

Centrum Energetických a Environmentálních Technologií – Explorer (CEETe)

Projektová dokumentace pro provádění stavby

SO 01.2 Budova pro vodíkovou stanici

Statický výpočet

01.2.21 Stavebně konstrukční řešení - OK

Archivní číslo	:	20-026-5 / 01.2.21-03
Zhotovitel	:	CHVÁLEK ATELIÉR s.r.o. Kafkova 1064/12, 702 00 Ostrava - Moravská Ostrava
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Vypracoval	:	Ing. Ernest Jeżowicz
Objednatel	:	Vysoká škola báňská - Technická univerzita Ostrava 17. listopadu 2172/15, 708 00 Ostrava - Poruba
Datum	:	04 / 2020

OBSAH

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04/2020

Vypracoval: Ing. Jeżowicz

ZATÍŽENÍ

1. STÁLÉ

1.1 Vlastní hmotnost konstrukce generována z průřezových ploch prvků

1.2 Skladba střechy

Plech 4 mm 0.36
 $q_{\text{roof,k}} = 0.36 \text{ kN/m}^2$

1.3 Podélná stěna

Bondové AL panely (5 kg/m^2) 0,05
Podkonstrukce (5 kg/m^2) 0.05
 $g_{\text{foto,k}} = 0.10 \text{ kN/m}^2$

1.5 Pletivo

oka 2.5x50x50, prodyšnost 94%

hmotnost (0.86 kg/m^2) 0,0087
 $q_{\text{most,k}} = 0.009 \text{ kN/m}^2$

Součinitel zatížení $\gamma_i = 1.35$

2. PROMĚNLIVÉ

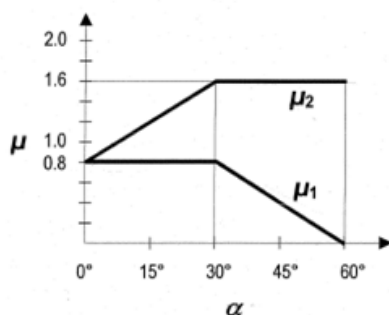
2.1 Sníh

sněhová oblast II (Ostrava)	$s_k=1.0 \text{ kN/m}^2$
tepelný součinitel	$C_t=1.0$
součinitel expozice	$C_e=1.0$

a) střecha objektu

tvarový součinitel μ

ČSN EN 1991-1-3



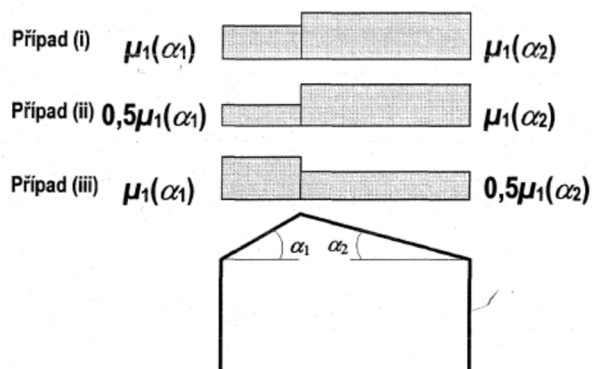
Obrázek 5.1 – Tvarové součinitele zatížení sněhem

(2) Hodnoty uvedené v tabulce 5.2 platí, pokud není zabráněno sklouzávání sněhu ze střechy. Pokud jsou na střeše sněžníky nebo jiné překážky nebo je dolní okraj střechy ukončen atikou (nadezdívkou), potom hodnota tvarového součinitele zatížení sněhem nemá klesnout pod 0,8.

Tabulka 5.2 – Tvarové součinitele zatížení sněhem

úhel sklonu střechy α	$0^\circ \leq \alpha \leq 30^\circ$	$30^\circ < \alpha < 60^\circ$	$\alpha \geq 60^\circ$
μ_1	0,8	$0,8(60 - \alpha)/30$	0,0
μ_2	$0,8 + 0,8\alpha/30$	1,6	—

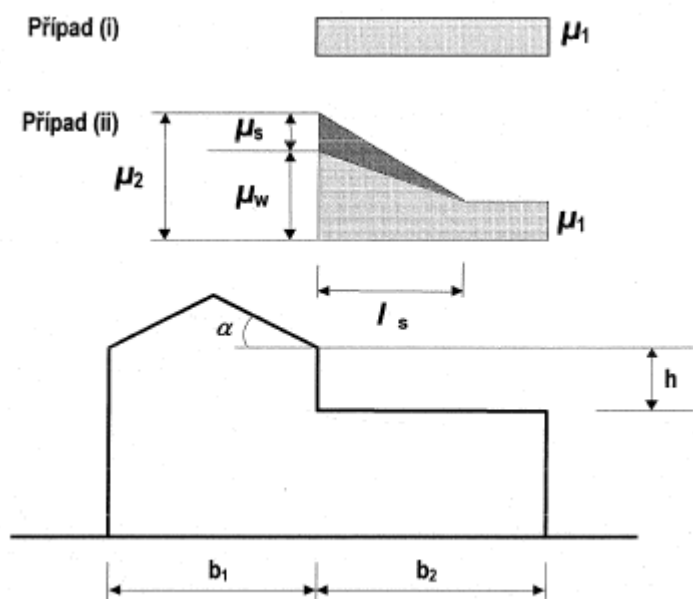
(3) Uspořádání zatížení podle obrázku 5.2 se má použít pro zatížení nenavátým i navátým sněhem.



$$\alpha=0^\circ \rightarrow \mu_1=0.8, \mu_2=0.8+0.8 \cdot 0/30=0.80 \text{ kN/m}^2$$

$$s_{1,k} = s_k \cdot C_t \cdot C_e \cdot \mu_1 = 1.0 \cdot 1 \cdot 1 \cdot 0.8 = 0.80 \text{ kN/m}^2 \text{ (zelená stěna)}$$

b) místní účinky – markýza (vodíková stanice)



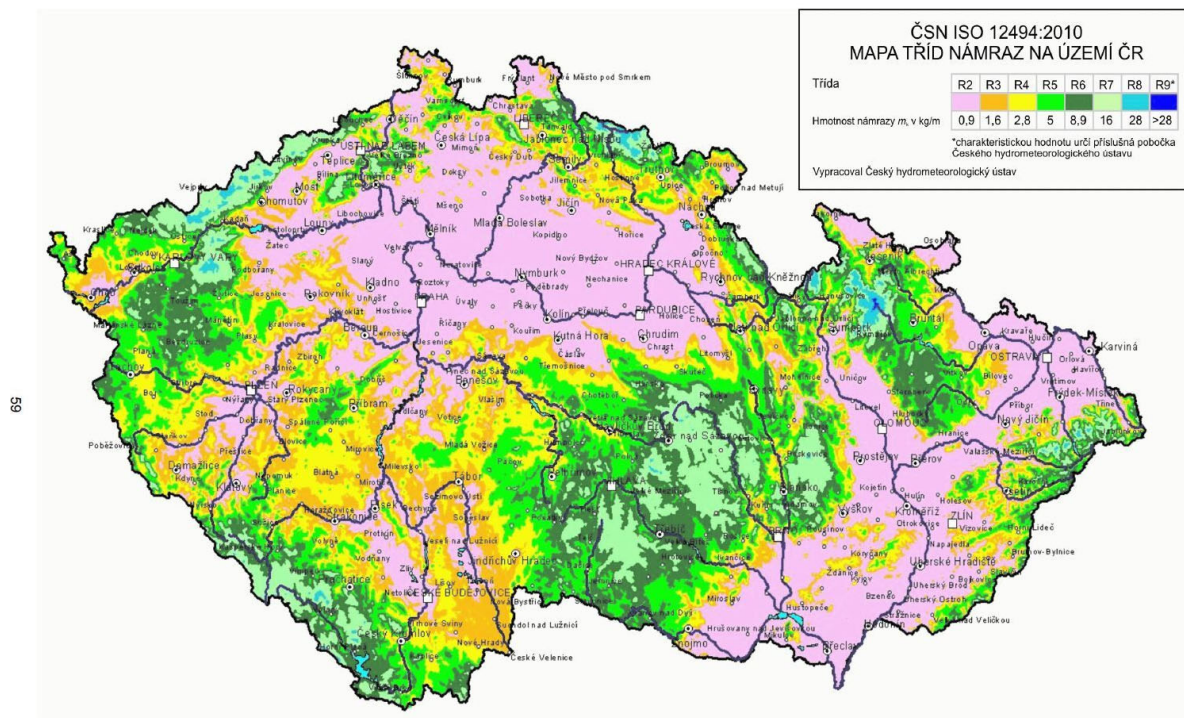
$$h=13.41 \text{ m} \rightarrow l_s=2 \cdot h=2 \cdot 1.2=2.4 \text{ m}, \mu_2=\mu_s+\mu_v, \mu_s=0, \mu_v=(b_1+b_2)/2h=(13.41+1.0)/(2 \cdot 1.2)=6 \Rightarrow \mu_v=2$$

$$s_{2,k}=s_k \cdot C_t \cdot C_e \cdot \mu_2=1,00 \cdot 1 \cdot 1 \cdot 2=2,00 \text{ kN/m}^2$$

2.2 Námraza (dle ČSN ISO 12494)

Třída námrazyR2

Hmotnost námrazy $m_k=0.9 \text{ kg/m}$

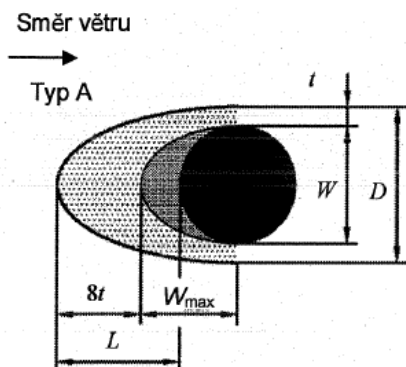


Obrázek NA.1 – Mapa tříd námraz pro území České republiky

ČSN ISO 12494

Tabulka 5 – Rozměry námrazy na profilech typů A a B
(platí pouze pro námrazu z oblačnosti, objemová hmotnost námrazy = 500 kg/m^3)

Tvary průřezů typů A a B									
Šířka profilu [mm]		10		30		100		300	
IC	Hmotnost námrazy <i>m</i> [kg/m]	Rozměry námrazy [mm]							
		<i>L</i>	<i>D</i>	<i>L</i>	<i>D</i>	<i>L</i>	<i>D</i>	<i>L</i>	<i>D</i>
R1	0,5	54	22	34	35	13	100	4	300
R2	0,9	78	28	54	40	23	100	8	300
R3	1,6	109	36	82	47	41	100	14	300
R4	2,8	150	46	120	56	67	104	24	300
R5	5,0	207	60	174	70	106	114	42	300
R6	8,9	282	79	247	88	165	129	76	300
R7	16,0	384	105	348	113	253	151	136	300
R8	28,0	514	137	478	146	372	181	217	317
R9	50,0	694	182	656	190	543	223	344	349
R10	Používá se pro extrémní námrazu								



Parametry tvorby námrazy:

$W = 2.5 \text{ mm}$, $L = 78 \text{ mm}$,

$IC\ R2 \rightarrow D = D(10\text{mm}) - W(10\text{mm}) + D = 28 - 10 + 2.5 = 20.5 \text{ mm}$

$t = (D - W)/2 = (20.5 - 2.5)/2 = 9 \text{ mm}$, $L = 78\text{mm}$

Prodyšnost plochy pletivaítě 50x50/2.5 při námraze :

$(50-2.5-2 \times 9)^2/50^2 = 0.348 \rightarrow \text{cca } 35\%$

Tabulka 27 – Součinitel pro snížení tlaku větru

ICG	k	ICR	k
G1	0,40	R1	0,40
G2	0,45	R2	0,45
G3	0,50	R3	0,50
G4	0,55	R4	0,55
G5	0,60	R5	0,60
		R6	0,70
		R7	0,80
		R8	0,90
		R9	1,00

$ICR = R2 \rightarrow$ Součinitel snížení tlaku větru $k=0.45$

Hmotnost námrazy na 1 bm lana sítě $\rightarrow 0.9 \text{ kg/bm}$

Hmotnost námrazy na 1 m² plochy sítě $> 40 \text{ ks} \times 0.9 \text{ kg/m}^2 = 36 \text{ kg/m}^2$.

Součinitel zatížení $\gamma_f=1.5$

VÝPOČET ZATÍŽENÍ VĚTREM PODLE ČTN EN 1991-1-4

Větrová oblast

místo: Ostrava

odečteno z mapy větrových oblastí ČR

$V_{b,0} = 25$ m/s

výchozí základní rychlost větru

Základní rychlost větru

$V_b = V_{b,0} \cdot C_{dir} \cdot C_{season} = 25$ m/s

základní rychlost větru 4.2 (4.1)

$C_{dir} = 1$

součinitel směru větru NA.2.6.

$C_{season} = 1$

součinitel ročního období NA.2.7.

Kategorie terénu

Příloha A.1

$z_0 = 0,3$ m

tab.4.1

$z_{min} = 5,00$ m

tab.4.1

$z_{max} = 200$ m

$z_{e1} = 4,00$ m

zadej $z = z_{min}$

referenční výška 7.2.2 (1)

$z_{e2} = 3$ m

Součinitel terénu

$k_r = 0,19 \cdot (z_0/z_{0,II})^{0,07} = 0,215$

součinitel terénu 4.3.2 (4.5)

$z_{0,II} = 0,05$

kat. terénu II tab.4.1

Součinitel drsnosti terénu

$c_r(z_{e1}) = k_r \cdot \ln(z/z_0) = 0,558$

4.3.2 (4.4)

$c_r(z_{e2}) = k_r \cdot \ln(z/z_0) = 0,496$

Součinitel orografie

$c_0(z) = 1$

4.3.1.

Střední rychlost větru

$v_m(z_{e1}) = c_r(z) \cdot c_0(z) \cdot v_b = 13,95 \text{ ms}^{-1}$

4.3.1 (4.3)

$v_m(z_{e2}) = c_r(z) \cdot c_0(z) \cdot v_b = 12,40 \text{ ms}^{-1}$

Intenzita turbulence

$I_v(z_{e1}) = k_t/c_0(z) \cdot \ln(z/z_0) = 0,386$

$k_t = 1$

součinitel turbulence 4.4 (4.7)

$I_v(z_{e2}) = k_t/c_0(z) \cdot \ln(z/z_0) = 0,434$

Maximální dynamický tlak větru

$q_p(z_{e1}) = [1+7I_v(z)] \cdot 0,5\rho \cdot v_m(z)^2 = 450 \text{ Nm}^{-2} = 0,45 \text{ kNm}^{-2}$

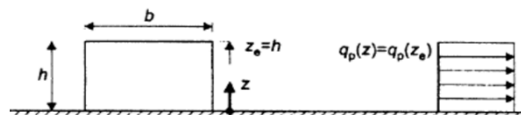
4.4 (4.8)

$q_p(z_{e2}) = [1+7I_v(z)] \cdot 0,5\rho \cdot v_m(z)^2 = 388 \text{ Nm}^{-2} = 0,388 \text{ kNm}^{-2}$

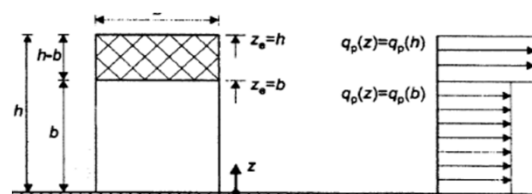
Rozměry objektu

$h =$	4,00 m	výška stavby
$b =$	3,00 m	rozměr kolmo na hřeben - délka štítu
$l =$	14,50 m	rozměr rovnoběžně s hřebenem
$l_1 =$	2,40 m	vzdálenost rámu
$l_2 =$	2,40 m	vzdálenost štítových sloupů
$l_3 =$	0,90 m	vzdálenost vaznic

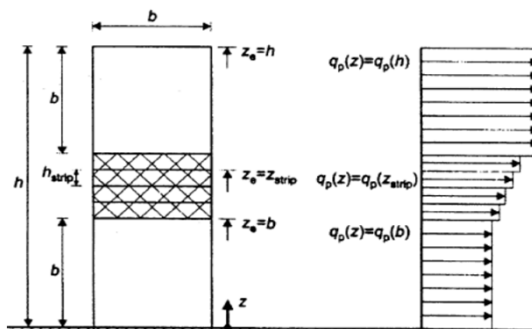
(1)		výška průběh	
$z_{e1} =$	4 m	0 až h konst.	$h < b$



(2)			
$z_{e1} = h$	4 m	b až h konst.	$b < h < 2b$
$z_{e2} = b$	3 m	0 až b konst.	



(3)			
$z_{e1} = h$	4 m	$(h - b)$ a konst.	$h > 2b$
$z_{es} = h$	m	b až $(h \cdot \text{lin.})$	
$z_{e2} = b$	3 m	0 až b konst.	



PLATÍ 2.PŘÍPAD

$$q_p(h) = 0,45 \text{ kNm}^{-2}$$

Typ přístřešku

uzavřený na 1 straně ▼

Půdorysné rozměry

$$d = 13,4 \text{ m}$$

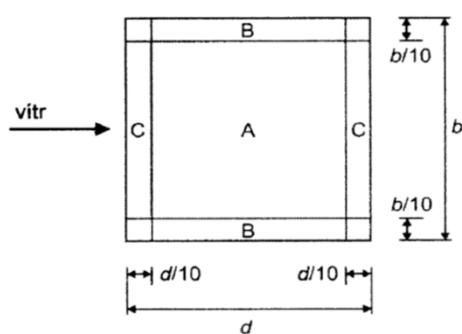
$$b = 2,5 \text{ m}$$

hřeben

tab.7.6

Součinitele výsledného tlaku - pro návrh střešních prvků - lokální

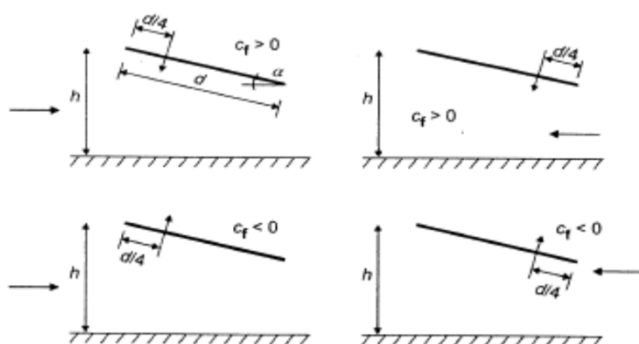
Sklon [°]	Oblast	A		B		C	
10	$C_{p,net}$	1,20	-2,10	2,40	-2,60	1,60	-2,70
	$W_e(Z_e)$	0,54	-0,95	1,08	-1,17	0,72	-1,22



Celková výslednice - pro návrh nosných prvků (sloupy)

C_f ... součinitel celk. síly	0,50	-1,40
$w = C_f g_p(h)$... na celé ploše	0,23	-0,63
$w = 2C_f g_p(h)$... na polovině	0,45	-1,26

...na polovině plochy přístřešku u návětrné strany



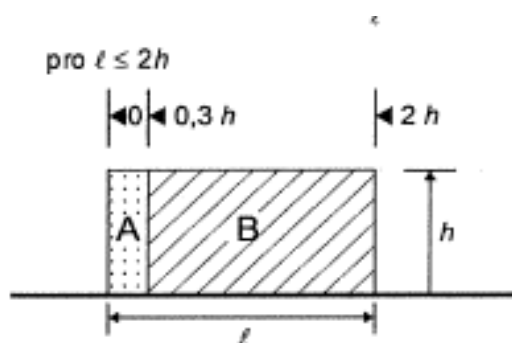
2.3.1 Volně stojící stěna (vodíková stanice)

max. dynamický tlak $q_p = 0.45 \text{ kN/m}^2$

součinitel plnosti (prodyšnost 0%)..... $\varphi = 1.0$

délka - podélná stěna $\ell = 13.4 \text{ m}$, $h = 4.0 \text{ m}$

- příčná stěna $\ell = 2.45 \text{ m}$, $h = 4.0 \text{ m}$



ČSN EN 1991-1-4 ed. 2

Tabulka 7.9 – Doporučené hodnoty součinitelů tlaku $c_{p,net}$ pro volně stojící stěny a zděná zábradlí

Součinitel plnosti	Oblast		A	B	C	D
$\varphi = 1$	Bez vedlejšího průčelí	$\ell/h \leq 3$	2,3	1,4	1,2	1,2
		$\ell/h = 5$	2,9	1,8	1,4	1,2
		$\ell/h \geq 10$	3,4	2,1	1,7	1,2
	S vedlejšími průčelími s délkou $\geq h^a$		2,1	1,8	1,4	1,2
$\varphi = 0,8$			1,2	1,2	1,2	1,2

^a Pro vedlejší průčelí s délkami mezi 0,0 a h lze použít lineární interpolaci.

Součinitel tlaku pro oblast A s vedleším průčelím

$$c_{p,net} = 2.1 \rightarrow \text{tlak větru } w = q_p \cdot c_{p,net} = 0.45 \times 2.1 = 0.945 \text{ kN/m}^2$$

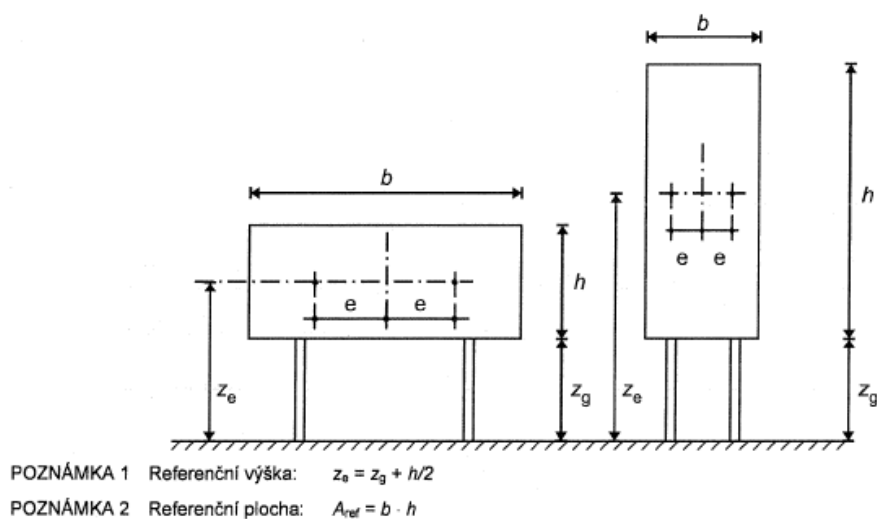
Součinitel tlaku pro oblast B s vedleším průčelím

$$c_{p,net} = 1.8 \rightarrow \text{tlak větru } w = q_p \cdot c_{p,net} = 0.45 \times 1.8 = 0.81 \text{ kN/m}^2$$

2.3.2 Potrubní most (vodíková stanice)

max. dynamický tlak $q_p = 0.45 \text{ kN/m}^2$

součinitel plnosti (prodyšnost 0%)..... $\phi = 1.0$

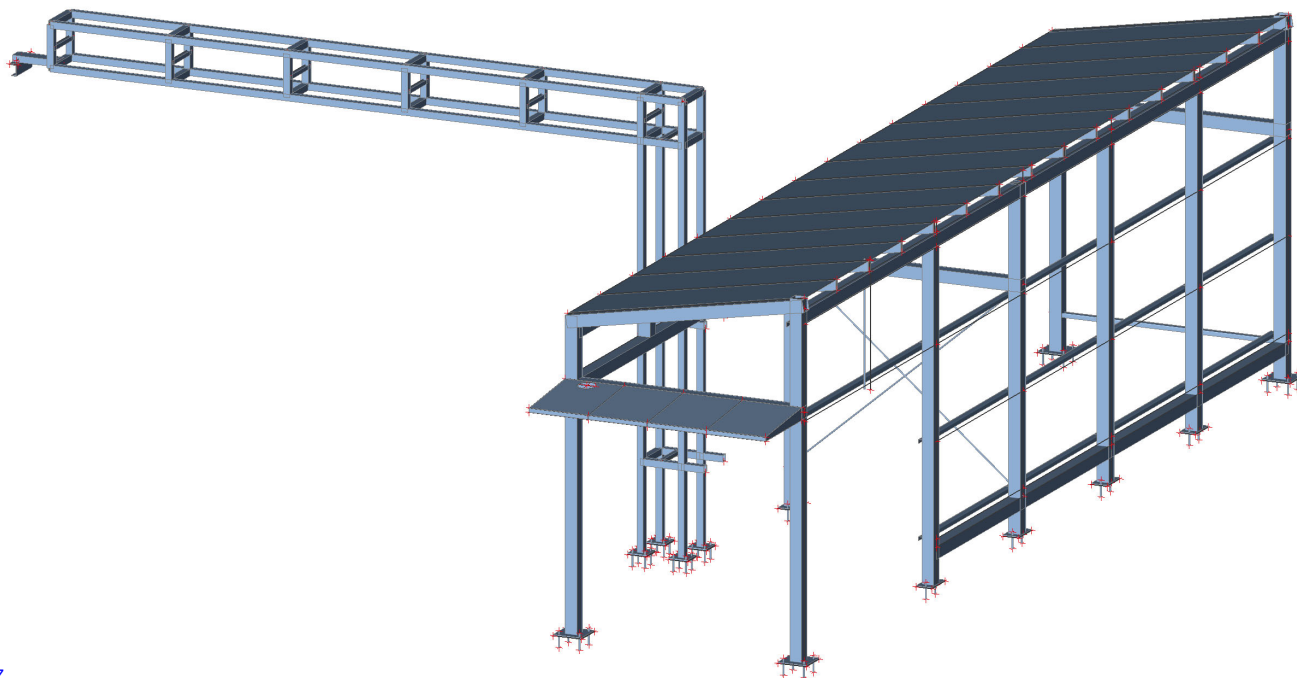


Součinitel tlaku

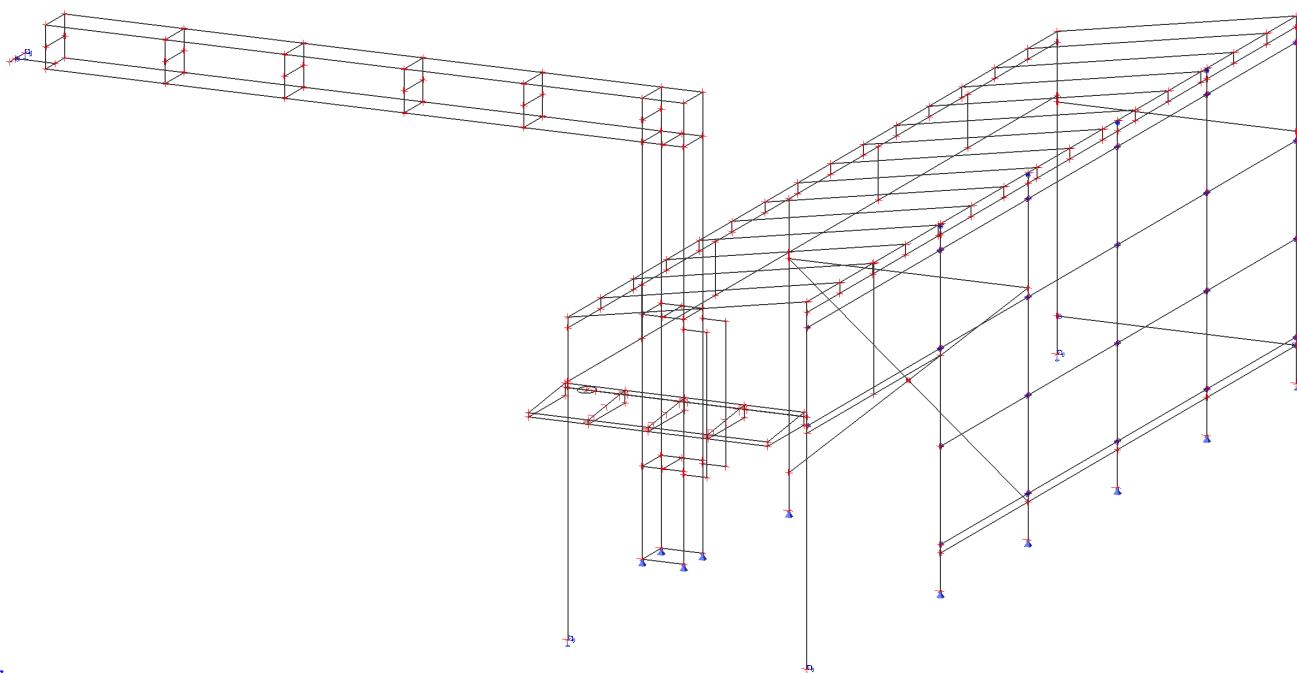
$C_f = 1.8 \rightarrow$ tlak větru $w = q_p \cdot c_f = 0.45 \times 1.8 = 0.81 \text{ kN/m}^2$

KONSTRUKCE VODÍKOVÉ STANICE

3D MODEL OF STRUCTURE



Structural model



Project Centrum Energetických a Enviromentálních Technologíí

Part SO 01.1 Objekt CEETe
Description Ocelová konstrukce - DPS
Author Ing. Jeřowicz

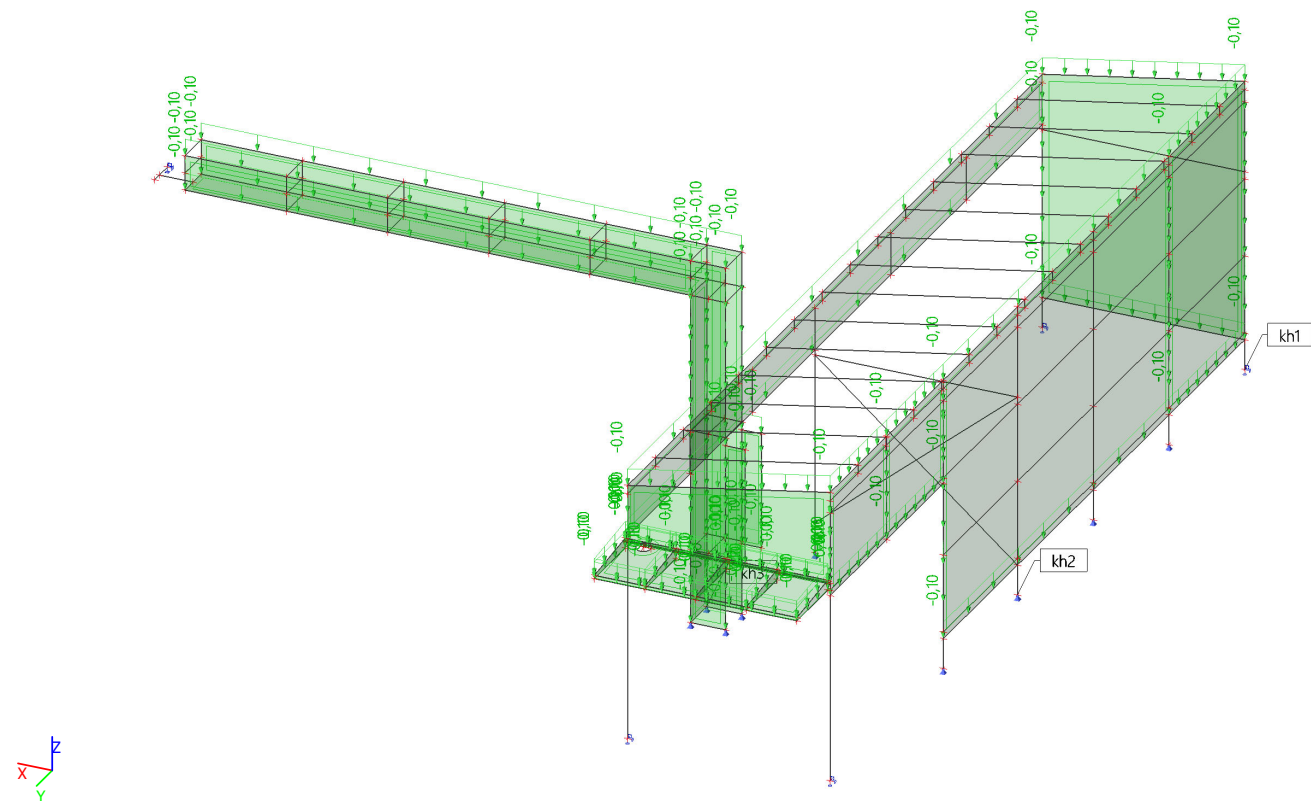
Project

Version	SCIA Engineer 17.1.2029
Licence number	555798
Project	Centrum Energetických a Enviromentálních Technologíí
Part	SO 01.1 Objekt CEETe
Description	Ocelová konstrukce - DPS
Author	Ing. Jeřowicz
Date	Date
Structure	General XYZ
No. of nodes :	1669
No. of beams :	520
No. of slabs :	176
No. of solids :	584
No. of used profiles :	44
No. of load cases :	14
No. of used materials :	3
Acceleration of gravity [m/s ²]	9,807
National code	EC - EN

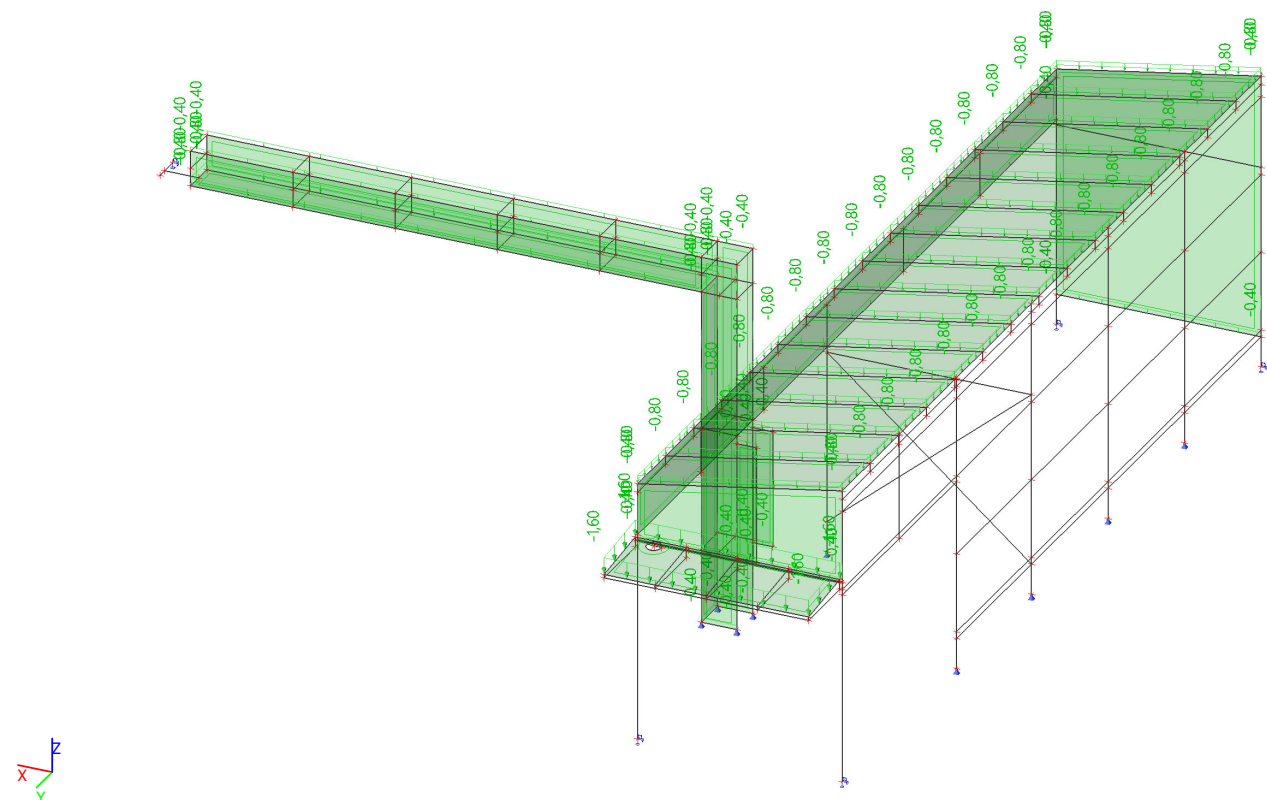
Load cases

Name	Description	Action type	Load group	Direction	Duration	Master load case
	Spec	Load type				
LC1	self weight	Permanent Self weight	LG1	-Z		
LC2	dead load	Permanent Standard	LG1			
LC3	snow/rime Standard	Variable Static	snow		Short	None
LC4	wind +x Standard	Variable Static	wind		Short	None
LC5	wind -x Standard	Variable Static	wind		Short	None
LC6	wind +y Standard	Variable Static	wind		Short	None
LC7	wind -y Standard	Variable Static	wind		Short	None
LC8	live load Standard	Variable Static	live		Short	None
LC9	Rmax (C) Standard	Variable Static	crane		Short	None
LC10	Ht+Hl_Rmax (C) Standard	Variable Static	Ht+Hl		Short	None
LC11	Hs_Rmax (C) Standard	Variable Static	Hs		Short	None
LC12	Mmax (C-D) Standard	Variable Static	crane		Short	None
LC13	Ht+Hl_Mmax (C-D) Standard	Variable Static	Ht+Hl		Short	None
LC14	Hs_Mmax (C-D) Standard	Variable Static	Hs		Short	None

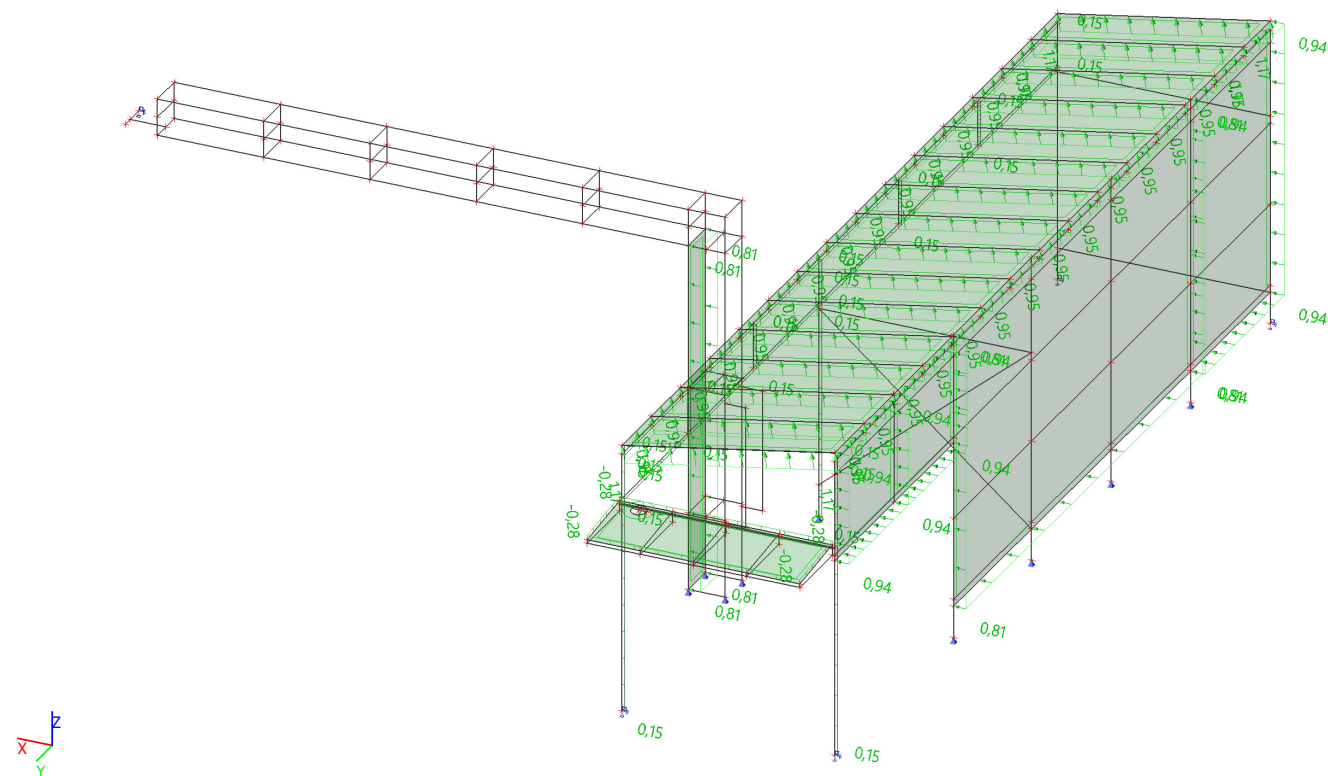
LC2 / Tot. value

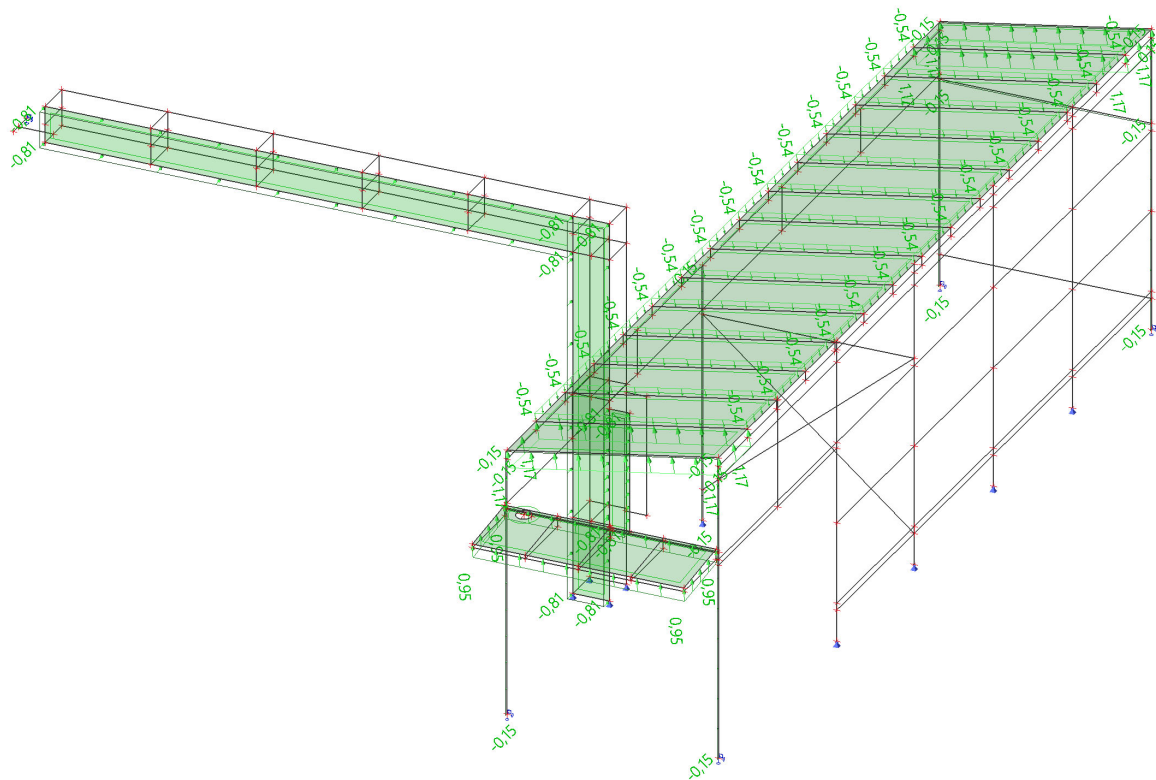
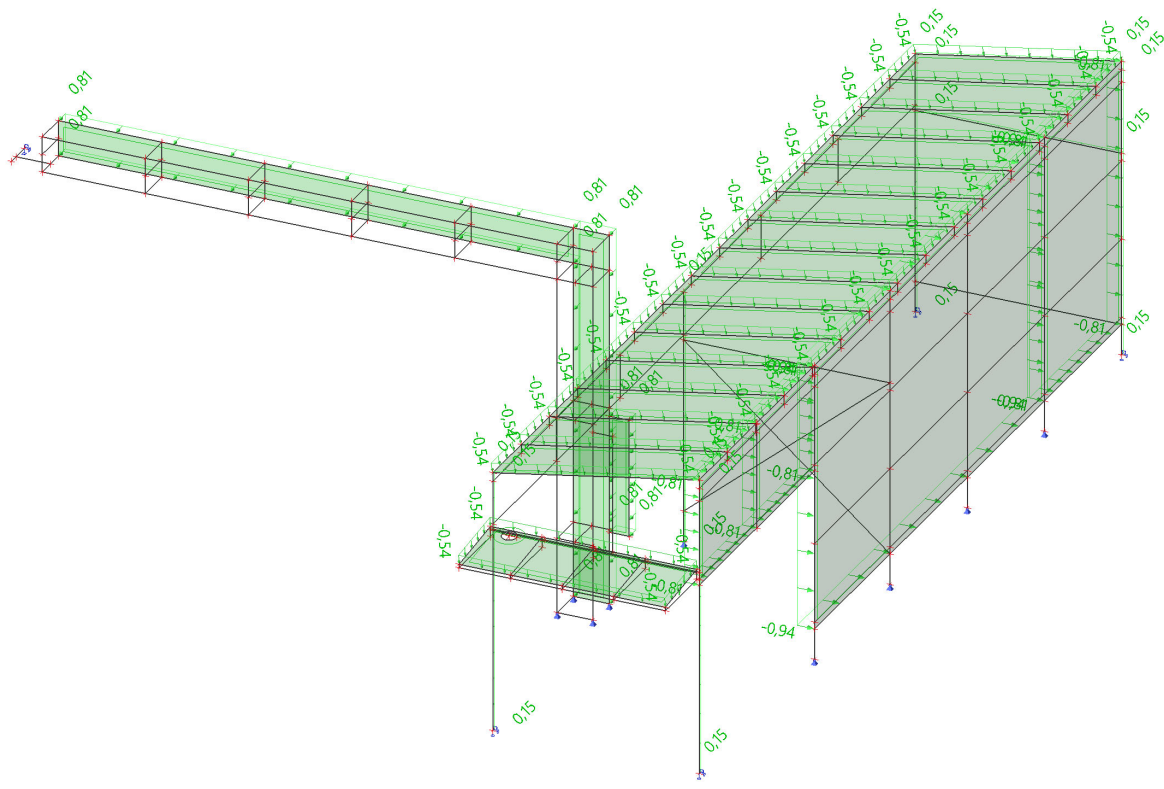


LC3 / Tot. value

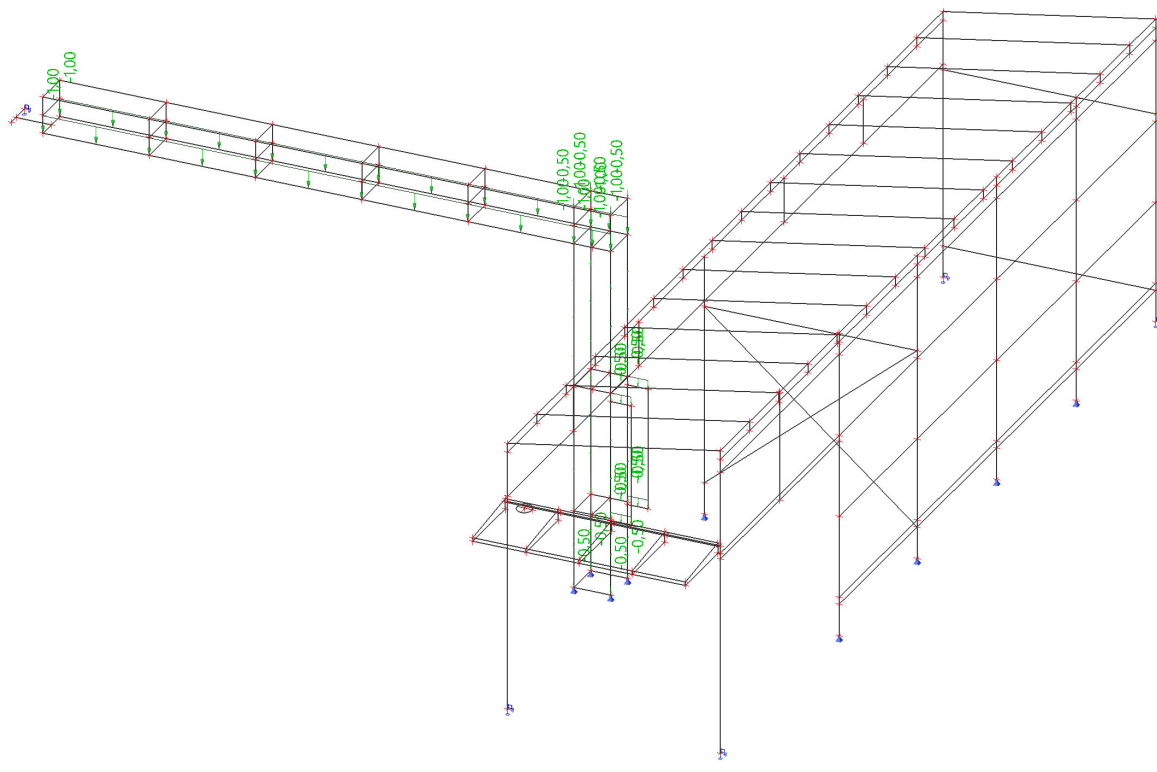


LC4 / Tot. value





LC8 / Tot. value



Load groups

Name	Load	Relation	Type
LG1	Permanent		
snow	Variable	Exclusive	Snow
wind	Variable	Exclusive	Wind
live	Variable	Exclusive	Cat C : Congregation
crane	Variable	Exclusive	Cat F : Vehicle <30kN
Ht+Hl	Variable	Exclusive	Cat F : Vehicle <30kN
Hs	Variable	Exclusive	Cat F : Vehicle <30kN

Combinations

Name	Description	Type	Load cases	Coeff. [-]
CO1		EN-ULS (STR/GEO) Set B	LC1 - self weight	1,00
			LC2 - dead load	1,00
			LC3 - snow/rime	1,00
			LC4 - wind +x	1,00
			LC5 - wind -x	1,00
			LC6 - wind +y	1,00
			LC7 - wind -y	1,00
			LC8 - live load	1,00
CO2		EN-SLS Characteristic	LC1 - self weight	1,00
			LC2 - dead load	1,00
			LC3 - snow/rime	1,00
			LC4 - wind +x	1,00
			LC5 - wind -x	1,00
			LC6 - wind +y	1,00
			LC7 - wind -y	1,00
			LC8 - live load	1,00
Rmax +		Envelope - ultimate	LC1 - self weight	1,35
			LC9 - Rmax (C)	1,50

Project Centrum Energetických a Enviromentálních Technologíí

Part SO 01.1 Objekt CEETe
 Description Ocelová konstrukce - DPS
 Author Ing. Jeřowicz

Name	Description	Type	Load cases	Coeff. [-]
			LC10 - Ht+Hl_Rmax (C)	1,35
			LC11 - Hs_Rmax (C)	1,35
Rmax -		Envelope - ultimate	LC1 - self weight	1,35
			LC9 - Rmax (C)	1,50
			LC10 - Ht+Hl_Rmax (C)	-1,35
			LC11 - Hs_Rmax (C)	-1,35
Mmax +		Envelope - ultimate	LC1 - self weight	1,35
			LC12 - Mmax (C-D)	1,50
			LC13 - Ht+Hl_Mmax (C-D)	1,35
			LC14 - Hs_Mmax (C-D)	1,35
Mmax -		Envelope - ultimate	LC1 - self weight	1,35
			LC12 - Mmax (C-D)	1,50
			LC13 - Ht+Hl_Mmax (C-D)	-1,35
			LC14 - Hs_Mmax (C-D)	-1,35
Mmax +def		Envelope - serviceability	LC1 - self weight	1,00
			LC12 - Mmax (C-D)	1,00
			LC13 - Ht+Hl_Mmax (C-D)	1,00
			LC14 - Hs_Mmax (C-D)	1,00
Mmax -def		Envelope - serviceability	LC1 - self weight	1,00
			LC12 - Mmax (C-D)	1,00
			LC13 - Ht+Hl_Mmax (C-D)	-1,00
			LC14 - Hs_Mmax (C-D)	-1,00
CO3		EN-Accidental 1	LC1 - self weight	1,00
			LC2 - dead load	1,00
			LC3 - snow/rime	1,00
			LC4 - wind +x	1,00
			LC5 - wind -x	1,00
			LC6 - wind +y	1,00
			LC7 - wind -y	1,00
			LC8 - live load	1,00

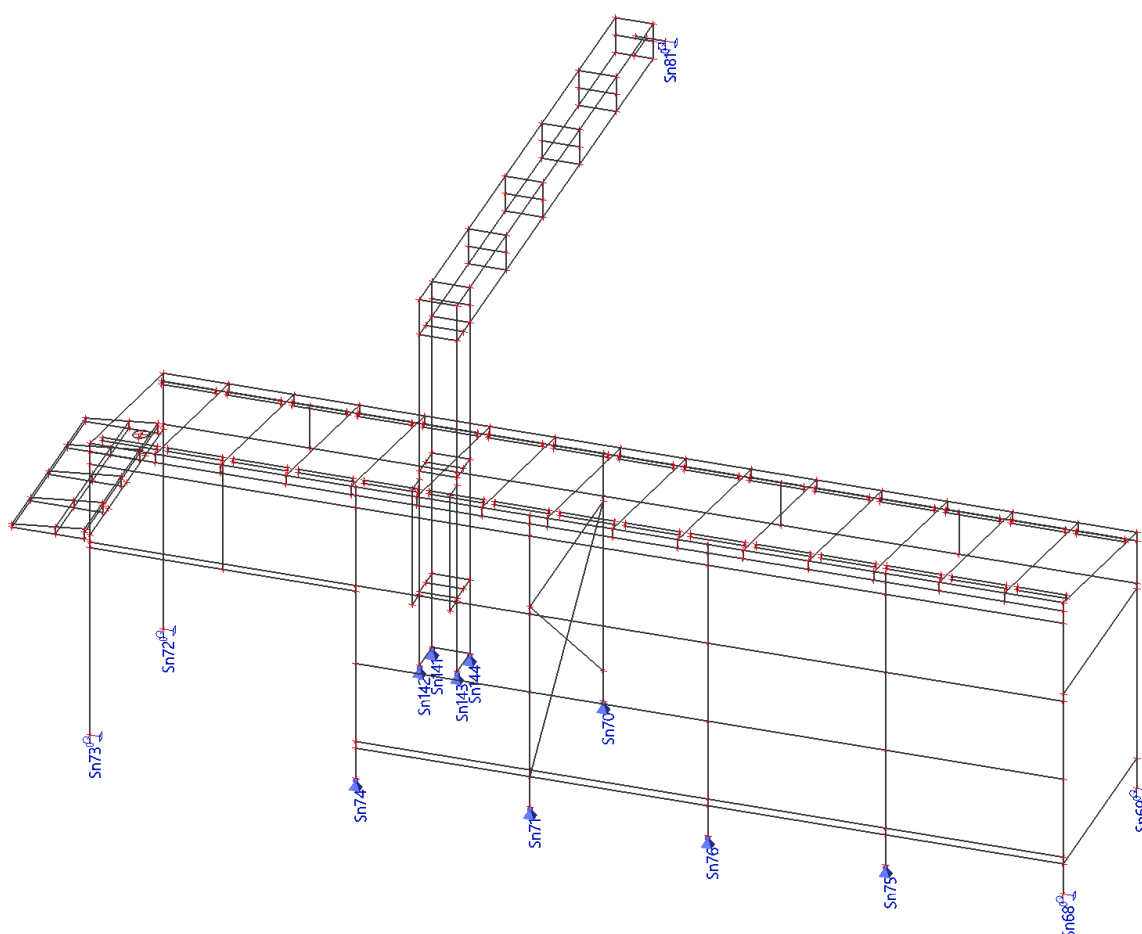
Result classes

Name	List
All ULS	CO1 - EN-ULS (STR/GEO) Set B
	Rmax + - Envelope - ultimate
	Rmax - - Envelope - ultimate
	Mmax + - Envelope - ultimate
	Mmax - - Envelope - ultimate
	CO3 - EN-Accidental 1
All SLS	CO2 - EN-SLS Characteristic
	Mmax +def - Envelope - serviceability
	Mmax -def - Envelope - serviceability

REAKCE

REACTIONS

Structural model - name of supports



R1 - Reactions; R_x; R_y; R_z; M_x; M_y; M_zValues: M_z, M_x, M_y, R_z, R_y, R_x

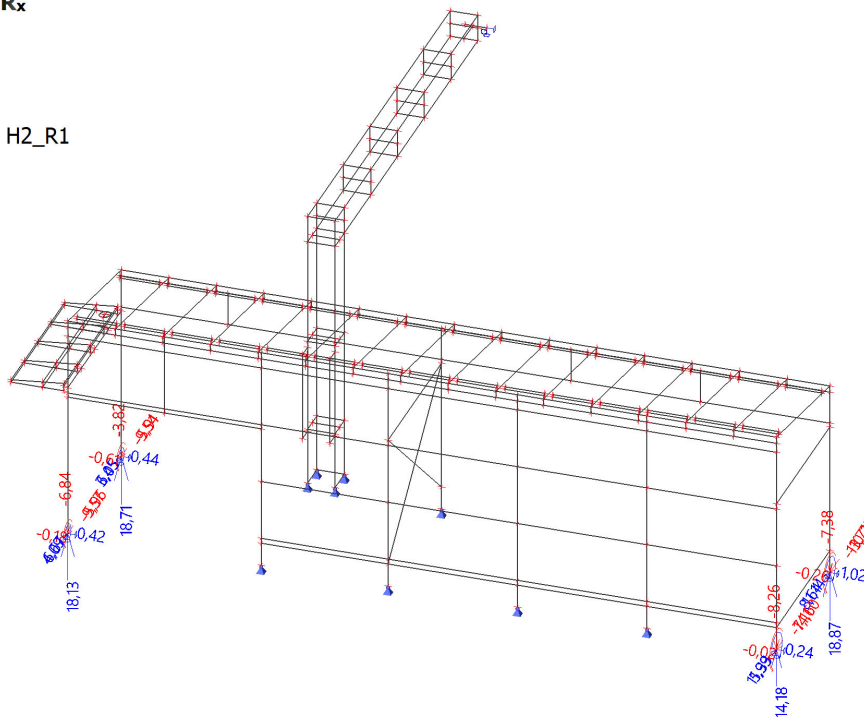
Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R1

**Reactions**

Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R1

Nodal reactions

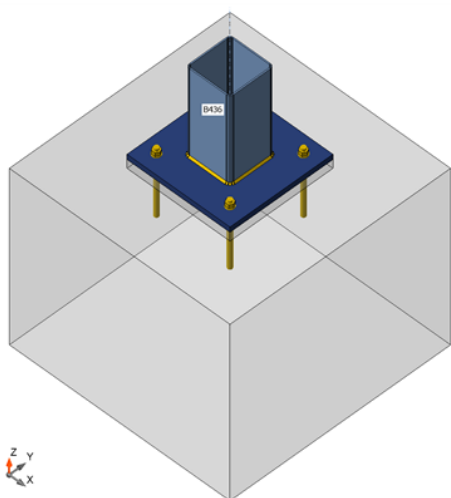
Name	Case	R _x [kN]	R _y [kN]	R _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]	e _x [mm]	e _y [mm]
Sn68/N2243	CO1/1	5,33	-0,02	11,07	0,00	11,99	0,00	0,0	1083,6
Sn68/N2243	CO1/2	0,50	0,24	7,91	0,00	1,10	0,00	0,0	139,3
Sn68/N2243	CO1/3	-7,01	0,12	-8,26	0,00	-14,56	0,00	0,0	1762,0
Sn68/N2243	CO1/4	5,24	0,00	14,18	0,00	11,95	0,00	0,0	842,9
Sn68/N2243	CO1/5	-7,11	0,15	-5,15	0,00	-14,60	0,00	0,0	2834,1
Sn69/N2245	CO1/6	8,64	-0,16	6,75	0,00	11,08	0,00	0,0	1642,5
Sn69/N2245	CO1/1	8,63	-0,26	1,20	0,00	11,14	0,00	0,0	9321,1
Sn69/N2245	CO1/2	0,76	1,02	12,29	0,00	1,01	0,00	0,0	81,8
Sn69/N2245	CO1/7	7,09	-0,04	-7,38	0,00	8,48	0,00	0,0	-1148,9
Sn69/N2245	CO1/8	-6,11	0,13	18,87	0,00	-8,34	0,00	0,0	-442,2
Sn69/N2245	CO1/5	-10,21	-0,11	14,22	0,00	-13,71	0,00	0,0	-964,2
Sn69/N2245	CO1/9	-10,23	-0,21	8,67	0,00	-13,65	0,00	0,0	-1574,0
Sn72/N2256	CO1/4	3,30	-0,61	10,52	0,00	5,88	0,00	0,0	558,9
Sn72/N2256	CO1/10	0,23	0,44	2,39	0,00	0,37	0,00	0,0	152,7
Sn72/N2256	CO1/7	3,09	0,22	-3,82	0,00	4,87	0,00	0,0	-1274,5
Sn72/N2256	CO1/8	-3,78	-0,06	18,71	0,00	-5,99	0,00	0,0	-320,3
Sn72/N2256	CO1/1	3,45	-0,59	4,18	0,00	6,05	0,00	0,0	1446,3
Sn72/N2256	CO1/5	-5,91	-0,02	14,14	0,00	-9,54	0,00	0,0	-674,9
Sn73/N2259	CO1/1	4,01	-0,18	13,34	0,00	6,61	0,00	0,0	495,4
Sn73/N2259	CO1/11	0,27	0,42	10,91	0,00	0,31	0,00	0,0	28,5
Sn73/N2259	CO1/12	2,57	0,15	18,13	0,00	4,09	0,00	0,0	225,5
Sn73/N2259	CO1/4	4,09	-0,06	17,86	0,00	6,67	0,00	0,0	373,3
Sn73/N2259	CO1/3	-5,96	0,05	-6,84	0,00	-9,57	0,00	0,0	1399,9

Con N2243

Analysis: Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B436	1 - VHP150/150x4.0	0,0	0,0	0,0	0	0	0	Position



Material

Steel	S 235 (EN)
Concrete	C25/30 (EN)
Bolts	M16 8.8

Foundation block

CB 1

Dimensions	750 x 750	mm
Depth	600	mm
Anchor	M16 8.8	
Anchoring length	160	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
CO1(1)	B436	9,3	-0,1	-7,0	0,0	14,6	0,0

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,4 < 5,0%	OK
Anchors	61,1 < 100%	OK
Welds	98,1 < 100%	OK
Concrete block	42,0 < 100%	OK
Buckling	Not calculated	

Project: CEETe - TU Ostrava
 Project no: Kh1
 Author: Ing. Jeřowicz

Project item Con N2243

Design

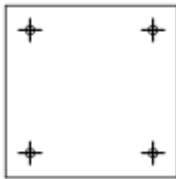
Name Con N2243
 Description
 Analysis Stress, strain/ loads in equilibrium

Foundation block

Item	Value	Unit
CB 1		
Dimensions	750 x 750	mm
Depth	600	mm
Anchor	M16 8.8	
Anchoring length	160	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P18,0x350,0-350,0 (S 235)		1	Fillet: a = 4,0	566,1	M16 8.8	4

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	4,0	5,7	566,1

Anchors

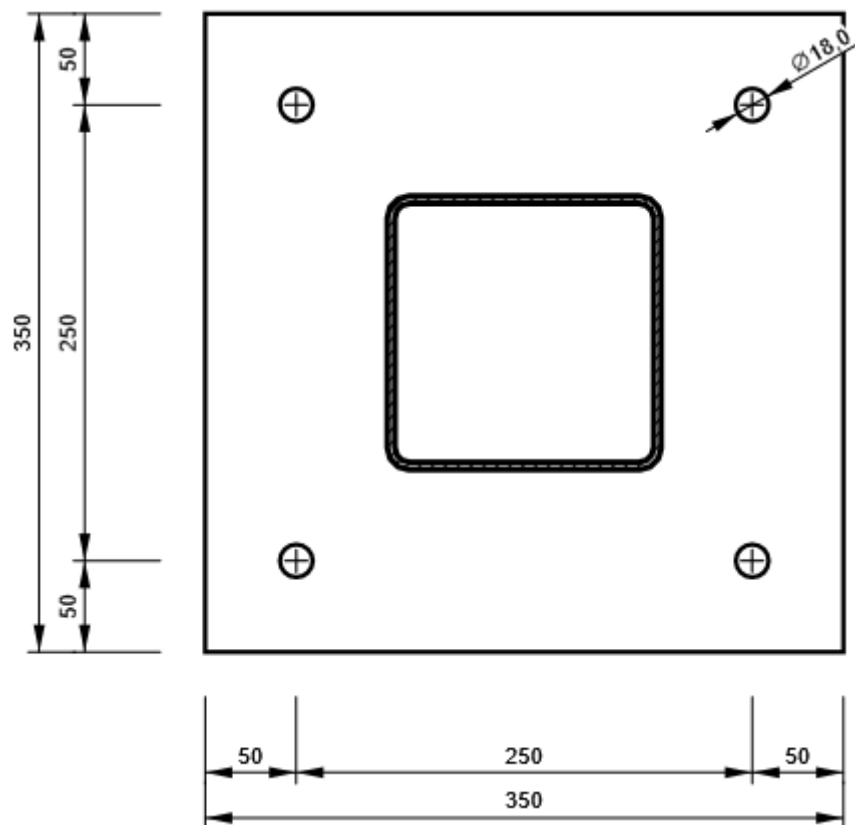
Name	Length [mm]	Drill length [mm]	Count
M16 8.8	208	160	4

Drawing

BP1

Project: CEETe - TU Ostrava
Project no: Kh1
Author: Ing. Jeřowicz

P18,0x350-350 (S 235)



R2 - Reactions; R_x; R_y; R_z; M_x; M_y; M_z

Values: M_z, M_x, M_y, R_z, R_y, R_x

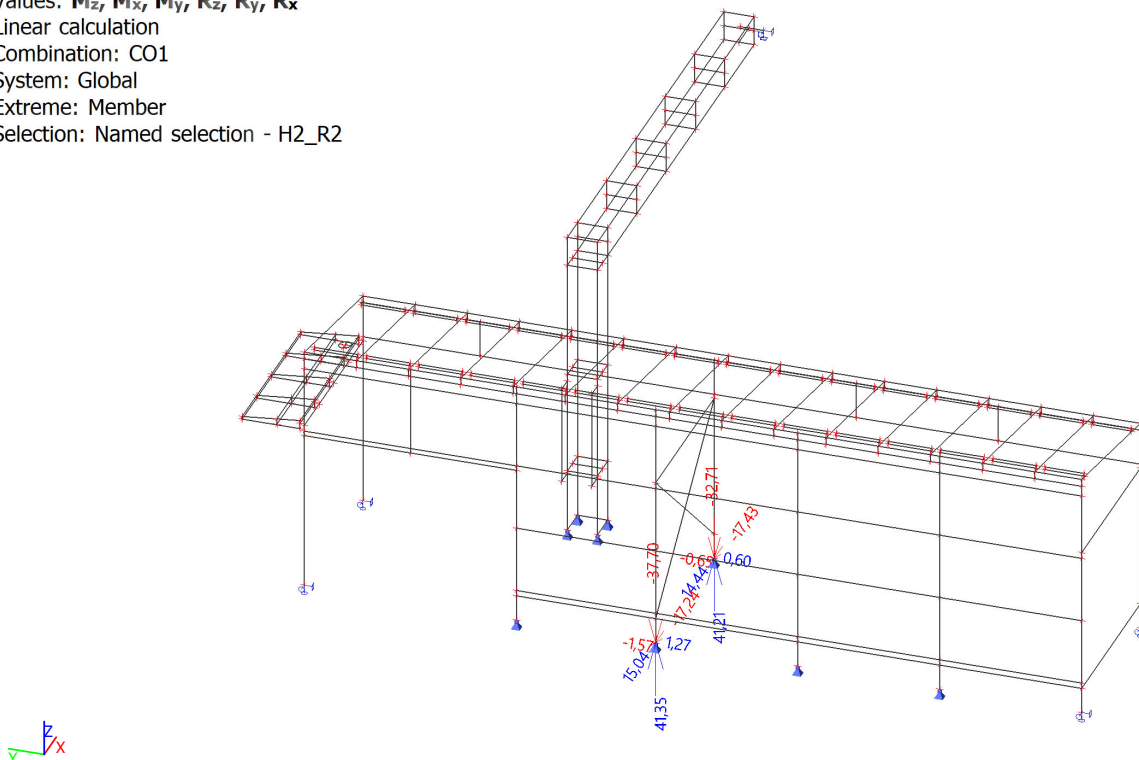
Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R2



Reactions

Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R2

Nodal reactions

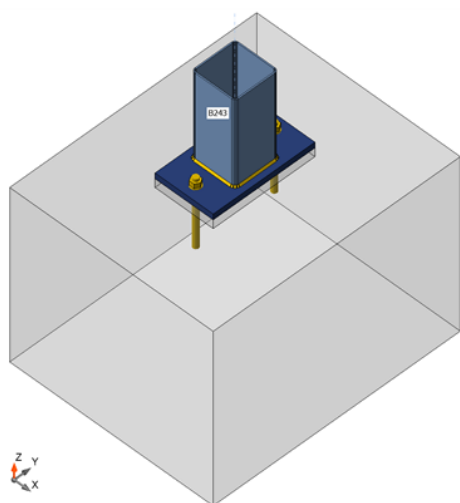
Name	Case	R _x [kN]	R _y [kN]	R _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]	e _x [mm]	e _y [mm]
Sn70/N2250	CO1/1	14,44	-0,59	-13,83	0,00	0,00	0,00	0,0	0,0
Sn70/N2250	CO1/2	14,42	-0,65	-4,54	0,00	0,00	0,00	0,0	0,0
Sn70/N2250	CO1/3	0,68	0,60	15,38	0,00	0,00	0,00	0,0	0,0
Sn70/N2250	CO1/4	12,64	0,10	-32,71	0,00	0,00	0,00	0,0	0,0
Sn70/N2250	CO1/5	-17,43	-0,17	41,21	0,00	0,00	0,00	0,0	0,0
Sn71/N2253	CO1/2	15,04	-1,57	41,35	0,00	0,00	0,00	0,0	0,0
Sn71/N2253	CO1/3	1,02	1,27	10,24	0,00	0,00	0,00	0,0	0,0
Sn71/N2253	CO1/6	-17,24	0,12	-37,70	0,00	0,00	0,00	0,0	0,0

Con N2253

Analysis: Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B243	1 - VHP150/150x4.0	0,0	0,0	0,0	0	0	0	Position



Material

Steel	S 235 (EN)
Concrete	C25/30 (EN)
Bolts	M20 8.8

Foundation block

CB 1

Dimensions	850 x 700	mm
Depth	600	mm
Anchor	M20 8.8	
Anchoring length	160	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
CO1(1)	B243	38,7	-0,1	-17,3	0,0	0,0	0,0

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,0 < 5,0%	OK
Anchors	64,0 < 100%	OK
Welds	42,1 < 100%	OK
Concrete block	Not calculated	
Buckling	Not calculated	

Project: CEETe - TU Ostrava
 Project no: Kh2
 Author: Ing. Jeřowicz

Project item Con N2253

Design


Name Con N2253
 Description
 Analysis Stress, strain/ loads in equilibrium

Foundation block

Item	Value	Unit
CB 1		
Dimensions	850 x 700	mm
Depth	600	mm
Anchor	M20 8.8	
Anchoring length	160	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P20,0x350,0-200,0 (S 235)		1	Fillet: a = 4,0	566,1	M20 8.8	2

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	4,0	5,7	566,1

Anchors

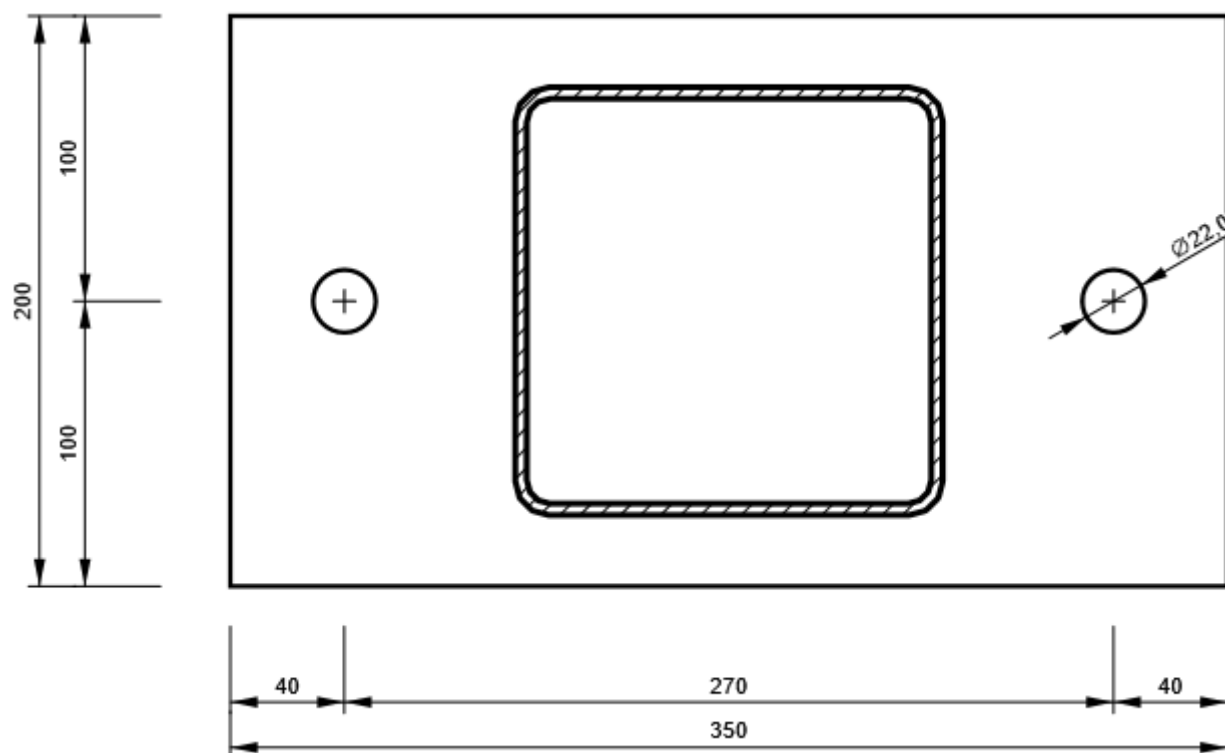
Name	Length [mm]	Drill length [mm]	Count
M20 8.8	210	160	2

Drawing

BP1

Project: CEETe - TU Ostrava
Project no: Kh2
Author: Ing. Jeřowicz

P20,0x200-350 (S 235)



R4 - Reactions; R_x; R_y; R_z; M_x; M_y; M_z

Values: M_z, M_x, M_y, R_z, R_y, R_x

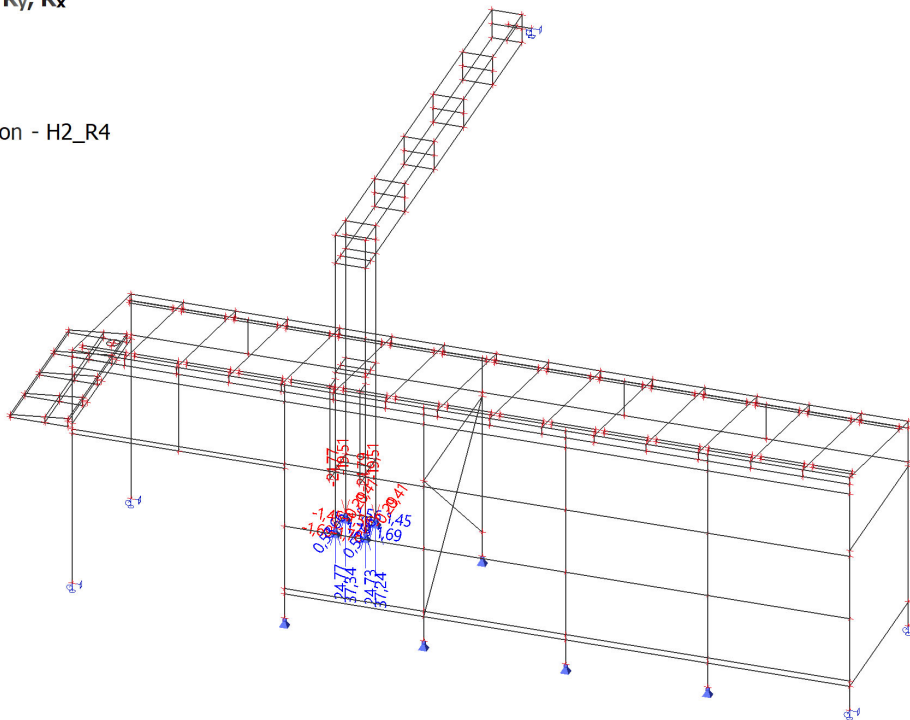
Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R4



Reactions

Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R4

Nodal reactions

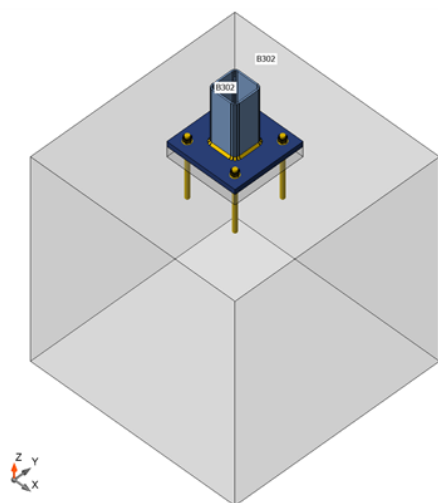
Name	Case	R _x [kN]	R _y [kN]	R _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]	e _x [mm]	e _y [mm]
Sn141/N2351	CO1/1	0,66	0,00	14,61	0,00	0,00	0,00	0,0	0,0
Sn141/N2351	CO1/2	0,09	-1,45	37,34	0,00	0,00	0,00	0,0	0,0
Sn141/N2351	CO1/3	0,16	1,56	-19,51	0,00	0,00	0,00	0,0	0,0
Sn141/N2351	CO1/4	-0,41	0,00	3,23	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/1	0,53	0,00	2,91	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/5	-0,05	-1,69	22,74	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/6	0,29	1,78	-19,74	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/3	0,14	1,78	-21,77	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/2	0,10	-1,69	24,77	0,00	0,00	0,00	0,0	0,0
Sn142/N2355	CO1/4	-0,29	0,00	0,08	0,00	0,00	0,00	0,0	0,0
Sn143/N2357	CO1/1	0,52	0,00	2,86	0,00	0,00	0,00	0,0	0,0
Sn143/N2357	CO1/7	0,14	-1,78	-21,79	0,00	0,00	0,00	0,0	0,0
Sn143/N2357	CO1/8	0,10	1,69	24,73	0,00	0,00	0,00	0,0	0,0
Sn143/N2357	CO1/4	-0,29	0,00	0,07	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/1	0,66	0,00	14,52	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/9	0,33	-1,56	-7,83	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/10	-0,08	1,45	25,56	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/7	0,16	-1,56	-19,51	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/8	0,09	1,45	37,24	0,00	0,00	0,00	0,0	0,0
Sn144/N2369	CO1/4	-0,41	0,00	3,21	0,00	0,00	0,00	0,0	0,0

Con N2369

Analysis: Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β - Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B302	1 - VHP80/80x4.0	0,0	0,0	0,0	0	0	0	Position



Material

Steel	S 235 (EN)
Concrete	C25/30 (EN)
Bolts	M12 8.8

Foundation block

CB 1

Dimensions	600 x 600	mm
Depth	600	mm
Anchor	M12 8.8	
Anchoring length	120	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
CO1(1)	B302	-28,7	2,2	-0,3	0,0	0,0	0,0
CO1(3)	B302	45,0	-2,1	0,1	0,0	0,0	0,0

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,0 < 5,0%	OK
Anchors	56,9 < 100%	OK
Welds	44,5 < 100%	OK
Concrete block	9,6 < 100%	OK
Buckling	Not calculated	

Project: CEETe - TU Ostrava
 Project no: Kh3
 Author: Ing. Jeřowicz

Project item Con N2369

Design

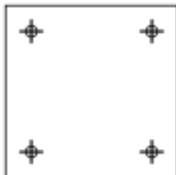
Name Con N2369
 Description
 Analysis Stress, strain/ loads in equilibrium

Foundation block

Item	Value	Unit
CB 1		
Dimensions	600 x 600	mm
Depth	600	mm
Anchor	M12 8.8	
Anchoring length	120	mm
Shear force transfer	Anchors	
Mortar joint	30	mm

Bill of material

Manufacturing operations

Name	Plates [mm]	Shape	Nr.	Welds [mm]	Length [mm]	Bolts	Nr.
BP1	P15,0x200,0-200,0 (S 235)		1	Fillet: a = 4,0	286,1	M12 8.8	4

Welds

Type	Material	Throat thickness [mm]	Leg size [mm]	Length [mm]
Fillet	S 235	4,0	5,7	286,1

Anchors

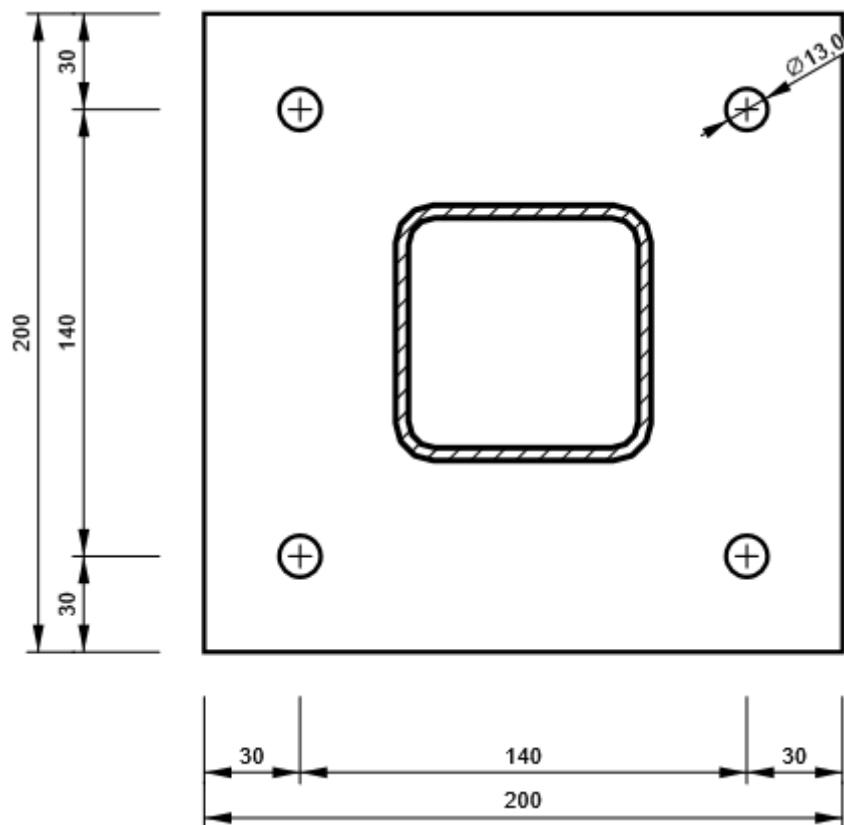
Name	Length [mm]	Drill length [mm]	Count
M12 8.8	165	120	4

Drawing

BP1

Project: CEETe - TU Ostrava
Project no: Kh3
Author: Ing. Jeřowicz

P15,0x200-200 (S 235)



R5 - Reactions; R_x; R_y; R_z; M_x; M_y; M_z

Values: M_z, M_x, M_y, R_z, R_y, R_x

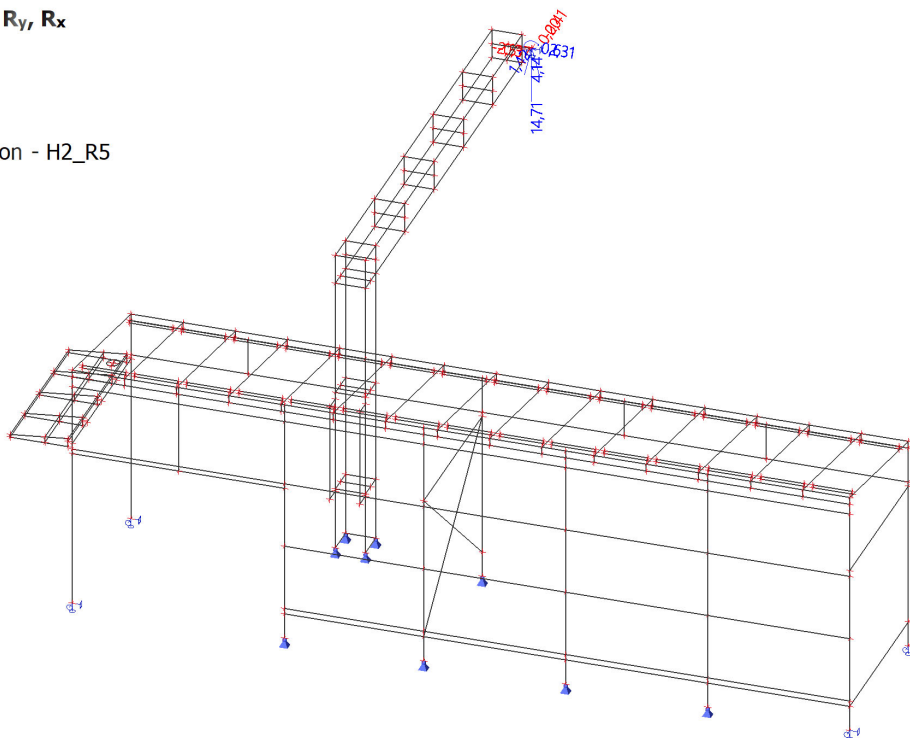
Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R5



Reactions

Linear calculation

Combination: CO1

System: Global

Extreme: Member

Selection: Named selection - H2_R5

Nodal reactions

Name	Case	R _x [kN]	R _y [kN]	R _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]	e _x [mm]	e _y [mm]
Sn81/N3310	CO1/1	-2,41	0,00	11,68	3,00	0,00	0,63	256,7	0,0
Sn81/N3310	CO1/2	-0,16	-2,31	2,48	1,25	0,00	0,04	504,8	0,0
Sn81/N3310	CO1/3	-0,83	2,31	11,74	2,40	0,00	0,22	204,1	0,0
Sn81/N3310	CO1/4	-1,74	0,00	2,42	0,62	0,00	0,45	255,6	0,0
Sn81/N3310	CO1/5	-0,16	2,31	2,48	0,02	0,00	0,04	6,7	0,0
Sn81/N3310	CO1/6	-1,04	-1,38	14,67	4,14	0,00	0,27	282,0	0,0
Sn81/N3310	CO1/7	-0,09	0,00	14,71	3,78	0,00	0,02	256,8	0,0
Sn81/N3310	CO1/8	1,42	0,00	2,54	0,65	0,00	-0,37	255,7	0,0

DEFORMACE

DEFORMATIONS

1D deformations; u_y

Values: u_y

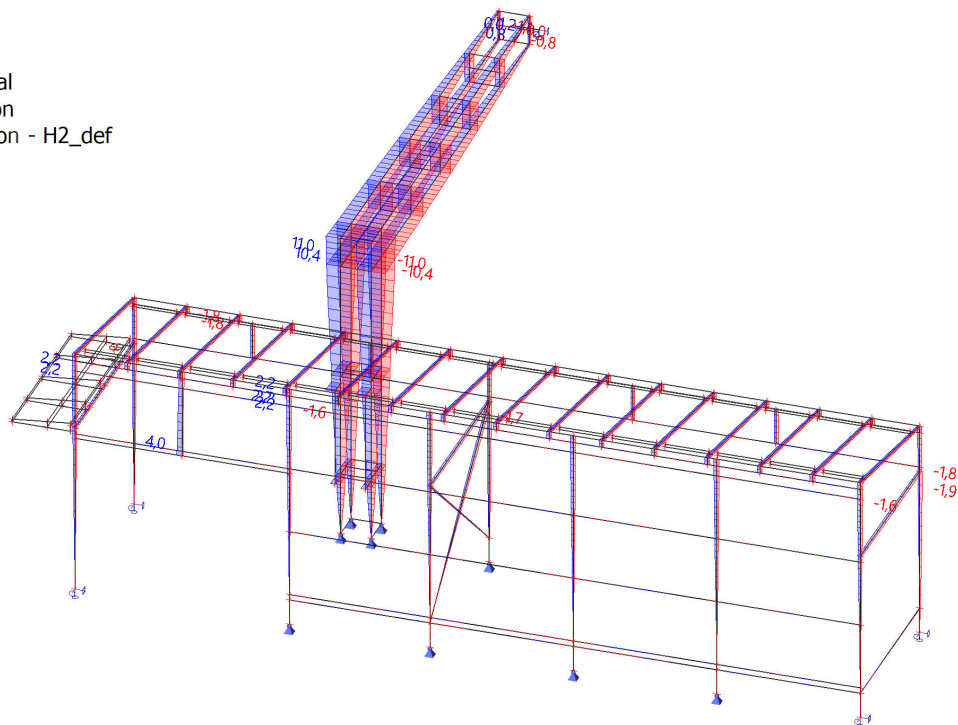
Linear calculation

Combination: CO2

Coordinate system: Global

Extreme 1D: Cross-section

Selection: Named selection - H2_def



1D deformations; u_x

Values: u_x

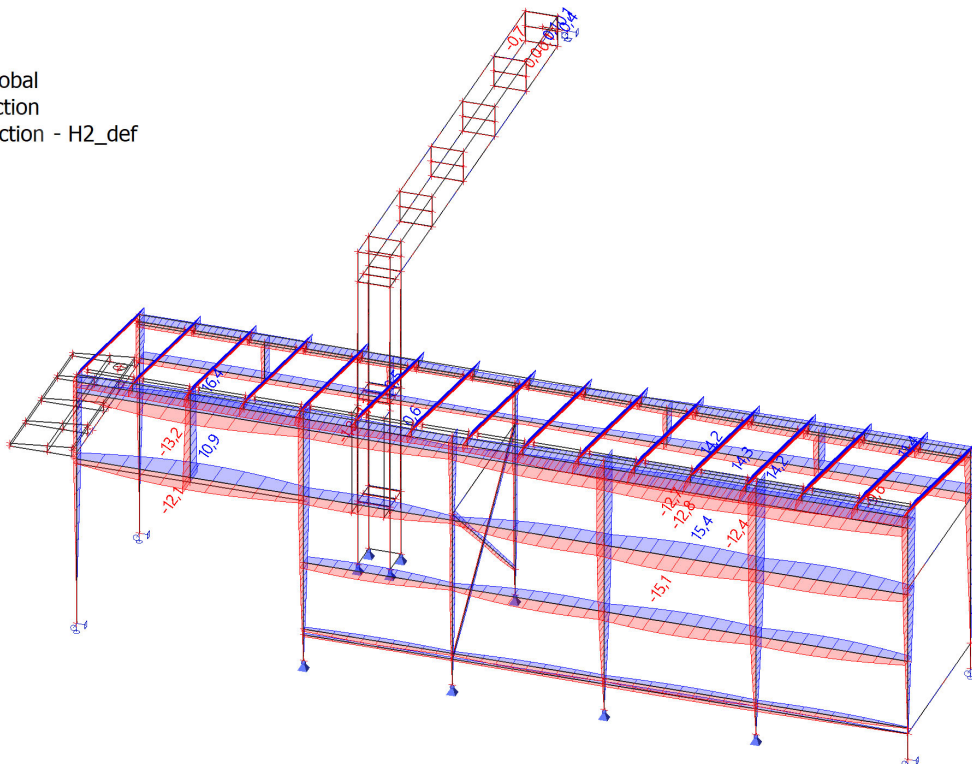
Linear calculation

Combination: CO2

Coordinate system: Global

Extreme 1D: Cross-section

Selection: Named selection - H2_def



1D deformations; u_z

Values: u_z

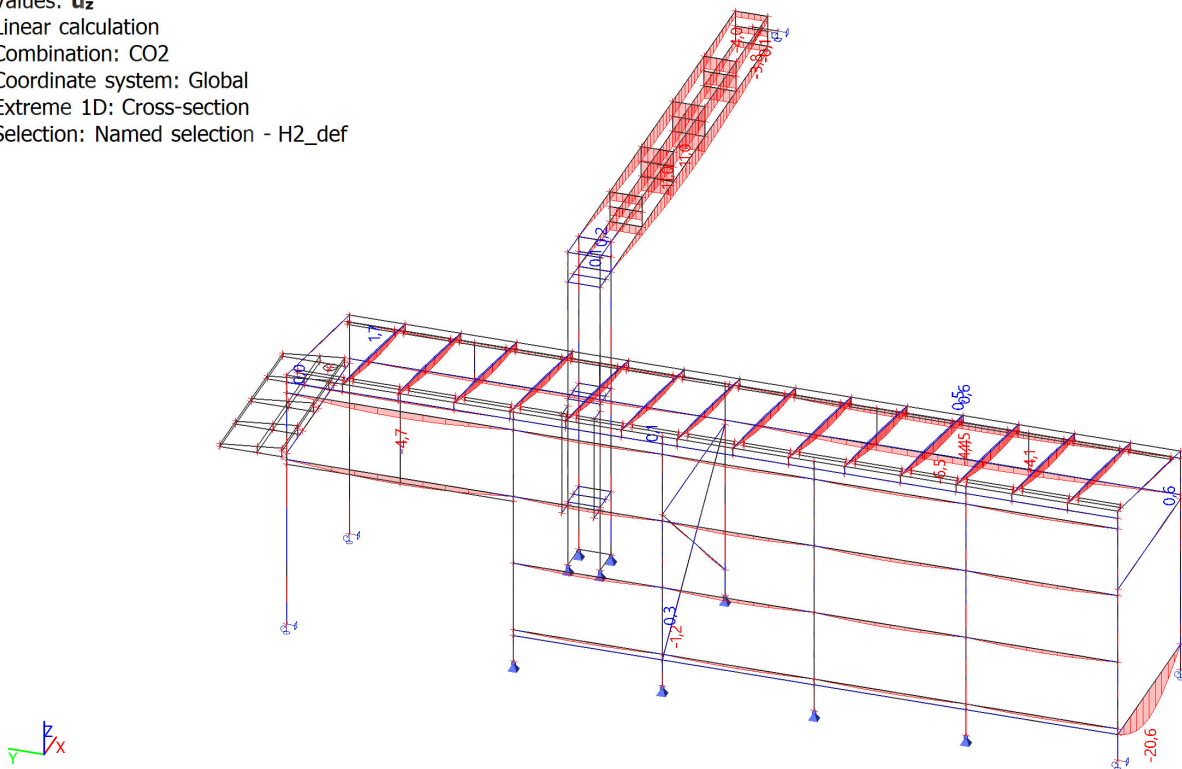
Linear calculation

Combination: CO2

Coordinate system: Global

Extreme 1D: Cross-section

Selection: Named selection - H2_def



Deformations on member

Linear calculation, Extreme : Global

Selection : Named selection - H2_def

Combinations : CO2

Member	dx [mm]	Case	ux [mm]	uy [mm]	uz [mm]	fix [mrad]	fiy [mrad]	fiz [mrad]	Resultant [mm]
B319	0,000	CO2/4	-11,0	0,3	-0,1	-0,4	-0,6	-1,1	11,0
B439	649,410	CO2/5	11,2	0,2	2,0	0,0	-0,2	0,2	11,3
B252	4040,000	CO2/6	-2,2	-12,8	-0,2	0,0	-0,1	0,0	13,0
B350	1500,480	CO2/7	-0,3	20,6	0,1	-0,2	0,0	0,0	20,6
B471	1830,000	CO2/3	-0,1	4,6	-16,4	0,6	-0,5	0,0	17,0
B449	1225,000	CO2/6	1,6	2,3	15,1	-1,3	0,2	0,0	15,4
B330	0,000	CO2/6	0,1	0,0	2,5	-5,4	0,4	0,2	2,5
B306	260,010	CO2/8	0,0	0,0	-3,8	5,8	-0,2	0,0	3,8
B510	63,470	CO2/3	0,1	-0,1	-12,4	0,3	-44,0	-0,1	12,4
B463	63,470	CO2/5	0,1	0,7	7,4	-0,4	51,1	-0,1	7,4
B350	3000,950	CO2/9	-0,2	0,0	-0,1	0,2	0,0	-21,9	0,2
B350	0,000	CO2/10	0,3	0,0	0,0	0,0	0,0	21,9	0,3

DEFORMATIONS OF PLATE ELEMENTS

2D displacement; U_{total}

Values: U_{total}

Linear calculation

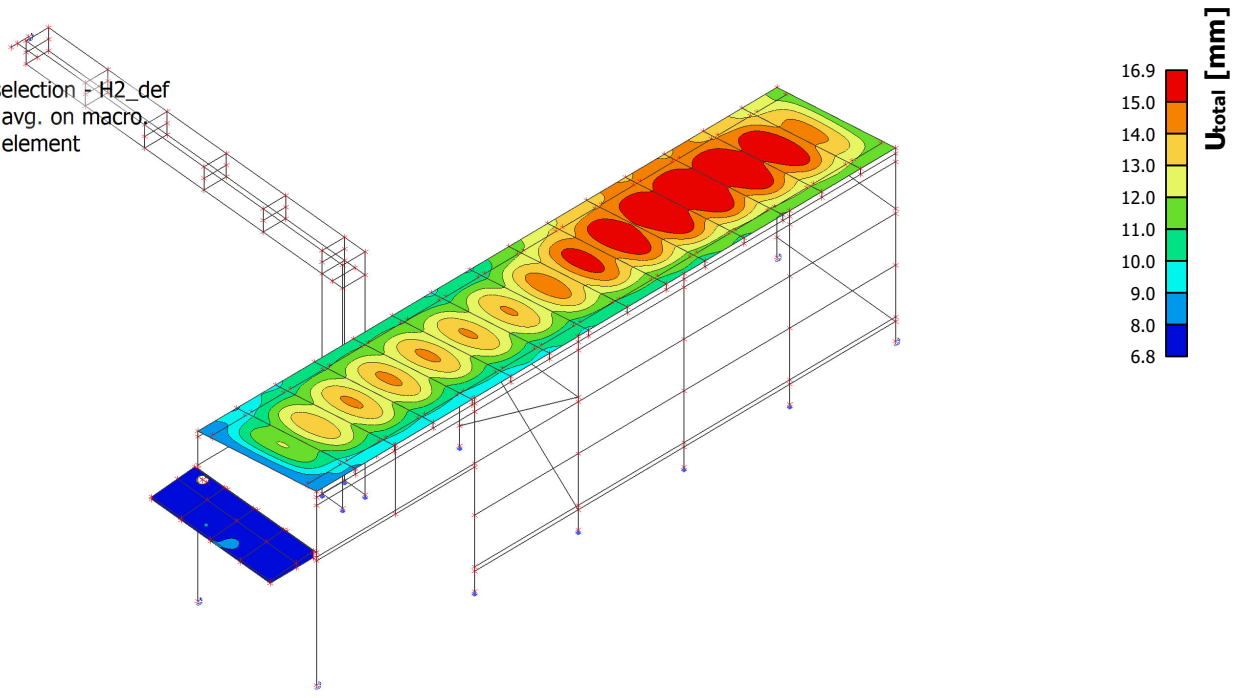
Combination: CO2

Selection: Named selection - H2_def

Location: In nodes avg. on macro

System: LCS mesh element

Extreme: Global



2D displacement

Linear calculation

Combination: CO2

Selection: Named selection - H2_results

Location: In nodes avg. on macro. System: LCS mesh element

Extreme: Global

Name	Case	u_x [mm]	u_y [mm]	u_z [mm]	ϕ_x [mrad]	ϕ_y [mrad]	ϕ_z [mrad]	U_{total} [mm]
S538	CO2/1	-4,7	1,3	0,1	0,0	-1,1	-0,2	5,0
S538	CO2/2	6,9	0,7	0,0	-0,2	1,2	0,5	7,1
S568	CO2/2	0,2	-11,2	2,0	-0,2	0,0	0,2	11,5
S568	CO2/1	1,9	9,0	-1,7	0,3	0,4	-0,3	9,5
S815	CO2/3	1,5	-3,4	-9,4	-2,9	0,0	-1,3	11,5
S817	CO2/2	0,7	0,3	11,4	0,8	0,3	-0,2	11,7
S560	CO2/4	1,1	4,2	-3,5	-7,2	0,2	-0,2	6,8
S565	CO2/4	1,5	4,9	-4,1	8,7	0,2	-0,1	7,9
S554	CO2/4	1,3	3,3	-3,1	0,2	-11,6	-0,2	5,6
S567	CO2/5	-0,7	0,5	-4,9	-0,1	9,9	0,0	5,8
S817	CO2/4	1,0	-0,6	-5,5	-0,8	0,4	-3,2	6,1
S789	CO2/4	1,0	-0,4	-3,3	-0,6	-0,7	2,8	3,9
S554	CO2/6	0,1	0,0	0,0	0,0	-0,2	0,0	0,1
S565	CO2/2	0,4	-10,4	2,3	0,4	0,0	0,2	16,9

Name	Combination key
CO2/1	LC1 + LC2 + LC6
CO2/2	LC1 + LC2 + 0.50*LC3 + LC4
CO2/3	LC1 + LC2 + 0.50*LC3 + LC6
CO2/4	LC1 + LC2 + LC3 + 0.60*LC6
CO2/5	LC1 + LC2 + LC3 + 0.60*LC7
CO2/6	LC1 + LC2

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STRESS ANALYSIS OF CROSS SECTIONS

CS51 - 1D internal forces; N

Values: **N**

Linear calculation

Combination: CO1

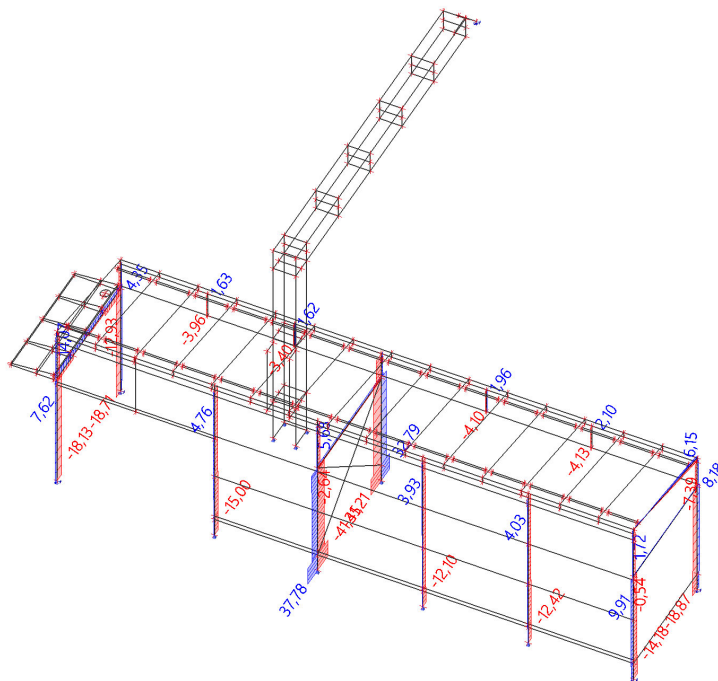
Coordinate system: Principal

Extreme 1D: Member

Selection: All

Filter: Cross-section = CS51 -

VHP150/150x4.0



CS51 - 1D internal forces; M_y

Values: M_y

Linear calculation

Combination: CO1

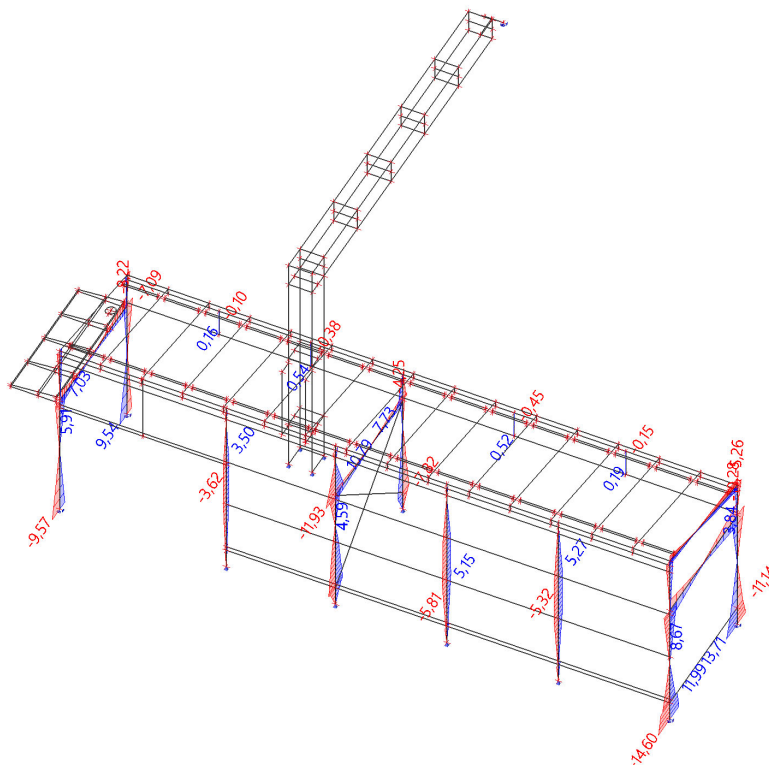
Coordinate system: Principal

Extreme 1D: Member

Selection: All

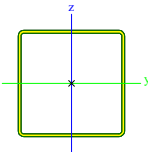
Filter: Cross-section = CS51 -

VHP150/150x4.0



Cross-sections

Cross-sections - CS51

Name	Type	Item material	Fabrication	buckling y-y	buckling z-z	Picture	Type description
	Detailed						
CS51	VHP150/150x4.0	S 235	cold formed	c	c		Rectangular hollow section

1D internal forces

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS51 - VHP150/150x4.0

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B243	450,000-	CO1/1	CS51 - VHP150/150x4.0	37,78	0,12	17,24	0,00	7,76	0,05
B440	126,927+	CO1/2	CS51 - VHP150/150x4.0	-8,42	-16,00	-1,71	-0,25	1,35	5,50
B243	0,000	CO1/3	CS51 - VHP150/150x4.0	-41,35	-1,57	-15,04	0,00	0,00	0,00
B241	3694,073	CO1/4	CS51 - VHP150/150x4.0	-41,21	0,17	17,43	0,00	0,00	0,00
B436	4223,073+	CO1/1	CS51 - VHP150/150x4.0	3,68	-5,45	-0,87	-3,57	3,95	-0,10
B436	4223,073+	CO1/3	CS51 - VHP150/150x4.0	-4,36	7,78	0,00	3,87	-3,76	-0,02
B436	0,000	CO1/4	CS51 - VHP150/150x4.0	5,15	0,15	7,11	0,00	-14,60	0,00
B440	3821,000	CO1/4	CS51 - VHP150/150x4.0	-14,22	0,11	10,21	0,00	13,71	0,00
B276	0,000	CO1/2	CS51 - VHP150/150x4.0	-3,97	20,29	-0,52	0,08	0,04	-6,37
B276	634,073	CO1/2	CS51 - VHP150/150x4.0	-4,10	20,29	-0,52	0,08	-0,29	6,50

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS51 - VHP150/150x4.0

Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]
B436	0,000	CO1/1	CS51 - VHP150/150x4.0	S 235	0,51	0,51	0,00

Name	Combination key
CO1/1	LC1 + LC2 + 1.50*LC4

CS52 - 1D internal forces; N

Values: **N**

Linear calculation

Combination: CO1

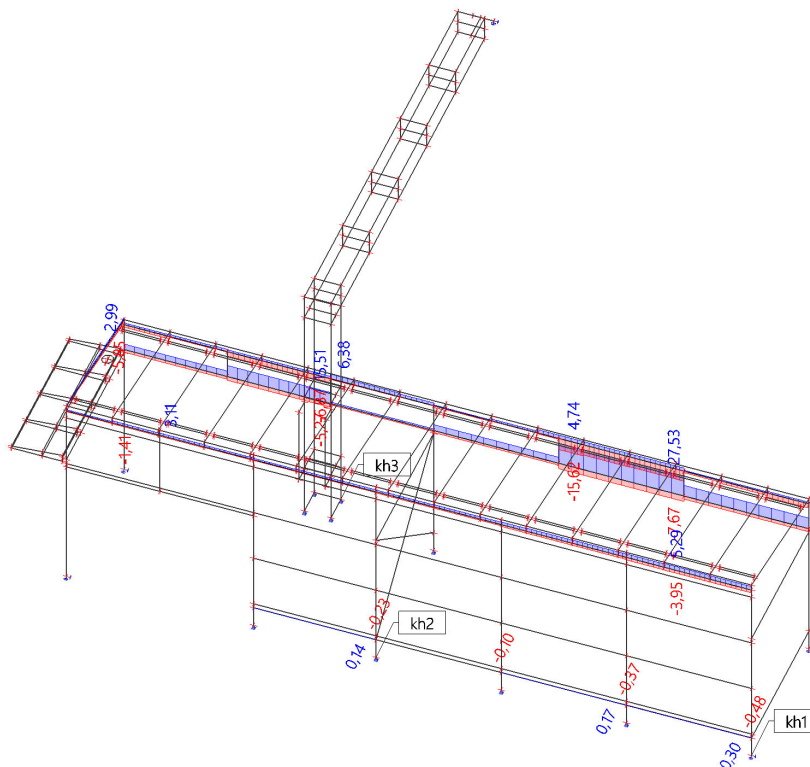
Coordinate system: Principal

Extreme 1D: Member

Selection: All

Filter: Cross-section = CS52 -

VHP150/150x4.0



CS52 - 1D internal forces; M_y

Values: **M_y**

Linear calculation

Combination: CO1

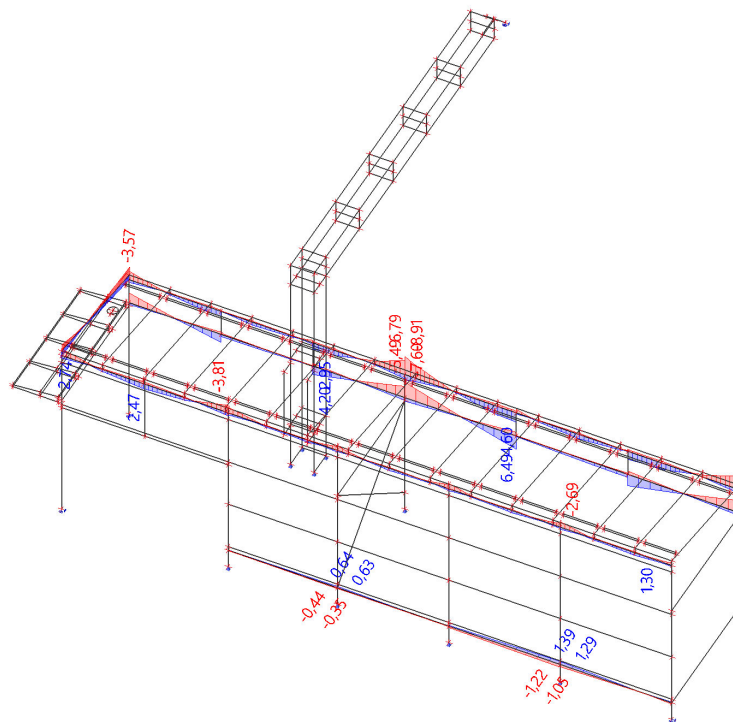
Coordinate system: Principal

Extreme 1D: Member

Selection: All

Filter: Cross-section = CS52 -

VHP150/150x4.0



CS52 - 1D internal forces; M_z

Values: **M_z**

Linear calculation

Combination: CO1

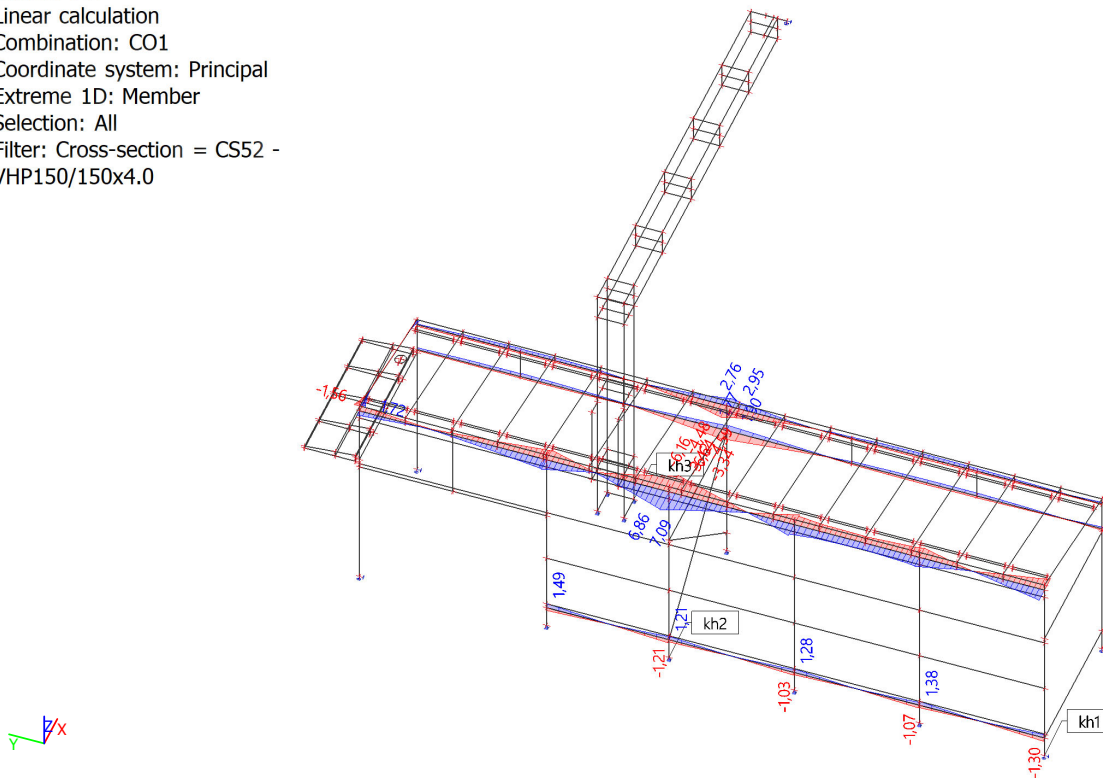
Coordinate system: Principal

Extreme 1D: Member

Selection: All

Filter: Cross-section = CS52 -

VHP150/150x4.0



Cross-sections

Cross-sections - CS52

Name	Type	Item material	Fabrication	buckling y-y	buckling z-z	Picture	Type description
CS52	Detailed VHP150/150x4.0	S 235	cold formed	c	c		Rectangular hollow section

1D internal forces

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS52 - VHP150/150x4.0

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B256	4410,000+	CO1/1	CS52 - VHP150/150x4.0	-15,62	0,56	-4,90	-0,07	0,69	-0,39
B273	2450,000+	CO1/1	CS52 - VHP150/150x4.0	27,53	0,07	-0,07	-0,07	1,46	-0,47
B441	0,000	CO1/2	CS52 - VHP150/150x4.0	-0,37	-6,94	3,53	-0,28	-2,81	1,72
B441	3047,221	CO1/1	CS52 -	-0,10	6,23	-1,34	0,14	0,74	0,81

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
			VHP150/150x4.0						
B257	0,000	CO1/3	CS52 - VHP150/150x4.0	3,93	-0,18	8,16	0,01	-6,79	0,31
B332	0,000	CO1/4	CS52 - VHP150/150x4.0	-0,01	-0,30	0,83	-2,08	-0,52	0,19
B332	0,000	CO1/2	CS52 - VHP150/150x4.0	-0,48	0,84	-0,67	2,13	0,41	-1,30
B256	7350,000	CO1/3	CS52 - VHP150/150x4.0	-2,41	0,24	-11,25	-0,05	-8,91	0,33
B273	4900,000+	CO1/1	CS52 - VHP150/150x4.0	7,24	0,58	-5,22	-0,35	6,49	-0,22
B252	0,000	CO1/2	CS52 - VHP150/150x4.0	2,52	4,76	5,07	1,64	-2,25	-6,64
B252	0,000	CO1/4	CS52 - VHP150/150x4.0	-1,50	-5,30	-1,89	-1,55	0,59	7,09

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC6
CO1/2	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC6
CO1/3	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC7
CO1/4	LC1 + LC2 + 1.50*LC4

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS52 - VHP150/150x4.0

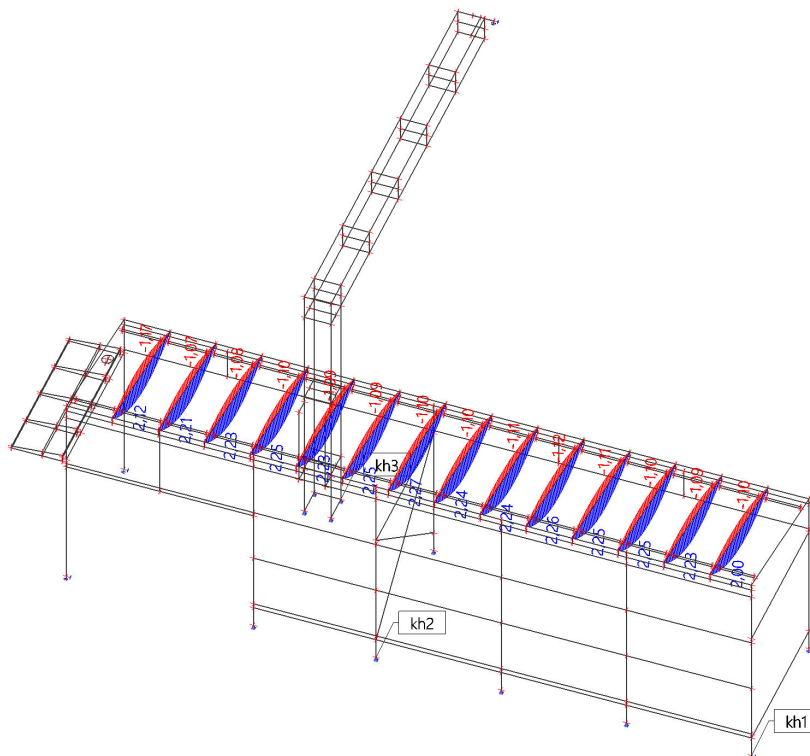
Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]
B256	7350,000	CO1/1	CS52 - VHP150/150x4.0	S 235	0,32	0,31	0,32

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC6

CS56 - 1D internal forces; M_y

Values: **M_y**
Linear calculation
Combination: CO1
Coordinate system: Principal
Extreme 1D: Member
Selection: All
Filter: Cross-section = CS56 -
VHP120/40x4.0



Cross-sections

Cross-sections - CS56

Name	Type	Item material	Fabrication	buckling y-y	buckling z-z	Picture	Type description
CS56	Detailed VHP120/40x4.0	S 235	cold formed	c	c		Rectangular hollow section

1D internal forces

Linear calculation
Combination: CO1
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS56 - VHP120/40x4.0

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B346	0,000	CO1/1	CS56 - VHP120/40x4.0	-1,39	0,03	-1,34	0,00	-0,09	0,00
B346	0,000	CO1/2	CS56 - VHP120/40x4.0	1,69	-0,09	2,51	-0,01	0,10	0,00
B336	0,000	CO1/3	CS56 - VHP120/40x4.0	0,18	-1,01	0,84	-0,19	0,00	0,02
B349	0,000	CO1/3	CS56 -	0,11	0,99	0,89	0,19	0,00	-0,02

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
			VHP120/40x4.0						
B342	3047,221	CO1/4	CS56 - VHP120/40x4.0	-0,35	0,39	-3,02	0,04	0,00	-0,01
B342	0,000	CO1/5	CS56 - VHP120/40x4.0	0,28	-0,10	2,97	-0,01	-0,02	0,00
B349	3047,221	CO1/3	CS56 - VHP120/40x4.0	0,07	-0,69	-0,92	-0,20	0,00	0,05
B336	3047,221	CO1/3	CS56 - VHP120/40x4.0	0,00	0,52	-0,86	0,20	0,00	-0,05
B336	1548,588-	CO1/1	CS56 - VHP120/40x4.0	-0,05	0,00	0,02	0,00	-1,17	0,00
B342	1548,588-	CO1/5	CS56 - VHP120/40x4.0	0,53	0,00	-0,02	0,00	2,27	0,00
B336	2997,266-	CO1/3	CS56 - VHP120/40x4.0	0,08	-0,06	-0,82	0,20	0,04	-0,05
B349	2997,266-	CO1/3	CS56 - VHP120/40x4.0	0,19	0,03	-0,88	-0,20	0,05	0,06

Name	Combination key
CO1/1	LC1 + LC2 + 1.50*LC4
CO1/2	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC6
CO1/3	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC7
CO1/4	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC7
CO1/5	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC6

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

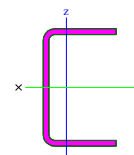
Selection: All

Filter: Cross-section = CS56 - VHP120/40x4.0

Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]
B342	1548,588-	CO1/1	CS56 - VHP120/40x4.0	S 235	0,24	0,24	0,00

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 1.50*LC3 + 0.90*LC6



Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B454	0,000	CO1/1	CS61 - KU80/50x4.0	-1,38	-0,15	1,17	0,00	0,00	0,00
B454	0,000	CO1/2	CS61 - KU80/50x4.0	2,59	-0,17	-1,00	0,00	0,00	0,00
B444	0,000	CO1/3	CS61 - KU80/50x4.0	0,02	-0,28	0,00	0,00	0,00	0,00
B444	2450.000	CO1/3	CS61 -	0,02	0,28	0,00	0,00	0,00	0,00

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
			KU80/50x4.0						
B444	2450,000	CO1/2	CS61 - KU80/50x4.0	0,17	0,24	2,02	0,00	0,00	0,00
B444	0,000	CO1/2	CS61 - KU80/50x4.0	0,17	-0,24	-2,02	0,00	0,00	0,00
B444	0,000	CO1/1	CS61 - KU80/50x4.0	-0,18	-0,21	1,73	0,00	0,00	0,00
B445	1225,000-	CO1/4	CS61 - KU80/50x4.0	-0,10	0,00	0,00	0,00	-1,24	-0,13
B446	1225,000-	CO1/5	CS61 - KU80/50x4.0	-0,07	0,00	0,00	0,00	1,24	-0,14
B445	1225,000-	CO1/3	CS61 - KU80/50x4.0	0,01	0,00	0,00	0,00	0,00	-0,17

Name	Combination key
CO1/1	LC1 + LC2 + 1,50*LC4
CO1/2	1,15*LC1 + 1,15*LC2 + 0,75*LC3 + 1,50*LC6
CO1/3	1,35*LC1 + 1,35*LC2
CO1/4	LC1 + LC2 + 1,50*LC6
CO1/5	1,15*LC1 + 1,15*LC2 + 1,50*LC4

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: Named selection - CS61

Filter: Cross-section = CS61 - KU80/50x4.0

Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]
B450	1225,000-	CO1/1	CS61 - KU80/50x4.0	S 235	0,60	0,44	0,60

Name	Combination key
CO1/1	1,15*LC1 + 1,15*LC2 + 1,50*LC4

CS65 - 1D internal forces; N

Values: **N**

Linear calculation

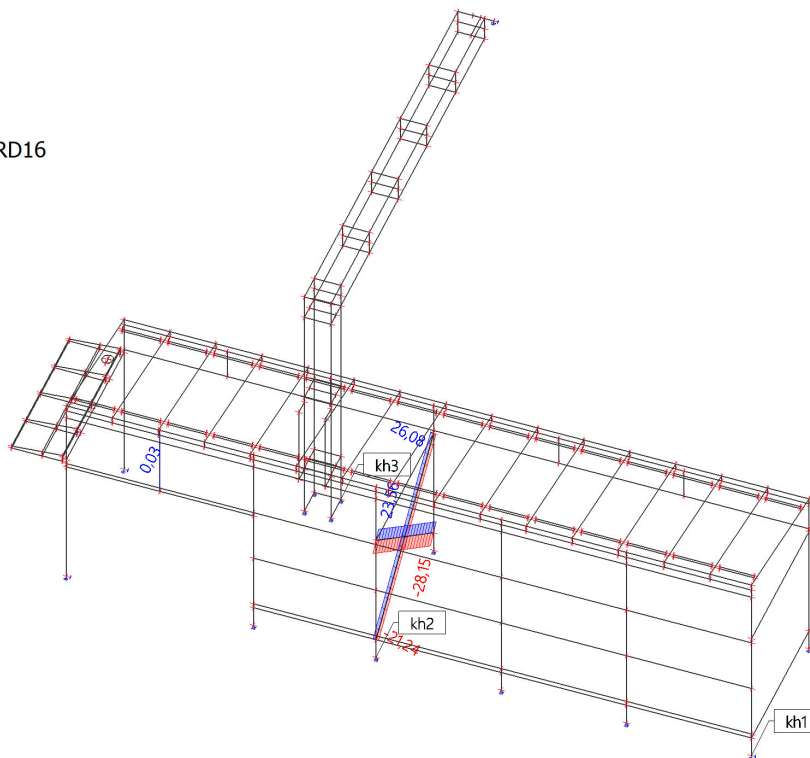
Combination: CO1

Coordinate system: Principal

Extreme 1D: Member

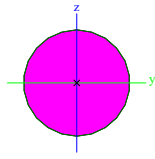
Selection: All

Filter: Cross-section = CS65 - RD16



Cross-sections

Cross-sections - CS65

Name	Type	Item material	Fabrication	buckling y-y	buckling z-z	Picture	Type description
	Detailed						
CS65	RD16	S 235	rolled	c	c		Round bar

1D internal forces

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS65 - RD16

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B352	0,000	CO1/1	CS65 - RD16	-28,15	0,00	0,02	0,00	-0,01	0,00
B351	3928,351	CO1/2	CS65 - RD16	26,08	0,00	-0,01	0,00	0,00	0,00
B351	1964,175-	CO1/3	CS65 - RD16	15,44	0,00	-0,02	0,00	-0,01	0,00
B351	0,000	CO1/4	CS65 - RD16	-13,02	0,00	0,02	0,00	-0,01	0,00
B352	0,000	CO1/5	CS65 - RD16	1,19	0,00	0,01	0,00	0,00	0,00
B351	0,000	CO1/6	CS65 - RD16	-21,24	0,00	0,02	0,00	-0,01	0,00
B351	785,670-	CO1/7	CS65 - RD16	25,99	0,00	0,00	0,00	0,00	0,00

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B351	0,000	CO1/5	CS65 - RD16	-1,83	0,00	0,01	0,00	0,00	0,00

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC4
CO1/2	LC1 + LC2 + 1.50*LC4
CO1/3	1.35*LC1 + 1.35*LC2 + 0.90*LC4
CO1/4	1.35*LC1 + 1.35*LC2 + 0.75*LC3 + 0.90*LC6
CO1/5	LC1 + LC2 + 1.50*LC7
CO1/6	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC6
CO1/7	1.15*LC1 + 1.15*LC2 + 1.50*LC4

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS65 - RD16

There are 2 warnings on selected members. 2 of them are shown.

Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]	Errors, warnings, notes
B352	0,000	CO1/1	CS65 - RD16	S 235	0,83	0,69	0,83	W2, W9

E/W/N	Present on members
W2	B351, B352, B472
W9	B351, B352, B472

CS71 - 1D internal forces; N

Values: **N**

Linear calculation

Combination: CO1

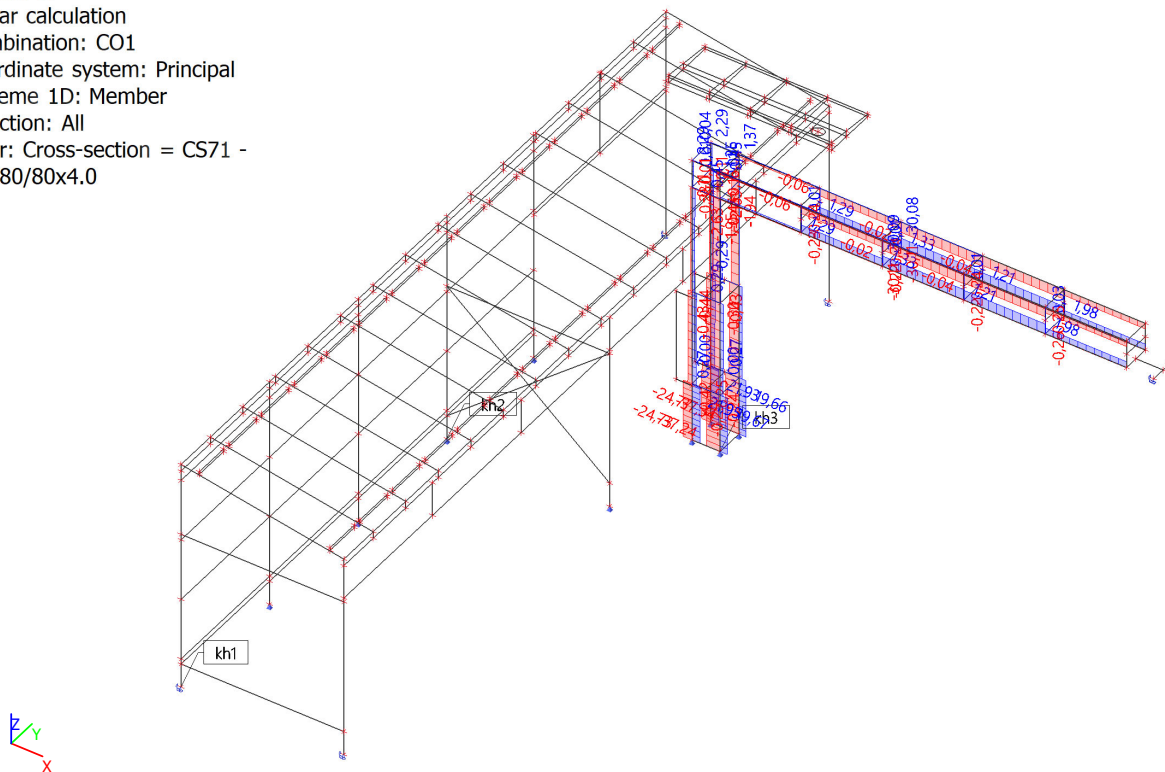
Coordinate system: Principal

Extreme 1D: Member

Selection: All

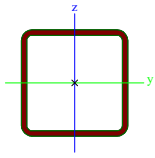
Filter: Cross-section = CS71 -

VHP80/80x4.0



Cross-sections

Cross-sections - CS71

Name	Type	Item material	Fabrication	buckling y-y	buckling z-z	Picture	Type description
CS71	Detailed VHP80/80x4.0	S 235	cold formed	c	c		Rectangular hollow section

1D internal forces

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS71 - VHP80/80x4.0

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
B294	5460,000	CO1/1	CS71 - VHP80/80x4.0	-37,34	1,45	-0,09	0,00	0,00	0,00
B525	2989,839+	CO1/2	CS71 - VHP80/80x4.0	30,09	0,02	1,97	0,01	-0,49	0,01
B318	0,000	CO1/3	CS71 - VHP80/80x4.0	-0,23	-1,98	0,01	0,00	0,00	0,51
B318	0,000	CO1/4	CS71 -	-0,23	1,94	0,04	0,00	-0,01	-0,51

Name	dx [mm]	Case	Cross-section	N [kN]	V _y [kN]	V _z [kN]	M _x [kNm]	M _y [kNm]	M _z [kNm]
			VHP80/80x4.0						
B316	260,000+	CO1/5	CS71 - VHP80/80x4.0	1,20	0,02	-15,87	0,01	0,00	-0,01
B760	0,000	CO1/1	CS71 - VHP80/80x4.0	-0,42	-0,32	10,98	-0,04	-2,82	0,08
B328	0,000	CO1/4	CS71 - VHP80/80x4.0	0,23	0,00	0,26	-0,16	-0,14	-0,06
B326	0,000	CO1/6	CS71 - VHP80/80x4.0	0,24	0,00	1,46	0,16	-0,46	0,06
B316	520,000	CO1/7	CS71 - VHP80/80x4.0	1,17	0,01	-15,83	0,00	-4,13	0,00
B316	0,000	CO1/7	CS71 - VHP80/80x4.0	1,23	0,01	-15,83	0,00	4,10	0,00
B296	4360,000+	CO1/8	CS71 - VHP80/80x4.0	-22,56	1,69	0,05	0,00	-0,05	-1,86
B297	4360,000+	CO1/3	CS71 - VHP80/80x4.0	-23,73	-1,69	-0,10	0,00	0,14	1,86

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC6 + 1.05*LC8
CO1/2	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 0.90*LC7 + 1.50*LC8
CO1/3	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 1.50*LC7 + 1.05*LC8
CO1/4	LC1 + LC2 + 1.50*LC6
CO1/5	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 0.90*LC6 + 1.50*LC8
CO1/6	LC1 + LC2 + 0.75*LC3 + 1.50*LC7 + 1.05*LC8
CO1/7	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 0.90*LC4 + 1.50*LC8
CO1/8	1.15*LC1 + 1.15*LC2 + 1.50*LC6

EC-EN 1993 Steel check ULS

Linear calculation

Combination: CO1

Coordinate system: Principal

Extreme 1D: Global

Selection: All

Filter: Cross-section = CS71 - VHP80/80x4.0

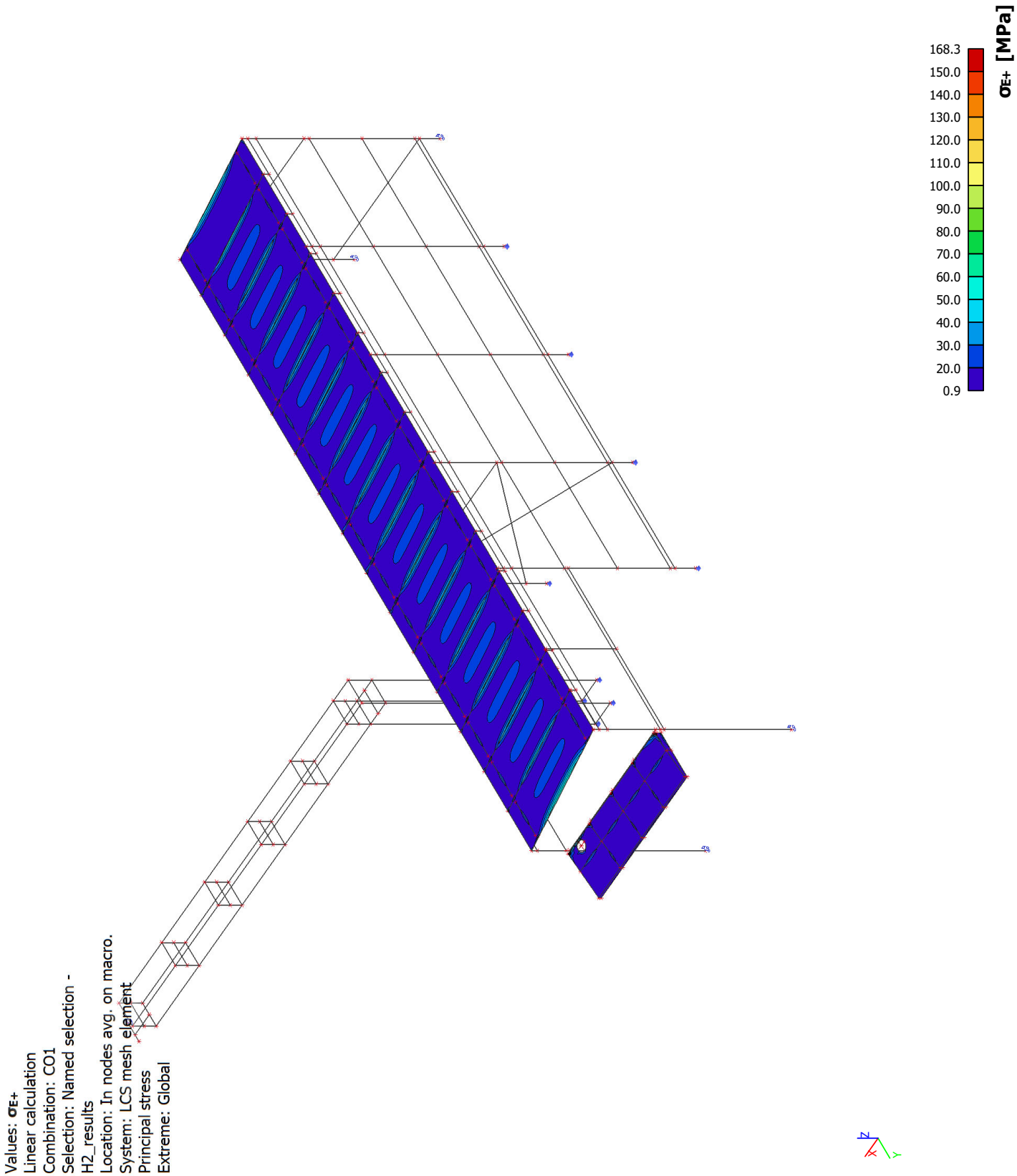
Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	UC _{Overall} [-]	UC _{Sec} [-]	UC _{Stab} [-]
B316	520,000	CO1/1	CS71 - VHP80/80x4.0	S 235	0,53	0,53	0,00

Name	Combination key
CO1/1	1.15*LC1 + 1.15*LC2 + 0.75*LC3 + 0.90*LC4 + 1.50*LC8

STRESS ANALYSIS OF PLATE ELEMENTS

2D stress/strain



2D member - Stresses

Linear calculation, Extreme : Global

Selection : Named selection - H2_results

Combinations : CO1

Principal magnitudes. In nodes, avg. on macro.

Member	Case	elem	sig1+ [MPa]	sig2+ [MPa]	alfa+ [deg]	sigE+ [MPa]	taumaxb [MPa]
			sig1- [MPa]	sig2- [MPa]	alfa- [deg]	sigE- [MPa]	
S629	CO1	25632	-52,4	-112,4	-83,16	11,0	0,8
			-6,8	-68,8	-54,55	12,5	
S537	CO1	7824	186,5	45,7	68,69	168,3	14,6
			92,1	23,8	62,12	101,9	
S563	CO1	19870	-8,0	-19,0	-90,00	8,8	0,1
			-4,3	-9,3	-87,40	7,6	
S558	CO1	13834	32,1	7,6	90,00	29,1	0,3
			19,4	4,7	0,57	31,7	
S629	CO1	25595	-0,1	-0,6	-18,46	0,1	0,0
			-0,3	-0,6	-5,71	0,5	
S533	CO1	7664	-22,3	-76,1	-33,35	61,0	10,6
			-35,8	-151,2	-38,94	102,7	
S533	CO1	7664	150,6	41,9	36,77	134,6	15,2
			127,6	52,1	57,53	136,9	
S558	CO1	13880	-7,5	-28,0	-89,83	11,0	0,1
			-12,9	-52,2	-90,00	10,9	
S554	CO1	9354	50,0	15,6	89,99	44,3	0,3
			34,5	10,2	90,00	44,7	
S562	CO1	18308	-0,2	-12,9	-4,86	1,8	0,0
			0,0	-2,8	-72,38	0,1	
S559	CO1	15708	-11,2	-26,4	-89,52	5,9	0,0
			-6,2	-14,1	-89,71	5,8	

ZÁVĚR

Ocelová konstrukce vodíkové stanice vyhovuje na mezní stav pevnosti a mezní stav použitelnosti dle ČSN EN 1993-1-1.