4.5.1 Example 3

Design reinforcement to column from 3D frame with rectangular cross-section without buckling data and user reinforcement

<u>Input values :</u>

Structure: Frame XYZ

Concrete: C30/37 – f_{ck} = 30MPa , f_{cd} = 20 (for persistant situation)

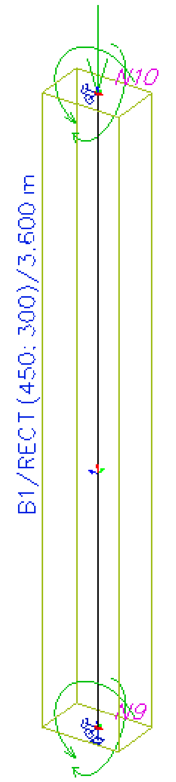
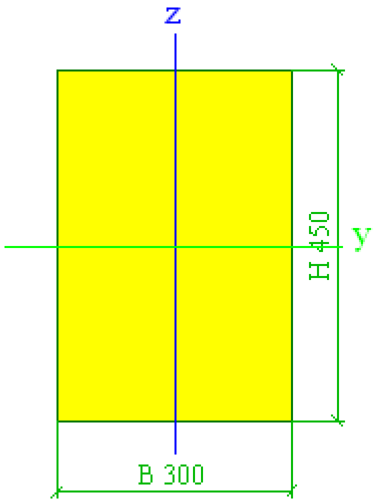
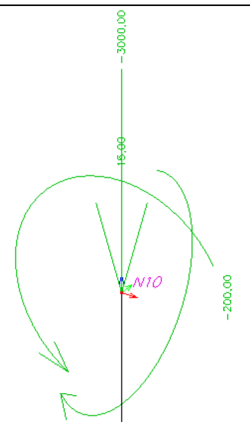
Reinforcement: B500A – f_{yk} = 500MPa, f_{yd} = 434,8 (for persistant situation)

Loads: LC1 permanent load in node

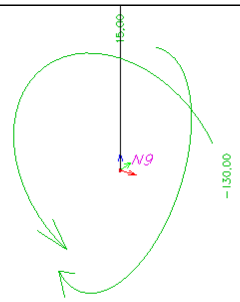
- head of column: N = -3000kN, M_y = -200kNm, Mz(Mx)=-15kNm
- foot of column : M_y = -130kNm, Mz(Mx)=-15kNm

Note: Mz1(Mx1) the value in brackets presents direction for input moment in GCS system

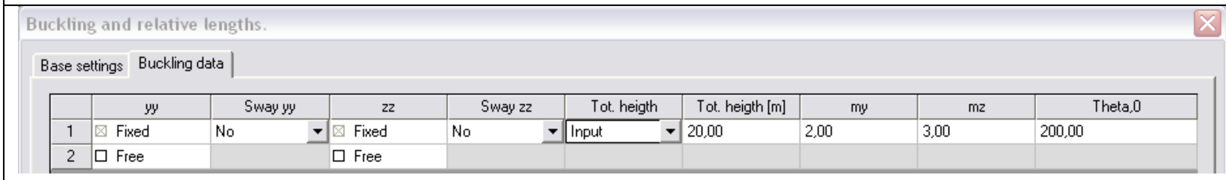
Combination C01 (EN-ULS(STR))

Scheme	Cross-section	Loads in head
		

Loads in foot



Buckling data: beta yy = Calculate, beta zz = Calculate



Buckling and relative lengths.

Base settings | Buckling data

	yy	Sway yy	zz	Sway zz	Tot. heigth	Tot. heigth [m]	my	mz	Theta,0
1	☒ Fixed	No	☒ Fixed	No	Input	20,00	2,00	3,00	200,00
2	☐ Free		☐ Free						

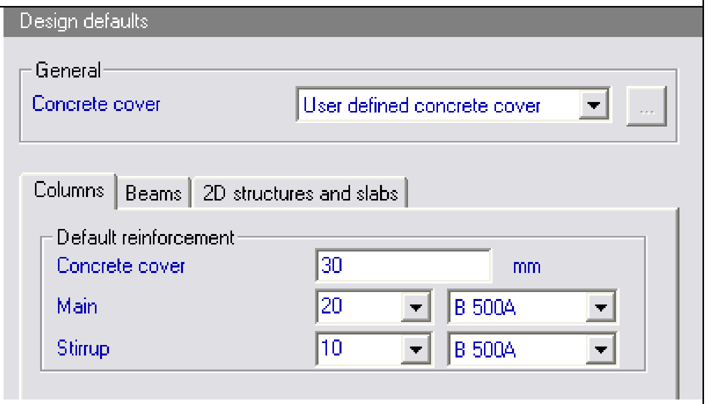
Setting of calculation

The basic parameter for design reinforcement can set for member without concrete member data in Concrete setup or for member with concrete member data directly in this data.

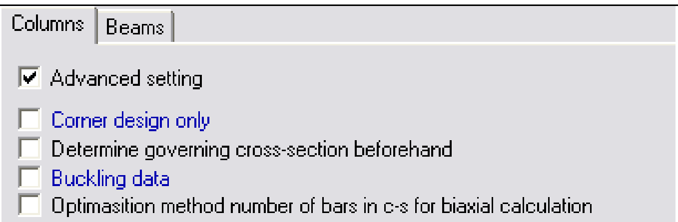
Alt.1 Concrete setup

(member without concrete member data)

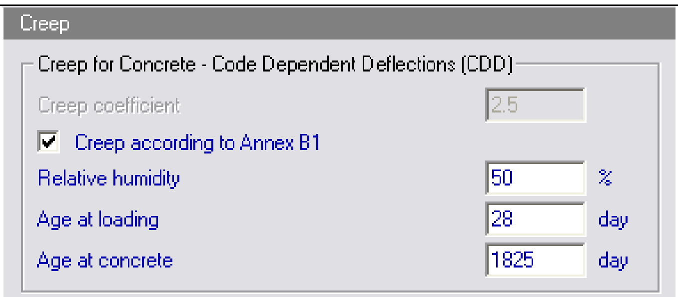
Item “Design default”



Item “Calculation >Column” (basic setting)

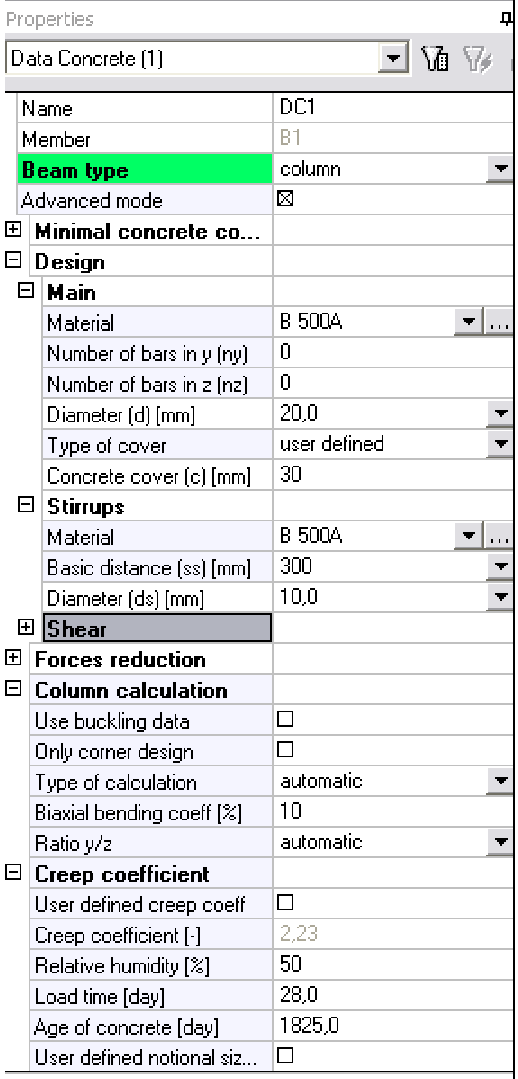


Item “Creep”



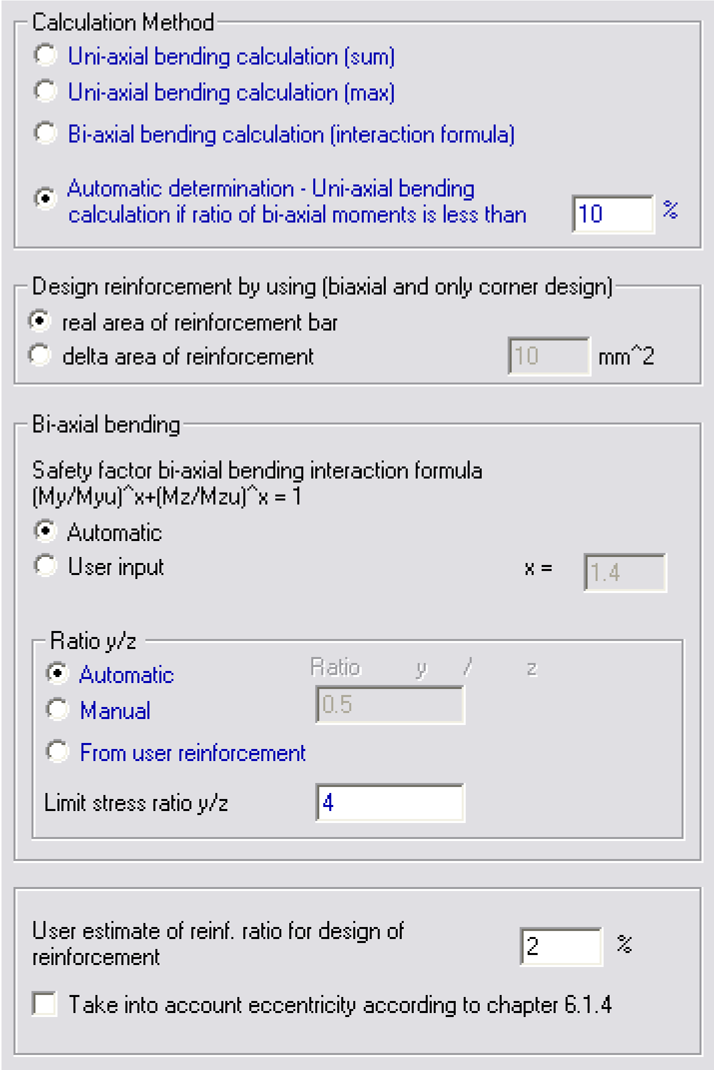
Alt.2 Concrete setup

(member with concrete member data)



There is switched “Advanced setting too” in basic setting, because we want to change the following default values:

- Take into account eccentricity according to chapter 6.1.4 is OFF (default value = ON)



Calculation of cross-section characteristic:

Calculation of concrete characteristic

$$A_c = b \cdot h = 0{,}45 \cdot 0{,}3 = 0{,}135 \text{ m}^2$$

$$i_{c,y} = \frac{h}{\sqrt{12}} = \frac{0{,}45}{\sqrt{12}} = 0{,}130 \text{ m}$$

$$i_{c,z} = \frac{b}{\sqrt{12}} = \frac{0{,}3}{\sqrt{12}} = 0{,}087 \text{ m}$$

Calculation of concrete characteristic in SEN

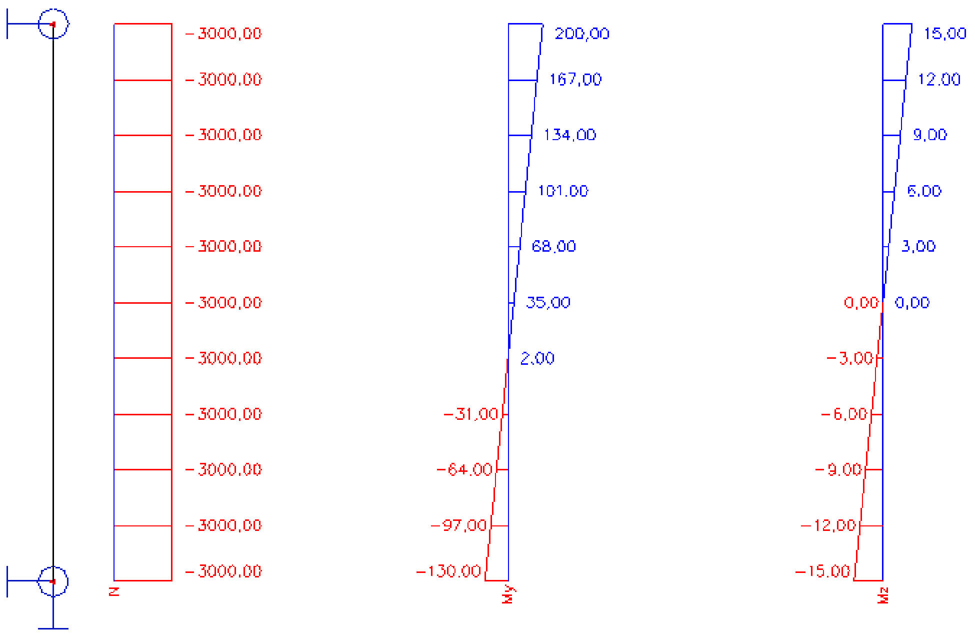
Cross-section characteristics EN 1992-1-1

Linear calculation, Extreme : Member
Selection : All
Load cases : LC1
Cross section characteristics for selected members

Member	d_x [m]	Case	Y_c [mm] Z_c [mm]	t_y [mm] t_z [mm]	A [mm²] b_w [mm]	I_y [mm⁴] I_z [mm⁴]	i_y [mm] i_z [mm]	S_y [mm³] S_z [mm³]	W_{y+} [mm³] W_{z+} [mm³]	W_{y-} [mm³] W_{z-} [mm³]
B1	0,000	LC1	150	0	135000	227812491 4	130	0	10125000	10125000
			225	0	300	1012500143	87	0	6750000	6750000

<u>Internal forces on column without second order effects and imperfections</u>

Internal forces at length of column



Calculation of first order eccentricities

$$e_{o,y} = \frac{M_{0Ed,z}}{|N_{Ed}|} \geq e_{0e,y} = \frac{M_{0e,z}}{|N_{Ed}|}\ ,\ e_{o,z} = \frac{M_{0Ed,y}}{|N_{Ed}|} \geq e_{0e,z} = \frac{M_{0e,y}}{|N_{Ed}|}$$

Note: the equivalent first order eccentricity e0e,y(z) are not calculated and compared with first order eccentricity because buckling data is not take into account.

- In head of column(section x =3,6m)

$$e_{o,y} = \frac{15}{|-3000|} = 0{,}005 \text{ m}\ ,\quad e_{o,z} = \frac{200}{|-3000|} = 0{,}067 \text{ m}$$

- In foot of column(section x =0m)

$$e_{o,y} = \frac{-15}{|-3000|} = \text{-0,005 m} \quad , \quad e_{o,z} = \frac{-130}{|-3000|} = \text{-0,043 m}$$

Check of slenderness

The limit slenderness in not calculated , because buckling data is not take into account for this example. The values of slenderness are calculated, because the values are needed for checking condition 5.8.9(3) in diagram of automatic design.

Calculation slenderness

$l_{0,y} = \beta_{yy} \cdot l = 1{,}0 \cdot 3{,}6 = 3{,}6$ m (effective length around y axis (perpendicular to y))

$l_{0,z} = \beta_{zz} \cdot l = 1{,}0 \cdot 3{,}6 = 3{,}6$ m (effective length around z axis (perpendicular to z))

$$\lambda_y = \frac{l_{0,y}}{i_{c,y}} = \frac{3{,}6}{0{,}130} = 27{,}7$$

$$\lambda_z = \frac{l_{0,z}}{i_{c,z}} = \frac{3{,}6}{0{,}087} = 41{,}38$$

Note: *the value β_y and β_z are calculated by program automatically because in dialog Buckling and relative lengths the values beta yy and beta zz = Calculate. The calculated values of β_y and β_z are 1,0, because the column are hinged support on the end of column and the column is non sway.*

Calculation slenderness in SEN

Concrete slenderness

Member	CS Name	Part	Sway$_y$ Sway$_z$	l_y [m] l_z [m]	β_y [-] β_z [-]	$l_{0,y}$ [m] $l_{0,z}$ [m]	i_y [mm] i_z [mm]	λ_y [-] λ_z [-]	$\lambda_{lim,y}$ [-] $\lambda_{lim,z}$ [-]	Check$_{calc}$ [-] Check$_{lim}$ [-]	Check
B1	CS2	1	No	3,600	1,00	3,600	130	27,71	42,16	0,86	OK
			No	3,600	1,00	3,600	87	41,57	48,44	1,00	

Internal forces on column with second order effects and imperfections

Internal forces on column with second order effects and imperfections are same as internal forces from FE analysis, because the check boxes “Buckling data” and “Take into account eccentricity according to chapter 6.1.4” are OFF. It follows the formulas

$M_{Ed,y} = M_{0Ed,y}$, $M_{Ed,z} = M_{0Ed,z}$, $e_{Ed,y} = e_{0,y}$, $e_{Ed,z} = e_{0,z}$

Note: the value $M_{Ed,y}$ and $M_{Ed}y$ are named as recalculated internal forces ($M_{y,recal}$ and $M_{z,recal}$) in SEN (the service Internal forces in concrete tree)

the value $e_{Ed,y}$ and $e_{Ed}y$ are named as total value of eccentricity ($e_{tot,y}$ and $e_{tot,z}$) in SEN (the service Internal forces in concrete tree)

The recalculated internal forces in SEN

Internal forces EN 1992-1-1

Internal forces

Member	d_x [m]	Case	N [kN]	V_y [kN]	V_z [kN]	M_y [kNm]	M_z [kNm]	N_{rec} [kN]	$V_{y\,rec}$ [kN]	$V_{z\,rec}$ [kN]	$M_{y\,rec}$ [kNm]	$M_{z\,rec}$ [kNm]
B1	0,000	LC1	-3000,00	8,33	91,67	-130,00	-15,00	-3000,00	8,33	91,67	**-130,00**	-15,00
B1	3,600	LC1	-3000,00	8,33	91,67	200,00	15,00	-3000,00	8,33	91,67	**200,00**	15,00

Determination type of automatic calculation for design reinforcement

Type of calculation in head of the column (section x =3,6m)

Check condition 5.8.9 (3)

- slenderness ratio

$$\frac{\lambda_y}{\lambda_z} = \frac{27,7}{41,38} = 0,67 \le 2 \;\; (\text{ OK })$$

$$\frac{\lambda_z}{\lambda_y} = \frac{41,38}{27,4} = 1,51 \le 2 \;\; (\text{ OK })$$

Check of slendernes ratio is fulfilled, because both conditions are OK

- relative eccentricity

$$\frac{e_{Ed,y}/b_{eq}}{e_{Ed,z}/h_{eq}} \le 0,2 \quad \text{or} \quad \frac{e_{Ed,z}/h_{eq}}{e_{Ed,y}/b_{eq}} \le 0,2$$

where

b_{eq} = b =0,3 m and h_{eq} = h =0,45 because rectangular section

$e_{Ed,z(y)}$ see chapter "Internal forces on column with second order effects and imperfections "

$$\frac{e_{Ed,y}/b_{eq}}{e_{Ed,z}/h_{eq}} = \frac{0,005/0,3}{0,067/0,45} = \frac{0,0167}{0,134} = 0,112 \le 0,2 \;\; (\text{ OK })$$

$$\frac{e_{Ed,z}/h_{eq}}{e_{Ed,y}/b_{eq}} = \frac{0,067/0,45}{0,005/0,3} = \frac{0,134}{0,0167} = 8,022 > 0,2 \;\; (\text{ NOT OK })$$

Check of relative slenderness is fulfilled, because one condition from both is OK

The conditions according to chapter 5.8.9 (3) are fulfilled, because check of slenderness ratio and relative eccentricity are OK.

Check ratio of biaxial bending moment

$$\text{Ratio}(M_y/Mz) = \frac{\min(|M_{Ed,y}|,|M_{Ed,z}|)}{\max(|M_{Ed,y}|,|M_{Ed,z}|)}\cdot 100 = \frac{\min(|200|,|15|)}{\max(|200|,|15|)}\cdot 100 = \frac{15}{200}\cdot 100 =$$

$$= 7{,}5\% < \text{limit value} = 10\% \Rightarrow \text{condition is fulfilled}$$

The type of calculation for head of column is Uniaxial (max) because conditions 5.8.9(3) and condition for ratio of biaxial moment are fulfilled

Conditions 5.8.9(3)	Ratio of biaxial moment	Type of calculation
OK	OK	**Uniaxial (max)**

Type of calculation in foot of the column (section x =0,0m)

Check condition 5.8.9(3)

- slenderness ratio

$$\frac{\lambda_y}{\lambda_z} = \frac{27{,}7}{41{,}38} = 0{,}67 \le 2 \ \ (\text{ OK })$$

$$\frac{\lambda_z}{\lambda_y} = \frac{41{,}38}{27{,}4} = 1{,}51 \le 2 \ \ (\text{ OK })$$

Check of slenderness ratio is fulfilled, because both conditions are OK

- relative eccentricity

$$\frac{e_{Ed,y}/b_{eq}}{e_{Ed,z}/h_{eq}} \le 0{,}2 \quad \text{or} \quad \frac{e_{Ed,z}/h_{eq}}{e_{Ed,y}/b_{eq}} \le 0{,}2$$

where

b_{eq} = b =0,3 m and h_{eq} = h =0,45 because rectangular section

$e_{Ed,z(y)}$ see chapter "Internal forces on column with second order effects and imperfections "

$$\frac{e_{Ed,y}/b_{eq}}{e_{Ed,z}/h_{eq}} = \frac{-0{,}005/0{,}3}{-0{,}043/0{,}45} = \frac{-0{,}0167}{-0{,}096} = 0{,}174 \le 0{,}2 \ \ (\text{ OK })$$

$$\frac{e_{Ed,z}/h_{eq}}{e_{Ed,y}/b_{eq}} = \frac{-0{,}043/0{,}45}{-0{,}005/0{,}3} = \frac{-0{,}096}{-0{,}0167} = 5{,}75 > 0{,}2 \ \ (\text{ NOT OK })$$

Check of relative slenderness is fulfilled, because one condition from both is OK

The conditions according to chapter 5.8.9(3) are fulfilled, because check of slenderness ratio and relative eccentricity are OK.

Check ratio of biaxial bending moment

$$\text{Ratio}(M_y/Mz) = \frac{\min(|M_{Ed,y}|,|M_{Ed,z}|)}{\max(|M_{Ed,y}|,|M_{Ed,z}|)} \cdot 100 = \frac{\min(|-130|,|-15|)}{\max(|-130|,|-15|)} \cdot 100 = \frac{15}{130} \cdot 100 =$$

= 11,54% > limit value = 10% => condition is not fulfilled

The type of calculation for head of column is Uniaxial (sum) because conditions 5.8.9(3) are fullfiled, but condition for ratio of biaxial moment is not fulfilled

Conditions 5.8.9(3)	**Ratio of biaxial moment**	**Type of calculation**
OK	NOT OK	**Uniaxial (sum)**

Design reinforcement with item “Determine governing cross-section in beforehand “ OFF

Design reinforcement in head of column (section x =3,6 m)

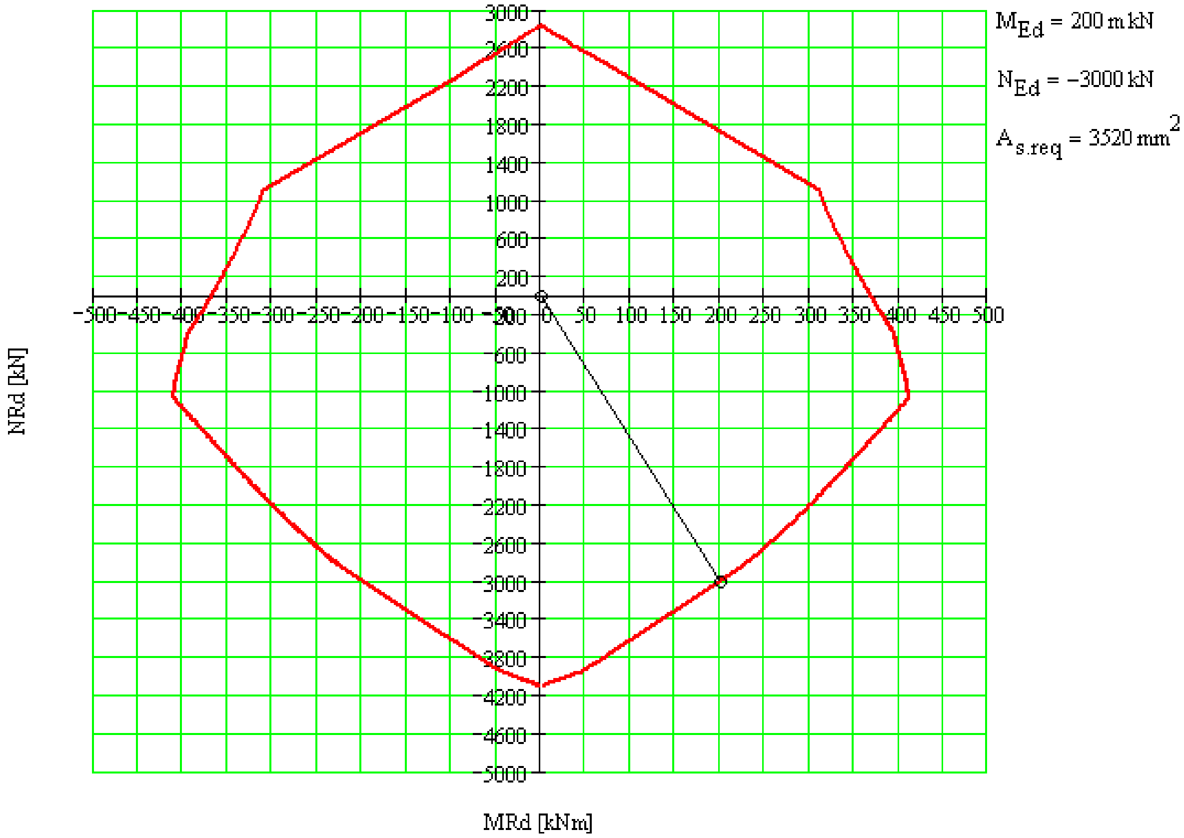
The uniaxial(max) method is used for automatic calculation in head of column. Uniaxial(max) method is design reinforcement only around the axis with the bigger bending moment .

$M_{Ed,y}$ = 200 kNm > $M_{Ed,z}$ = 15 kNm = > design reinforcement around y axis.

Design reinforcement around y axis

The reinforcement is located parallel with z axis

N_{Ed} = -3000 kN, $M_{Ed,y}$ = 200 kNm



Calculation of total area of reinforcement

$$A_{1,s} = \frac{\pi \cdot (d_s)^2}{4} = \frac{3,14 \cdot 20^2}{4} = 314,59 \text{ mm}^2$$

$A_{s,req,y} = 3520 \text{ mm}^2$

$A_{s,req,z} = 0 \text{ mm}^2$

$A_{s,req} = A_{s,req,y} = 3520 \text{ mm}^2$

$A_{s,cor} = 4 \cdot A_{1,s} = 4 \cdot 314,59 = 1258,36 \text{ mm}^2$

$A_{s,req,ed,y} = A_{s,req,y} - A_{s,cor} = 3520 - 1258,36 = 2261 \text{ mm}^2$

$$\text{Ratio y/z} = \frac{(A_{s,req,y} / A_{s,req}) \cdot 100}{(A_{s,req,z} / A_{s,req}) \cdot 100} = \frac{(3520/3520) \cdot 100}{(0/3520) \cdot 100} = \frac{100}{0} = 100/0$$

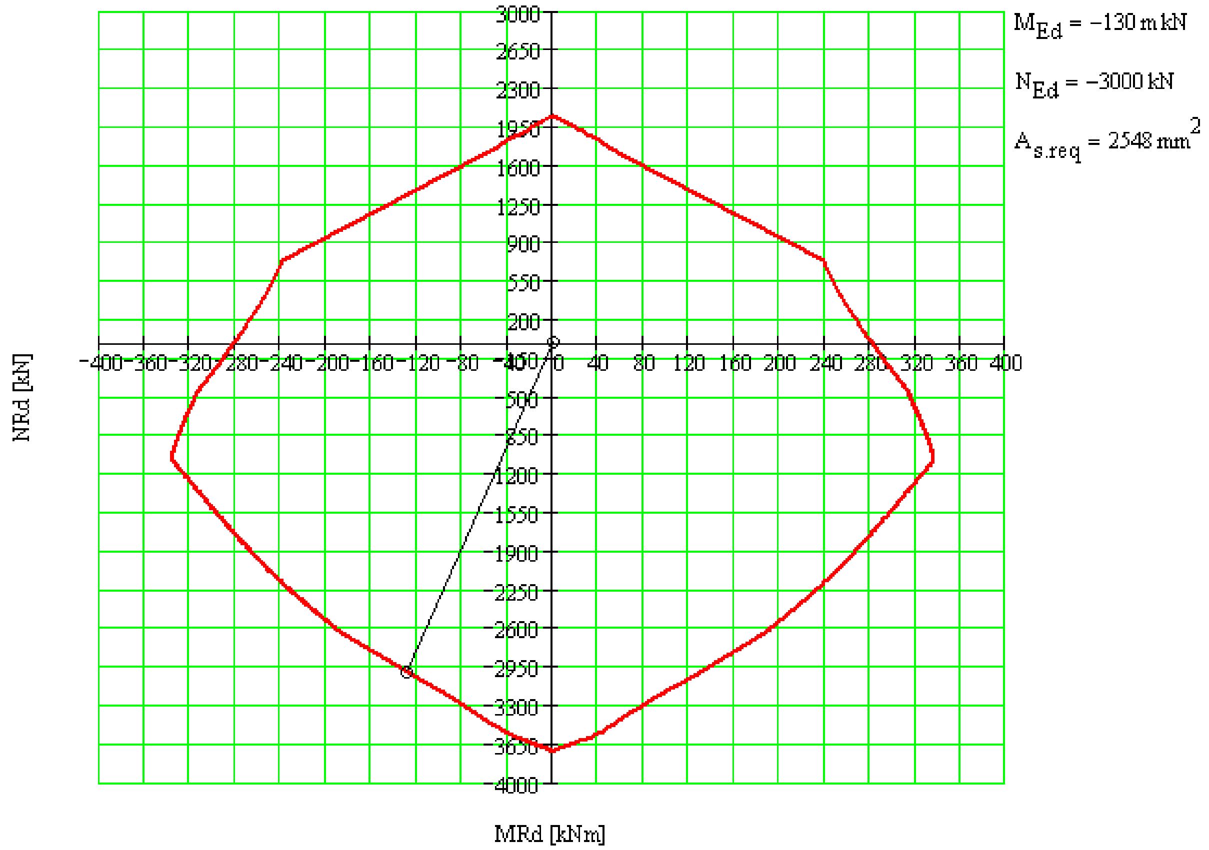
Design reinforcement in foot of column (section x =0,0 m)

The uniaxial(sum) method is used for automatic calculation in head of column. The reinforcement is separately designed around the both axis and the final area of reinforcement is sum of reinforcement from the both direction for this method

Design reinforcement around y axis

The reinforcement is located parallel with y axis

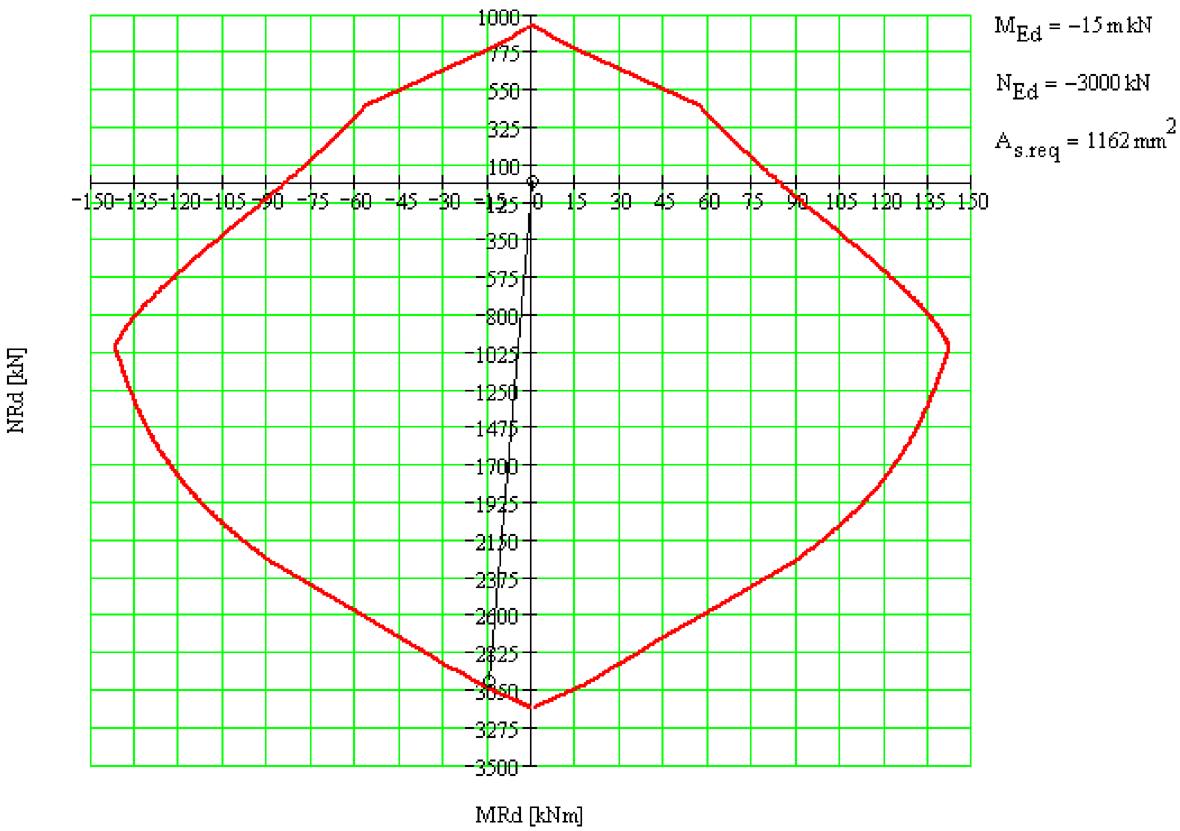
N_{Ed} = -3000 kN, $M_{Ed,y}$ = -130 kNm



Design reinforcement around z axis

The reinforcement is located parallel with z axis

N_{Ed} = -3000 kN, $M_{Ed,y}$ = -15 kNm



Calculation of total area of reinforcement

$$A_{1,s} = \frac{\pi \cdot (d_s)^2}{4} = \frac{3{,}14 \cdot 20^2}{4} = 314{,}59 \text{ mm}^2$$

$A_{s,req,y} = 2548 \text{ mm}^2$

$A_{s,req,z} = 1162 \text{ mm}^2$

$A_{s,req} = A_{s,req,y} + A_{s,req,z} = 2548 + 1162 = 3710 \text{ mm}^2$

$A_{s,cor} = 4 \cdot A_{1,s} = 4 \cdot 314{,}59 = 1258{,}36 \text{ mm}^2$

$A_{s,req,ed,y} = A_{s,req,y} - 0{,}5 \cdot A_{s,cor} = 2548 - 0{,}5 \cdot 1258{,}36 = 1918{,}8 \text{ mm}^2$

$A_{s,req,ed,z} = A_{s,req,z} - 0{,}5 \cdot A_{s,cor} = 1162 - 0{,}5 \cdot 1258{,}36 = 532{,}8 \text{ mm}^2$

$$\text{Ratio y/z} = \frac{(A_{s,req,y} / A_{s,req}) \cdot 100}{(A_{s,req,z} / A_{s,req}) \cdot 100} = \frac{(2548/3710) \cdot 100}{(1162/3710) \cdot 100} = \frac{68{,}7}{31{,}3} = 68{,}7/31{,}3$$

Graphical and numerical output of required reinforcement in SEN

The graphical and numerical output of designed reinforcement is presented in SEN in service. We can present results at length of member or detailed result in selected section with using action button “SingleCheck”.

<u>The numerical presentation of reinforcement in member check</u>

Design As EN 1992-1-1

Linear calculation, Extreme : Section
Selection : All
Load cases : LC1

Main reinforcement for selected columns

Member	d_x [m]	Case	N_d [kN]	M_yd [kNm]	M_zd [kNm]	Calc. type	Ratio y/z [%]	A_s,req,y [mm^2]	A_s,req,z [mm^2]	A_s,req [mm^2]	Reinf_req	W/E
B1	0,000	LC1	-3000,00	-130,00	-15,00	Us	69/31	2548	1163	3711	14(12/6)x20,0	134
B1	3,600	LC1	-3000,00	200,00	15,00	Um	100/0	3520		3520	12(12/4)x20,0	134

Design As EN 1992-1-1

Linear calculation, Extreme : Section
Selection : All
Load cases : LC1

Main reinforcement for selected columns

Member	d_x [m]	Case	N_d [kN]	M_yd [kNm] M_zd [kNm]	A_s,req,cor [mm^2]	A_s,req,ed,y [mm^2]	A_s,req,ed,z [mm^2]	A_s,req [mm^2]	Reinf_tot	W/E
B1	0,000	LC1	-3000,00	-130,00 -15,00	1257	1919	535	3711	14x20,0(4398)	134
B1	3,600	LC1	-3000,00	200,00 15,00	1257	2263		3520	12x20,0(3770)	134

<u>The numerical presentation of reinforcement in single check</u>

In head of column (section x = 3,6 m)

EN 1992-1-1 concrete design

Main reinforcement for selected column

x.loc [m]	Combi Case	Nd [kN]	Mdy [kNm] Mdz [kNm]	Calc. Type Ratio y/z	A_s,req,cor [mm^2] A_s,user,cor [mm^2]	A_s,req,ed,y [mm^2] A_s,user,ed,y [mm^2]	A_s,req,ed,z [mm^2] A_s,user,ed,z [mm^2]	A_s,req [mm^2] A_s,user [mm^2]
3.60	LC1	-3000.00	199.98 0.00	Um 1.00/0.00	1256.64 0.00	2263.16 0.00	0.00 0.00	3519.80 0.00

Detailed description of reinforcement bars for selected column

x.loc [m]	Combi Case	Reinf_cor,req Reinf_cor,user	Reinf_ed,y,req Reinf_ed,y,user	Reinf_ed,z,req Reinf_ed,z,user	Reinf_tot,req Reinf_tot,user
3.60	LC1	4x B 500A (20) = 1257 mm^2	8x B 500A (20) = 2513 mm^2		12x B 500A (20) = 3770 mm^2

In foot of column (section x = 0,0 m)

EN 1992-1-1 concrete design

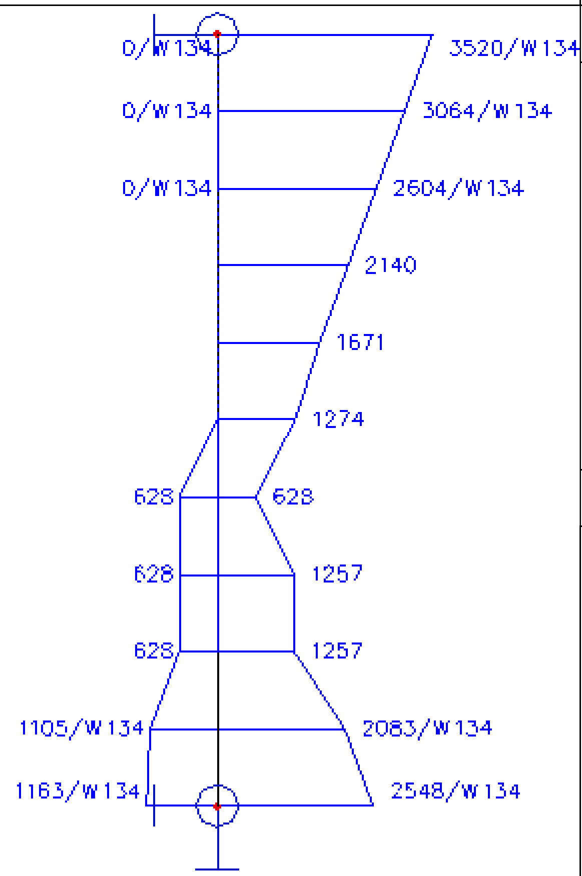
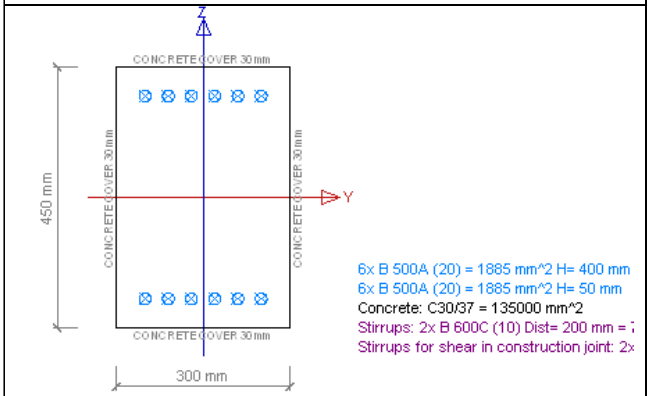
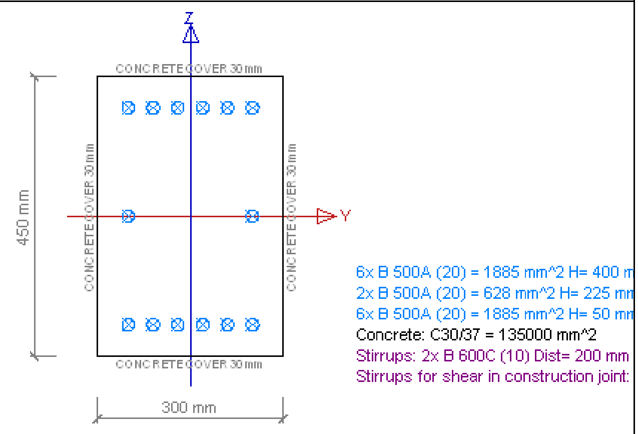
Main reinforcement for selected column

x.loc [m]	Combi Case	Nd [kN]	Mdy [kNm] Mdz [kNm]	Calc. Type Ratio y/z	A_s,req,cor [mm^2] A_s,user,cor [mm^2]	A_s,reg,ed,y [mm^2] A_s,user,ed,y [mm^2]	A_s,req,ed,z [mm^2] A_s,user,ed,z [mm^2]	A_s,req [mm^2] A_s,user [mm^2]
0.00	LC1	-3000.00	-129.99 -15.00	Us 0.69/0.31	1256.64 0.00	1919.30 0.00	534.50 0.00	3710.43 0.00

Detailed description of reinforcement bars for selected column

x.loc [m]	Combi Case	Reinf_cor,req Reinf_cor,user	Reinf_ed,y,req Reinf_ed,y,user	Reinf_ed,z,req Reinf_ed,z,user	Reinf_tot,req Reinf_tot,user
0.00	LC1	4x B 500A(20)= 1257 mm^2	8x B 500A(20) = 2513 mm^2	2x B 500A(20)= 628 mm^2	14x B 500A(20)= 4398 mm^2

The graphical presentation of reinforcement

Member check (design)	Single check(design)
	In head of column (section x = 3,6 m)  In foot of column (section x = 0,0 m) 

Design reinforcement with item "Determine governing cross-section in beforehand " ON

Calculation of total area of reinforcement

The reinforcement at whole length of the column is the same and it is designed as max. value of area from all section. The maximum area of reinforcement is in the head and foot of the column in this case and it follows:

$A_{s,req,y} = \max(A_{s,req,y,head};\ A_{s,req,y,foot}) = \max(3520;\ 2548) = 3520\ mm^2$

$A_{s,req,z} = \max(A_{s,req,z,head};\ A_{s,req,z,foot}) = \max(0;\ 1162) = 1162\ mm^2$

$A_{s,req} = A_{s,req,y} + A_{s,req,z} = 3520 + 1162 = 4682\ mm^2$

$A_{s,cor} = 4\cdot A_{1,s} = 4\cdot 314,59 = 1258,36\ mm^2$

$A_{s,req,ed,y} = A_{s,req,y} - 0,5\cdot A_{s,cor} = 3520 - 0,5\cdot 1258,36 = 2890,8\ mm^2$

$A_{s,req,ed,z} = A_{s,req,z} - 0,5\cdot A_{s,cor} = 1162 - 0,5\cdot 1258,36 = 532,8\ mm^2$

$$\text{Ratio y/z} = \frac{(A_{s,req,y} / A_{s,req})\cdot 100}{(A_{s,req,z} / A_{s,req})\cdot 100} = \frac{(3520/4682)\cdot 100}{(1162/4682)\cdot 100} = \frac{75,2}{24,8} = 75,2/24,8$$

Graphical and numerical output of required reinforcement in SEN

The graphical and numerical output of designed reinforcement is presented in SEN in service. We can present results at length of member or detailed result in selected section with using action button "SingleCheck". The check box "Determine governing cross-section in beforehand" is not take into account in the single check.

<u>The numerical presentation of reinforcement in member check</u>

Design As EN 1992-1-1

Linear calculation, Extreme : Section
Selection : All
Load cases : LC1

Main reinforcement for selected columns

Member	d_x [m]	Case	N_d [kN]	M_{yd} [kNm]	M_{zd} [kNm]	Calc. type	Ratio y/z [%]	$A_{s,req}$ [mm^2]	$Reinf_{req}$	$Reinf_{tot}$	W/E
B1	0,000	LC1	-3000,00	-130,00	0,00	Um	75/25	4683	12(12/4)x20,0	12x20,0(3770)	134
B1	3,600	LC1	-3000,00	200,00	0,00	Um	75/25	4683	12(12/4)x20,0	12x20,0(3770)	134

<u>The numerical presentation of reinforcement in single check</u>

In head of column (section x = 3,6 m)

EN 1992-1-1 concrete design

Main reinforcement for selected column

Determine governing cross-section beforehand is allowed in member check only

x.loc [m]	Combi Case	Nd [kN]	Mdy [kNm] Mdz [kNm]	Calc. Type Ratio y/z	A_s,req,cor [mm^2] A_s,user,cor [mm^2]	A_s,reg,ed,y [mm^2] A_s,user,ed,y [mm^2]	A_s,req,ed,z [mm^2] A_s,user,ed,z [mm^2]	A_s,req [mm^2] A_s,user [mm^2]
3.60	LC1	-3000.00	199.98 0.00	Um 1.00/0.00	1256.64 0.00	2263.16 0.00	0.00 0.00	3519.80 0.00

Detailed description of reinforcement bars for selected column

Determine governing cross-section beforehand is allowed in member check only

x.loc [m]	Combi Case	Reinf_cor,req Reinf_cor,user	Reinf_ed,y,req Reinf_ed,y,user	Reinf_ed,z,req Reinf_ed,z,user	Reinf_tot,req Reinf_tot,user
3.60	LC1	4x B 500A (20) = 1257 mm^2	8x B 500A (20) = 2513 mm^2		12x B 500A (20) = 3770 mm^2

In foot of column (section x = 0,0 m)

EN 1992-1-1 concrete design

Main reinforcement for selected column

Determine governing cross-section beforehand is allowed in member check only

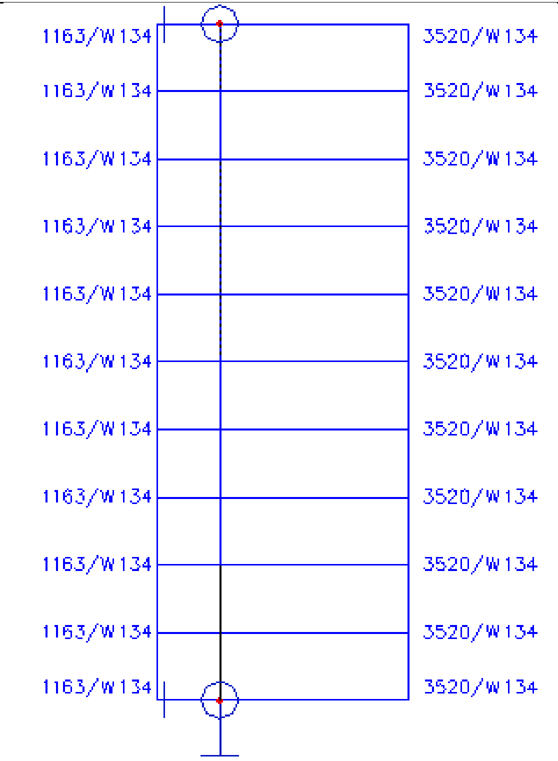
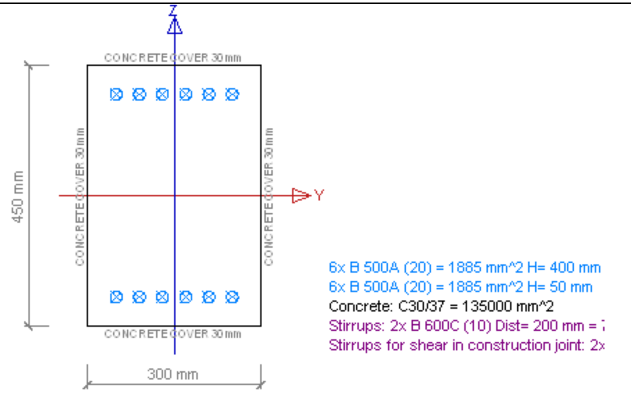
x.loc [m]	Combi Case	Nd [kN]	Mdy [kNm] Mdz [kNm]	Calc. Type Ratio y/z	A_s,req,cor [mm^2] A_s,user,cor [mm^2]	A_s,reg,ed,y [mm^2] A_s,user,ed,y [mm^2]	A_s,req,ed,z [mm^2] A_s,user,ed,z [mm^2]	A_s,req [mm^2] A_s,user [mm^2]
0.00	LC1	-3000.00	-129.99 -15.00	Us 0.69/0.31	1256.64 0.00	1919.30 0.00	534.50 0.00	3710.43 0.00

Detailed description of reinforcement bars for selected column

Determine governing cross-section beforehand is allowed in member check only

x.loc [m]	Combi Case	Reinf_cor,req Reinf_cor,user	Reinf_ed,y,req Reinf_ed,y,user	Reinf_ed,z,req Reinf_ed,z,user	Reinf_tot,req Reinf_tot,user
0.00	LC1	4x B 500A (20) = 1257 mm^2	8x B 500A (20) = 2513 mm^2	2x B 500A (20) = 628 mm^2	14x B 500A (20) = 4398 mm^2

The graphical presentation of reinforcement

Member check (design)	**Single check(design)**
	In head of column (section x = 3,6 m)  In foot of column (section x = 0,0 m)