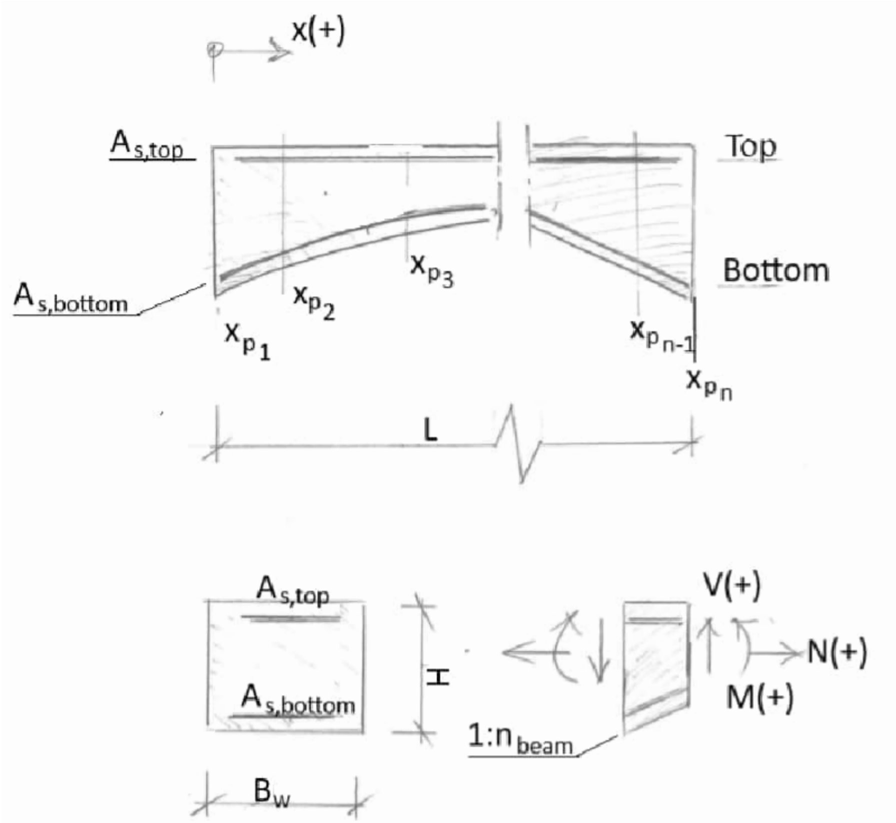
Object: Beam L1 - max/min Q

PRINCIPLE SKETCH



THEORY

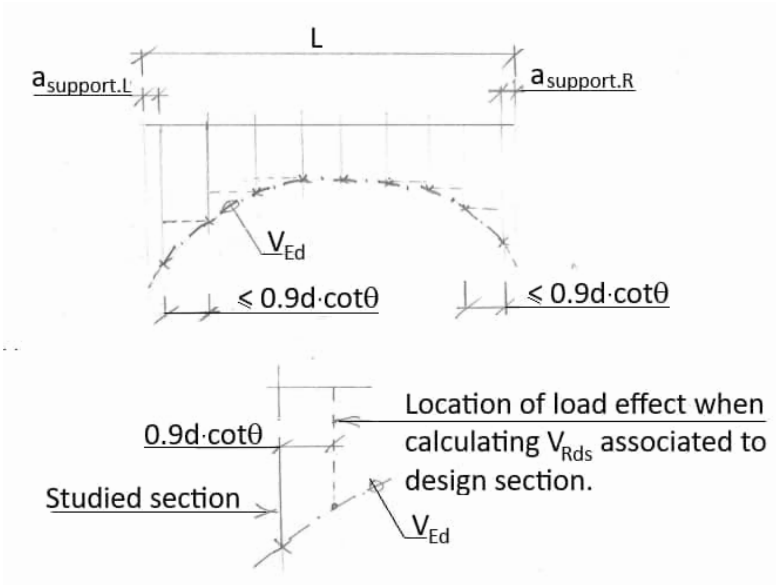
Areas without shear reinforcement

When $V_{Ed} < V_{Rdc}$, no shear reinforcement is required. The effect of load near the support has been neglected on the safe side. The first critical section is considered to be located d from the support edge (= $a_{support}$ + d). The requirement of SS-EN 1992-1-1 equation 6.4 shall be fulfilled for all sections, i.e., $V_{Ed} < V_{Rdc.3}$.

Areas with shear reinforcement

When $V_{Ed} > V_{Rdc}$, shear reinforcement is required. The effect of load near the support has been neglected on the safe side. The first critical section is considered to be located $d \cdot cot(\theta)$ from the support edge (= $a_{stöd} + 0.9 \cdot d \cdot cot(\theta)$).

When determining the required shear reinforcement in the studied section, it is assumed that the required load effect in a section $0.9 \cdot d \cdot cot(\theta)$ away from design section as seen in sketch below.



INPUT

Limitation of permissible stress to 250 MPa ("Yes" or "No")

$Limit := \text{"No"}$

Width support

$a_{support.L} := 0.5 \cdot m$ $a_{support.R} := 0.5 \cdot m$

Pretension beam ("Yes" or "No")

$Pretension := \text{"Yes"}$

Type concrete (C30/37, C35/45, C40/50 , C45/55 & C50/60):

$Type_C := \text{"C35/45"}$

Material coefficient

$\gamma_c := 1.50$: ultimate state (ULS) see EC2-1-1 table 2.1N

Correction factor:

$\alpha_{cc} := 1.00$

Shear reinforcement

Rebar dimension (ϕ10, ϕ12, ϕ16, ϕ20, ϕ25 och ϕ32):

$\phi := 20 \cdot mm$

Type rebar (B500 och Ks60) :

$Type_R := \text{"B500"}$

Number of rebars in transveral direction of beam width:

$n_R := 2\ pcs$

Ange of rebar:

$\alpha := 90 \cdot °$

Material coefficient :

$\gamma_s := 1.15$: ultimate state (ULS) see EC2-1-1 tablel 3.1

$f_{ck} = 35.0\ MPa$ $f_{ctk\_0.05} = 2.2\ MPa$ $f_{ctk\_0.95} = 4.2\ MPa$ $\varepsilon_{cu} = 0.0035$ $E_{cm} = 34.1\ GPa$

$\phi = 20\ mm$ $f_{yk} = 500\ MPa$ $E_{sk} = 200\ GPa$

Minimum shear reinforcement

Requirement VVFS 2009:19 chapter 21 ("Yes" / "No"):

$VVFS := \text{"Yes"}$

Requirement SS-EN 1992-1-1 section 9.2.2 ("Yes" / "No"):

$EC2 := \text{"No"}$

Anchorage length for longitudinal reinforcement associated to bending moment

$l_{b.T} := 1000 \cdot mm$: rebars at top

$l_{b.B} := 1000 \cdot mm$: rebars at bottom

Number of section

$n_p := 11 \cdot pcs$

Total length

$L \equiv 26.0 \cdot m$

Geometry and load effect ultimate state (ULS)

x_p	Q^{max}	N_1^{tillh}	M_1^{tillh}	Q^{min}	N_2^{tillh}	M_2^{tillh}	B_w	H	n_{beam}
0	6500	0	1	1	0	1	2000	1500	1000
0,5	6000	-21494	11802	1309	-33834	14902	2000	1500	1000
3,0	5000	-28933	11265	586	-18573	8279	2000	1500	1000
4,0	4000	-30274	4782	261	-18798	7069	2000	1500	1000
7,0	2500	-31324	-1490	110	-18445	7008	2000	1500	1000
13,0	2000	-30879	-9457	412	-18551	3610	2000	1500	1000
19,0	2500	-31142	-7700	690	-18858	-1080	2000	1500	1000
22,0	4000	-31209	-87	120	-18804	1690	2000	1500	1000
23,0	5000	-31826	9103	489	-18638	2811	2000	1500	1000
25,5	6000	-19030	957	1420	-31387	13058	2000	1500	1000
26,0	6500	-19207	-2228	560	-32999	10180	2000	1500	1000
m	kN	kN	kNm	kN	kN	kNm	mm	mm	-

Selected shear reinforcement
(Shear reinforcement i selected for a maximum of 6 areas.)

Angle of concrete compression bar accrding to EC2-1-1 section 6.2.3.
For none pretension $1 \le \cot\theta \le 2.5$ & pretension $1 \le \cot\theta \le 3.0$.

Area	$s_{l.select}$	x_{start}	x_{slut}	$\cot\theta$
I	200	0,5	3,7	2,5
II	300	3,7	5,0	2,5
III	300	5,0	6,5	2,5
IV	300	19,5	21,0	2,5
V	300	21,0	22,3	2,5
VI	200	22,3	25,5	2,5
-	mm	m	m	-

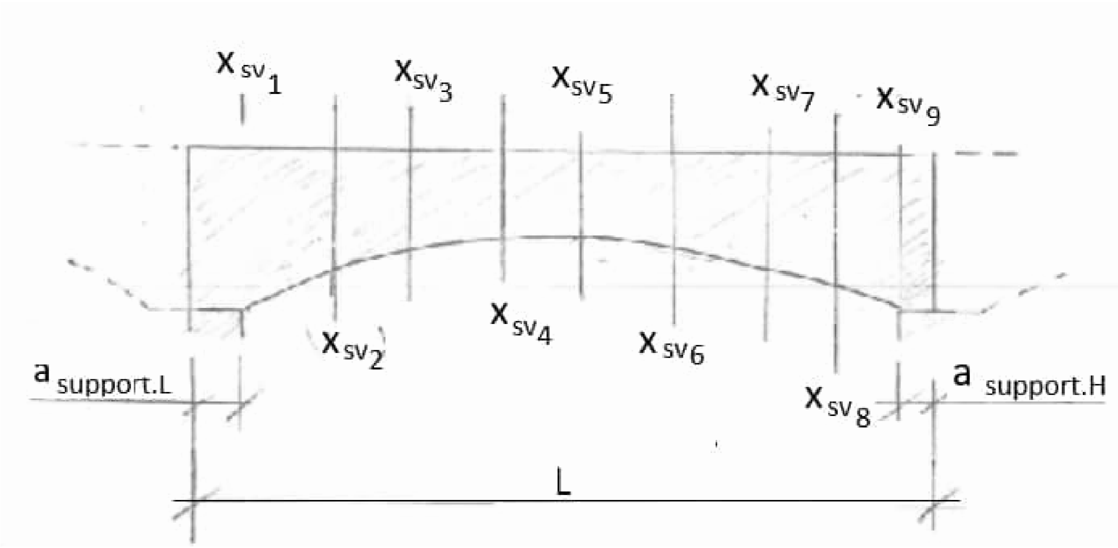
Longitudinal reinforcement A_{s0} associated to sections x_p

x_p	$A_{s0,B}$	d_B	$A_{s0,T}$	d_T
0	2011	1424	2011	1424
0,5	2011	1424	2011	1424
3,0	2011	1424	2011	1424
4,0	2011	1424	2011	1424
7,0	2011	1424	2011	1424
13,0	2011	1424	2011	1424
19,0	2011	1424	2011	1424
22,0	2011	1424	2011	1424
23,0	2011	1424	2011	1424
25,5	2011	1424	2011	1424
26,0	2011	1424	2011	1424
m	mm^2	mm	mm^2	mm

Number of evaluted sections

$n_{sv} := 9 \cdot pcs$

Location of studied sections



i	$x_{sv,i}$	0.9d·cotθ	d	cotθ	Remark
1	0,5	3,2	1,4	2,5	$a_{support.L}$ = 0,5
2	3,7	3,2	1,4	2,5	-
3	6,5	3,2	1,4	2,5	-
4	9,7	3,2	1,4	2,5	-
5	13,0	3,2	1,4	2,5	0.5 L = 13,0
6	16,3	2,8	1,4	2,2	-
7	19,5	2,8	1,4	2,2	-
8	22,7	2,8	1,4	2,2	-
9	25,5	2,8	1,4	2,2	L - $a_{support.R}$ = 25,5
-	m	m	m	-	m

CALCULATE

Total shear reinforcement in transversal direction

$$A_{sw.rebars} := n_R \cdot \frac{\pi \cdot \phi^2}{4} \qquad A_{sw.rebars} = 628\ mm^2$$

Design values ultimate state (ULS)

Shear reinforcement:

$$f_{wd} := \begin{cases} \frac{f_{yk}}{\gamma_s} & \text{if } Limit = \text{“No”} \\ 250 \cdot MPa & \text{if } Limit = \text{“Yes”} \end{cases} \qquad f_{wd} = 435\ MPa$$

Concrete:

$$f_{cd} := \alpha_{cc} \cdot \frac{f_{ck}}{\gamma_c} = 23.3\ MPa$$: see EC2-1-1 equation 3.15

Function - shear force at arbitrary section

$$V_{Ed} = \begin{vmatrix} Q_1 \leftarrow \text{linterp}(x_p, Q_{max}, x) \\ Q_2 \leftarrow \text{linterp}(x_p, Q_{min}, x) \\ |Q_1| \ \text{if} \ |Q_1| > |Q_2| \\ |Q_2| \ \text{otherwise} \end{vmatrix}$$

Function - normal force associated to shear force at arbitrary section

$$N_d = \begin{vmatrix} \text{linterp}(x_p, N_{tillh.1}, x) \ \text{if} \ |Q_1| > |Q_2| \\ \text{linterp}(x_p, N_{tillh.2}, x) \ \text{otherwise} \end{vmatrix}$$

Function - bending moment associasted to shear force at arbitrary section

$$M_d = \begin{vmatrix} \text{linterp}(x_p, M_{tillh.1}, x) \ \text{if} \ |Q_1| > |Q_2| \\ \text{linterp}(x_p, M_{tillh.2}, x) \ \text{otherwise} \end{vmatrix}$$

Function - height of beam at arbitrary section

$$h = \text{linterp}(x_p, H, x)$$

Function - beam width at arbitrary section

$$b_w = \text{linterp}(x_p, B_w, x)$$

Function - beam inclination at arbitrary section

$$n_{beam.w} := \text{linterp}(x_p, n_{beam}, x)$$

Function - cot θ at arbitrary section

$$
\begin{aligned}
cot\theta := \; & cot\Theta \leftarrow 0 \\
& \text{if } x_{start_1} \le x \le x_{end_1} \\
& \quad cot\Theta \leftarrow cot\theta_1 \\
& \text{if } x_{start_2} < x \le x_{end_2} \\
& \quad cot\Theta \leftarrow cot\theta_2 \\
& \text{if } x_{start_3} < x \le x_{end_3} \\
& \quad cot\Theta \leftarrow cot\theta_3 \\
& \text{if } x_{start_4} < x \le x_{end_4} \\
& \quad cot\Theta \leftarrow cot\theta_4 \\
& \text{if } x_{start_5} < x \le x_{end_5} \\
& \quad cot\Theta \leftarrow cot\theta_5 \\
& \text{if } x_{start_6} < x \le x_{end_6} \\
& \quad cot\Theta \leftarrow cot\theta_6
\end{aligned}
$$

Function - effective height at arbitrary section

$$
\begin{aligned}
d := \; & \text{if } M_{tillh} > 0 \cdot kNm \\
& \quad linterp\left(x_p, d_B, x\right) \\
& \text{else} \\
& \quad linterp\left(x_p, d_T, x\right)
\end{aligned}
$$

Function - longtudinal reinforcement at "top" for a arbitrary section

$$A_{s0.T} := \text{linterp}\left(x_p, A_{s0.T}, x\right)$$

Function - longitudinal reinforcement at "bottom" for a arbitrary section

$$A_{s0.B} := \text{linterp}\left(x_p, A_{s0.B}, x\right)$$

Function - minimum longitudinal reinforcement ± (l_b+d) from studied arbitrary section

$$
\begin{aligned}
A_{sl} := \; & \text{if } M_{tillh} \geq 0 \cdot kNm \\
& \quad d \leftarrow \text{linterp}\left(x_p, d_B, x\right) \\
& \quad \text{if } \left(x - l_{b.T} - d\right) \leq 0 \cdot m \\
& \quad \quad x_L \leftarrow 0 \cdot m \\
& \quad \text{if } x - l_{b.B} - d > 0 \cdot m \\
& \quad \quad x_L \leftarrow \left(x - l_{b.B} - d\right) \\
& \quad \text{if } \left(x - l_{b.B} + d\right) \geq L \\
& \quad \quad x_R \leftarrow L \\
& \quad \text{if } x - l_{b.B} + d < L \\
& \quad \quad x_R \leftarrow \left(x - l_{b.B} + d\right) \\
& \quad A_{sl} \leftarrow min\left(A_{s0.B}\left(x_L\right), A_{s0.B}\left(x\right), A_{s0.B}\left(x_R\right)\right) \\
& \text{if } M_{tillh} < 0 \cdot kNm \\
& \quad d \leftarrow \text{linterp}\left(x_p, d_T, x\right) \\
& \quad \text{if } \left(x - l_{b.T} - d\right) \leq 0 \cdot m \\
& \quad \quad x_L \leftarrow 0 \cdot m \\
& \quad \text{if } x - l_{b.T} - d > 0 \cdot m \\
& \quad \quad x_L \leftarrow \left(x - l_{b.T} - d\right) \\
& \quad \text{if } \left(x - l_{b.T} + d\right) \geq L \\
& \quad \quad x_R \leftarrow L \\
& \quad \text{if } x - l_{b.T} + d < L \\
& \quad \quad x_R \leftarrow \left(x - l_{b.T} + d\right) \\
& \quad A_{sl} \leftarrow min\left(A_{s0.T}\left(x_L\right), A_{s0.T}\left(x\right), A_{s0.T}\left(x_R\right)\right)
\end{aligned}
$$

Function - minimum shear reinforcement according to VVFS 2009:19 chapter 21

$$
\begin{aligned}
A_{sw..min.1} := \; & b_{w.sv} \leftarrow b_w\left(x\right) \\
& h_{sv} \leftarrow h\left(x\right) \\
& \text{if } VVFS = \text{“Yes”} \\
& \quad \text{if } h_{sv} > b_{w.sv} \\
& \quad \quad A_{sw.min} \leftarrow \left(b_{w.sv} \cdot 0.15\right)\% \\
& \quad \text{if } h_{sv} \leq b_{w.sv} \\
& \quad \quad A_{sw.min} \leftarrow \left(b_{w.sv} \cdot \left(0.10 + 0.05 \cdot \frac{h_{sv}}{b_{w.sv}}\right)\right)\% \\
& \text{if } VVFS = \text{“No”} \\
& \quad A_{sw.min} \leftarrow 0 \cdot \frac{mm^2}{m}
\end{aligned}
$$

Function - minimum shear reinforcement according to SS-EN 1992-1-1 equation 9.5N

$$A_{sw..min.2} := \begin{array}{|l} b_{w.sv} \leftarrow b_w(x) \\ \text{if } EC2 = \text{"Yes"} \\ \quad A_{sw.min} \leftarrow b_{w.sv} \cdot 0.08 \cdot \dfrac{\sqrt{f_{ck}}}{f_{yk}} \\ \text{if } EC2 = \text{"No"} \\ \quad A_{sw.min} \leftarrow 0 \cdot \dfrac{mm^2}{m} \end{array}$$

Function - V_{Rdc} according to SS-EN 1992-1-1 equation 6.2a

$$V_{Rdc.1} = \begin{array}{|l} \rho \leftarrow \min\left(\dfrac{A_{sl}}{b_w \cdot d}, 0.02\right) \\ k \leftarrow \min\left(1 + \sqrt{\dfrac{0.2}{d}}, 2.0\right) \\ C_{Rdc} \leftarrow \dfrac{0.18}{\gamma_c} \\ k_1 \leftarrow 0.15 \\ A_c \leftarrow b_{w.sv} \cdot h_{sv} \\ \sigma_{cp} \leftarrow \min\left(\dfrac{|N_{Ed}|}{A_c}, 0.2 \cdot f_{cd}\right) \\ V_{Rdc.1} \leftarrow \left[C_{Rdc} \cdot k \cdot (100 \cdot \rho \cdot f_{ck})^{\frac{1}{3}} \cdot MPa + k_1 \cdot \sigma_{cp}\right] \cdot b_w \cdot d \end{array}$$

Function - $V_{Rdc,min}$ according to SS-EN 1992-1-1 equation 6.2b

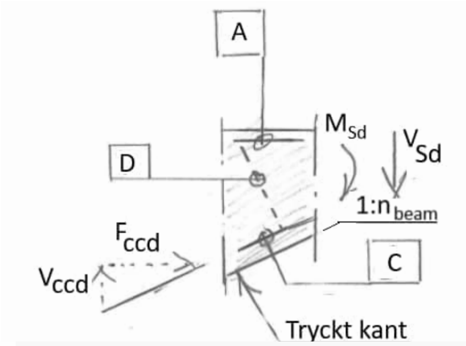
$$V_{Rdc.2} := \begin{array}{|l} b_{w.sv} \leftarrow b_w(x) \\ d_{sv} \leftarrow d(x) \\ h_{sv} \leftarrow h(x) \\ N_{Ed} \leftarrow N_d(x) \\ k \leftarrow min\left(1 + \sqrt{\dfrac{0.2}{d_{sv}}}, 2.0\right) \\ v_{min} \leftarrow 0.035 \cdot k^{\frac{3}{2}} \cdot \sqrt{f_{ck}} \\ A_c \leftarrow b_{w.sv} \cdot h_{sv} \\ \sigma_{cp} \leftarrow min\left(\dfrac{|N_{Ed}|}{A_c}, 0.2 \cdot f_{cd}\right) \\ k_1 \leftarrow 0.15 \\ V_{Rdc.2} \leftarrow (v_{min} + k_1 \cdot \sigma_{cp}) \cdot b_{w.sv} \cdot d_{sv} \end{array}$$

Function - shear capacity without shear reinforcement

$$V_{Rdc} := \max\left(V_{Rdc.1}, V_{Rdc.2}\right)$$

Function - added capacity due to compression force according to SS-EN 1992-1-1 section 6.2.1

According to truss theory load capacity is increased according to derivation seen below.



$$V_{ccd} = F_{ccd} \cdot \frac{1}{n_{beam}} \quad ; \quad F_{ccd} = \frac{M_{Sd}}{d} \qquad \Rightarrow \quad V_{ccd} = \frac{M_{Sd}}{d} \cdot \frac{1}{n_{beam}}$$

$$V_{ccd} := \left\| \begin{array}{l} M_{Sd} \leftarrow M_d(x) \\ d_{sv} \leftarrow d(x) \\ n_{beam} \leftarrow n_{beam.w}(x) \\ V_{ccd} \leftarrow \dfrac{M_{Sd}}{d_{sv}} \cdot \dfrac{1}{n_{beam}} \end{array} \right.$$

Function - compression failure in beam web according to SS-EN 1992-1-1 equation 6.5

$$V_{Rdc.3} = \left| \begin{array}{l} v \leftarrow 0.6 \cdot \left(1 - \dfrac{f_{ck}}{250MPa}\right) \\ V_{Rdc.3} \leftarrow 0.5 \cdot b_w \cdot d \cdot v \cdot f_{cd} \end{array} \right.$$

Effect of compressive force according to SS-EN 1992-1-1 equation 6.10

$$\alpha_{cw} := \left\| \begin{array}{l} b_{w.sv} \leftarrow b_w(x) \\ \text{if } Pretension = \text{“No”} \\ \quad \| \ \alpha_{cw} \leftarrow 1.00 \\ \text{if } Pretension = \text{“Yes”} \\ \quad \left\| \begin{array}{l} \sigma_{cp} \leftarrow \dfrac{-N_d(x)}{b_w(x)\ h(x)} \\ \text{if } 0 < \sigma_{cp} \le 0.25\ f_{cd} \\ \quad \left\| \ \alpha_{cw} \leftarrow 1 + \dfrac{\sigma_{cp}}{f_{cd}} \right. \\ \text{if } 0.25 \cdot f_{cd} < \sigma_{cp} \le 0.5\ f_{cd} \\ \quad \| \ \alpha_{cw} \leftarrow 1.25 \\ \text{if } 0.5 \cdot f_{cd} < \sigma_{cp} \le f_{cd} \\ \quad \left\| \ \alpha_{cw} \leftarrow 2.5 \left(1 - \dfrac{\sigma_{cp}}{f_{cd}}\right) \right. \end{array} \right. \end{array} \right.$$

Resistance reduction factor according to SS-EN 1992-1-1 equation 6.10

$$v_1 := \begin{cases} \text{if } f_{ck} \le 60 \cdot MPa \\ \quad 0.60 \\ \text{else} \\ \quad min\left(0.9 - \dfrac{f_{ck}}{200 \cdot MPa}, 0.5\right) \end{cases}$$

$v_1 = 0.60$

Function - c/c in longitudinal directed for selected shear reinforcement

$$s_{l.select} := \begin{cases} s_l \leftarrow 0\ mm \\ \text{if } x_{start_1} \le x \le x_{end_1} \\ \quad s_l \leftarrow s_{l.select_1} \\ \text{if } x_{start_2} < x \le x_{end_2} \\ \quad s_l \leftarrow s_{l.select_2} \\ \text{if } x_{start_3} < x \le x_{end_3} \\ \quad s_l \leftarrow s_{l.select_3} \\ \text{if } x_{start_4} < x \le x_{end_4} \\ \quad s_l \leftarrow s_{l.select_4} \\ \text{if } x_{start_5} < x \le x_{end_5} \\ \quad s_l \leftarrow s_{l.select_5} \\ \text{if } x_{start_6} < x \le x_{end_6} \\ \quad s_l \leftarrow s_{l.select_6} \end{cases}$$

Function - c/c for shear rebars in transversal direction

$$s_t := \begin{cases} b_{w.sv} \leftarrow b_w(x) \\ s_t \leftarrow \dfrac{b_{w.sv}}{n_R} \end{cases}$$

Function - permissible c/c for shear rebars in longitudinal direction
(See SS-EN 1992-1-1 equation 9.6N)

$$s_{l.max} = 0.75 \cdot d \cdot (1 + \cot(\alpha))$$

Function - permissible c/c for shear rebars in transversal direction
(See SS-EN 1992-1-1 equation 9.8N)

$$s_{t.max} = \min(0.75 \cdot d, 600mm)$$

Function - V_{Rds} see SS-EN 1992-1-1 equation 6.13 associated to selected shear reinforcement

$$V_{Rds.1} = \begin{cases} 0kN & \text{if } s_{l.vald} = 0mm \\ \dfrac{A_{sw.skär}}{s_{l.vald}} \cdot f_{yd} \cdot 0.9 \cdot d \cdot (\cot(\theta) + \cot(\alpha)) \cdot \sin(\alpha) & \text{otherwise} \end{cases}$$

Function - $V_{Rd,max}$ see SS-EN 1992-1-1 equation 6.14

$$V_{Rds.2} = \alpha_{cw} \cdot b_w \cdot z \cdot v_1 \cdot f_{cd} \cdot \left(\frac{\cot(\theta) + \cot(\alpha)}{1 + \cot(\theta)^2} \right)$$

Function - shear capacity with shear reinforcement

$$V_{Rds} = \min(V_{Rds.1}, V_{Rds.2})$$

Function - selected shear reinforcement

$$A_{sw.vald} = \begin{cases} 0 \dfrac{mm^2}{m} & \text{if } s_{l.vald} = 0mm \\ \dfrac{A_{sw.skär}}{s_{l.vald}} & \text{otherwise} \end{cases}$$

RESULTS

Presentation table format

Geometry & load effect:

x_{sv}	V_{Ed}	N_d^{tillh}	M_d^{tillh}	b_w	d	h	A_{sl}	n_{beam}	α_{cw}
0,5	6000	-21497	11802	2000	1424	1500	2011	1000	1,25
3,7	4350	-29805	7051	2000	1424	1500	2011	1000	1,25
6,5	2750	-31149	-445	2000	1424	1500	2011	1000	1,25
9,7	2279	-31127	-5009	2000	1424	1500	2011	1000	1,25
13,0	2000	-30879	-9457	2000	1424	1500	2011	1000	1,25
16,3	2275	-31024	-8491	2000	1424	1500	2011	1000	1,25
19,5	2750	-31153	-6431	2000	1424	1500	2011	1000	1,25
22,7	4728	-31658	6603	2000	1424	1500	2011	1000	1,25
25,5	6000	-19030	957	2000	1424	1500	2011	1000	1,25
m	kN	kN	kNm	mm	mm	mm	mm^2	-	-

Shear reinforcement:

x_{sv}	s_l^{select}	s_l^{max}	s_t^{select}	s_t^{max}	$A_{sw.select}$	$A_{sw.min.1}$	$A_{sw.min.2}$	Shear rebars
0,5	200	< 1068	1000	< 600	3142 >	2750	0	Yes
3,7	200	< 1068	1000	< 600	3142 >	2750	0	Yes
6,5	300	< 1068	1000	< 600	2094 >	2750	0	Yes
9,7	0	1068	1000	< 600	0 >	2750	0	No
13,0	0	1068	1000	< 600	0	2750	0	No
16,3	0	1068	1000	< 600	0	2750	0	No
19,5	300	< 1068	1000	< 600	2094 >	2750	0	Yes
22,7	200	< 1068	1000	< 600	3142 >	2750	0	Yes
25,5	200	< 1068	1000	< 600	3142 >	2750	0	Yes
m	mm	mm	mm	mm	mm^2/m	mm^2/m	mm^2/m	-

Shear capacity without shear reinforcement:

x_{sv}	$V_{Rdc.1}$	$V_{Rdc.2}$	$V_{Rdc.3}$	V_{Rdc}	V_{Ed}	Shear rebars	η
0,5	2629	2944	17145	2944	< 6000	Yes	**204%**
3,7	2629	2944	17145	2944	< 4350	Yes	148%
6,5	2629	2944	17145	2944	< 2750	Yes	93%
9,7	2629	2944	17145	2944	> 2279	No	77%
13,0	2629	2944	17145	2944	> 2000	No	68%
16,3	2629	2944	17145	2944	> 2275	No	77%
19,5	2629	2944	17145	2944	> 2750	Yes	93%
22,7	2629	2944	17145	2944	< 4728	Yes	161%
25,5	2629	2944	17145	2944	< 6000	Yes	**204%**
m	kN	kN	kN	kN	kN	-	-

Shear capacity with shear reinforcement:

x_{sv}	$V_{Rds.1}$	$V_{Rds.2}$	V_{ccd}	$V_{Rds} + V_{ccd}$	V_{Ed}	Shear rebars	η
0,5	4376	15468	8	4385	* 6000	Yes	*
3,7	4376	15468	5	4381	> 4350	Yes	99%
6,5	2918	15468	0	2917	> 2750	Yes	94%
9,7	0	0	-4	-4	< 2279	No	-
13,0	0	0	-7	-7	< 2000	No	-
16,3	0	0	-6	-6	< 2275	No	-
19,5	2918	15468	-5	2913	> 2750	Yes	94%
22,7	4376	15468	5	4381	> 4728	Yes	108%
25,5	4376	15468	1	4377	* 6000	Yes	*
m	kN	kN	kN	kN	kN	-	-

* = Not a design section

Graphical presentation