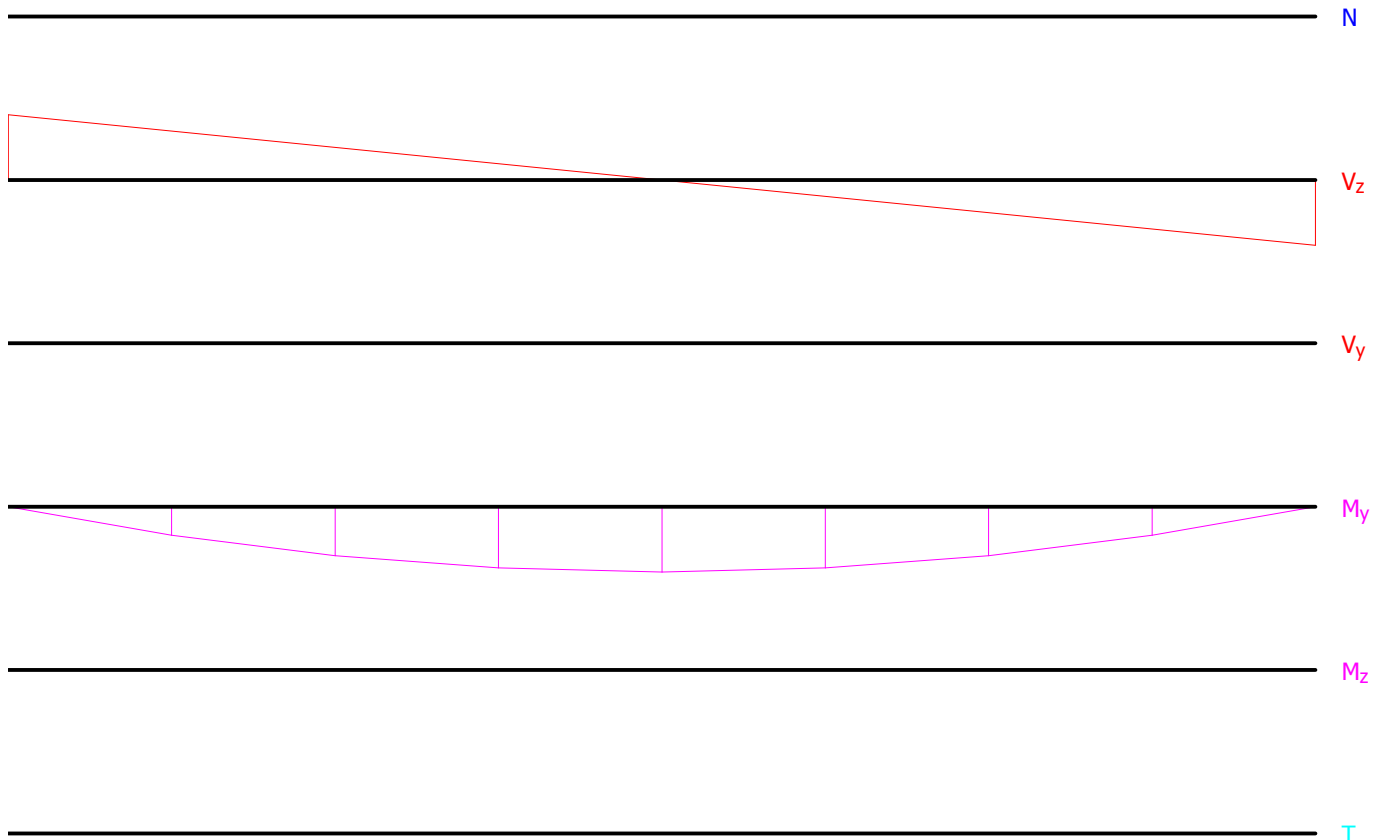
Longitudinal steel : B500 ($f_{yk} = 500,0 \text{ MPa}$; $E = 200000,0 \text{ MPa}$)

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

Internal forces

LOAD 1 - DESIGN (ULS)						
Position [m]	N_{Ed} [kN]	V_{Edz} [kN]	V_{Edy} [kN]	M_{Edy} [kNm]	M_{Edz} [kNm]	T_{Ed} [kNm]
0,00	0,00	-40,00	0,00	0,00	0,00	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	0,00	0,00	0,00

Load 1 - design (ULS)



Reinforcement

Sector no.: 1, (0,00m - 1,20m)



Concrete Grid Co.
London - Watford
Clarendon Rd. 25, UK

Shopping center - Black Rose
www.cgrid.com
cgrid@cgrid.com

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

Sector no.: 2, (1,20m - 3,00m)

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

Sector no.: 3, (3,00m - 5,00m)

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

Sector no.: 4, (5,00m - 6,80m)

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

Sector no.: 5, (6,80m - 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 considered.

Shear area

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

Stirrups

Profile: 4,0 mm; Distance: 0,10 m; Vertical legs: 2; Horiz. legs: 2

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

Stirrups

Profile: 4,0 mm; Distance: 0,12 m; Vertical legs: 2; Horiz. legs: 2

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

Stirrups

Profile: 4,0 mm; Distance: 0,10 m; Vertical legs: 2; Horiz. legs: 2

Minimum cover

Structural class: S4

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

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

5.2 Results

Ultimate limit state (ULS) is checked

Max. utilization: 94,4%, X= 0,000m

Count of entered cross-sections on member: 1

Member PASSES