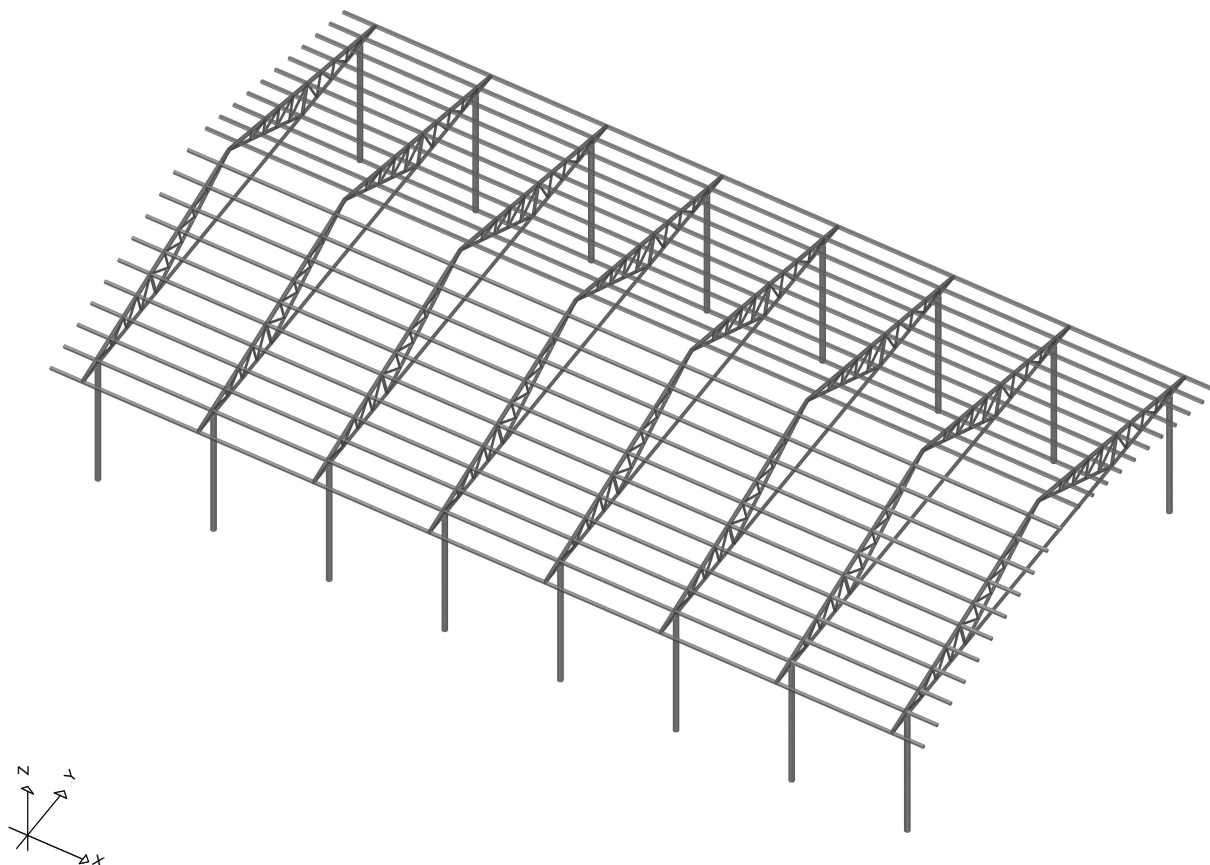


Statická analýza

SO-04 Skladová hala

Posúdenie možnosti osadenia FVE na strechu ocelejovej haly

Vypracoval: Ing. Tomáš Keresztesi



Input data - Structure

Level scheme

Name	z [m]	h [m]
	4.50	4.50

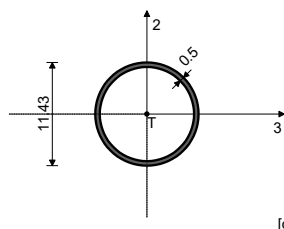
Name	z [m]	h [m]
	0.00	

Table of materials

No	Material name	E[kN/m ²]	μ	γ [kN/m ³]	α_t [1/C]	Em[kN/m ²]	μ_m
1	Stahl	2.100e+8	0.30	78.50	1.000e-5	2.100e+8	0.30
2	Holz-Nadelhplz-Masives	1.000e+7	0.20	5.00	1.000e-5	1.000e+7	0.20

Beam sets

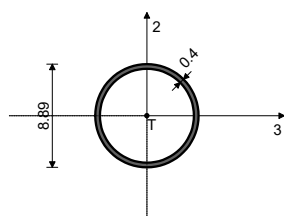
Set: 1 Section: D= 114.3x5, Approx. eccentricity, PV - HP



Mat.	A1	A2	A3	I1	I2	I3
1 - Stahl	1.717e-3	8.580e-4	8.580e-4	5.136e-6	2.569e-6	2.569e-6
ST: EA1 x 1, EA2 x 1, EA3 x 1, EI1 x 0.1, EI2 x 1, EI3 x 1, γ x 1;						
SE: EA1 x 1, EA2 x 1, EA3 x 1, EI1 x 0.1, EI2 x 1, EI3 x 1, γ x 1;						

[cm]

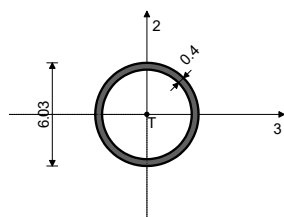
Set: 2 Section: D= 88.9x4, Approx. eccentricity, PV - HP



Mat.	A1	A2	A3	I1	I2	I3
1 - Stahl	1.067e-3	5.332e-4	5.332e-4	1.926e-6	9.634e-7	9.634e-7

[cm]

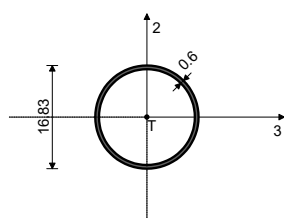
Set: 3 Section: D= 60.3x4, Approx. eccentricity, PV - D



Mat.	A1	A2	A3	I1	I2	I3
1 - Stahl	7.070e-4	3.536e-4	3.536e-4	5.632e-7	2.817e-7	2.817e-7

[cm]

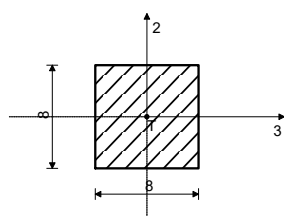
Set: 4 Section: D= 168.3x6, Approx. eccentricity, Stlp



Mat.	A1	A2	A3	I1	I2	I3
1 - Stahl	3.059e-3	1.529e-3	1.529e-3	2.016e-5	1.009e-5	1.009e-5

[cm]

Set: 5 Section: b/d=8/8, Approx. eccentricity, Krokva



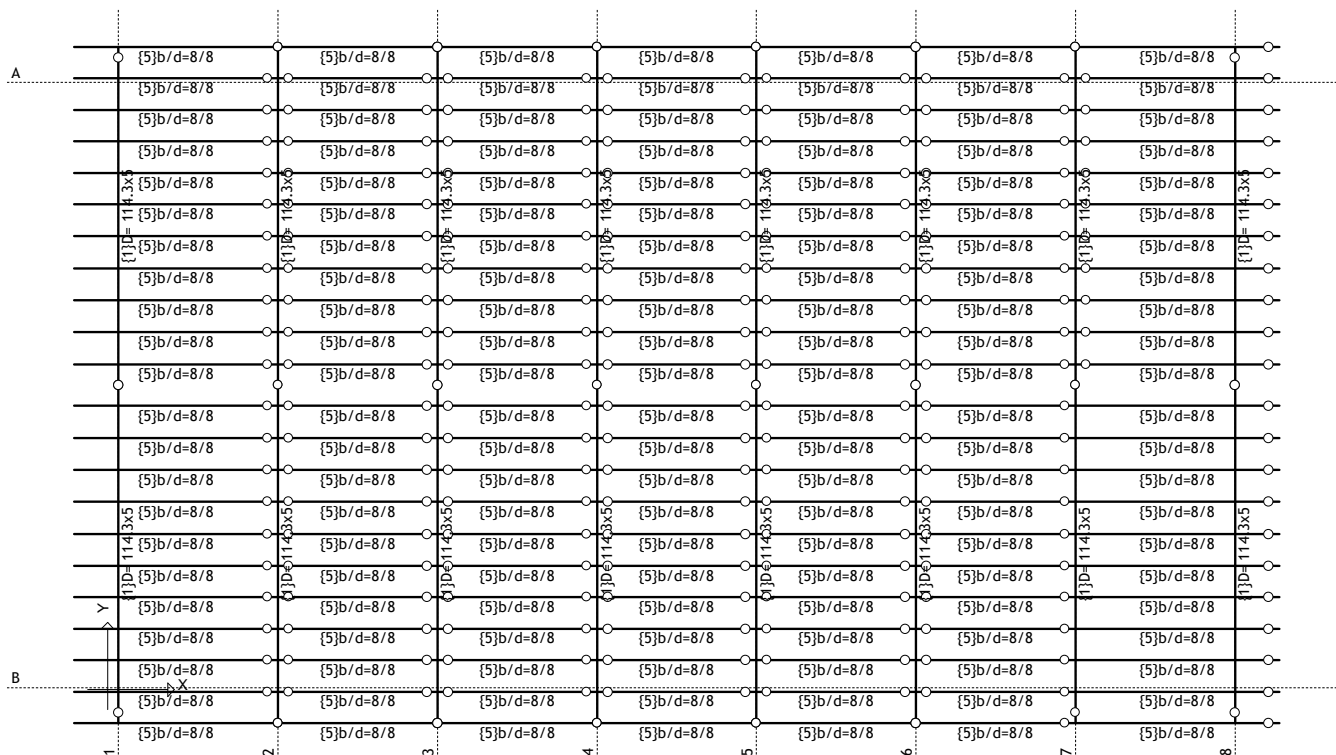
Mat.	A1	A2	A3	I1	I2	I3
2 - Holz-Nadelhpl...	6.400e-3	5.333e-3	5.333e-3	5.769e-6	3.413e-6	3.413e-6
ST: EA1 x 1, EA2 x 1, EA3 x 1, EI1 x 0.1, EI2 x 1, EI3 x 1, γ x 1;						
SE: EA1 x 1, EA2 x 1, EA3 x 1, EI1 x 0.1, EI2 x 1, EI3 x 1, γ x 1;						

[cm]

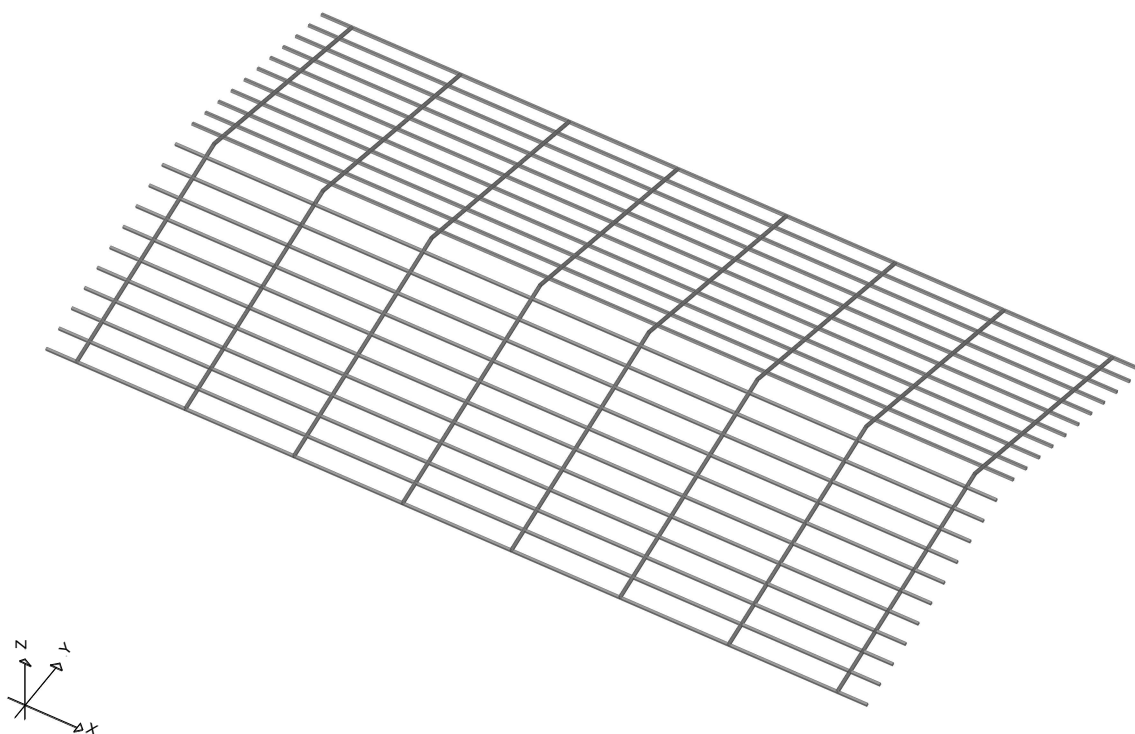
Point support sets

Set	K,R1	K,R2	K,R3	K,M1	K,M2	K,M3
2	1.000e+10	1.000e+10	1.000e+10	1.000e+10	1.000e+10	

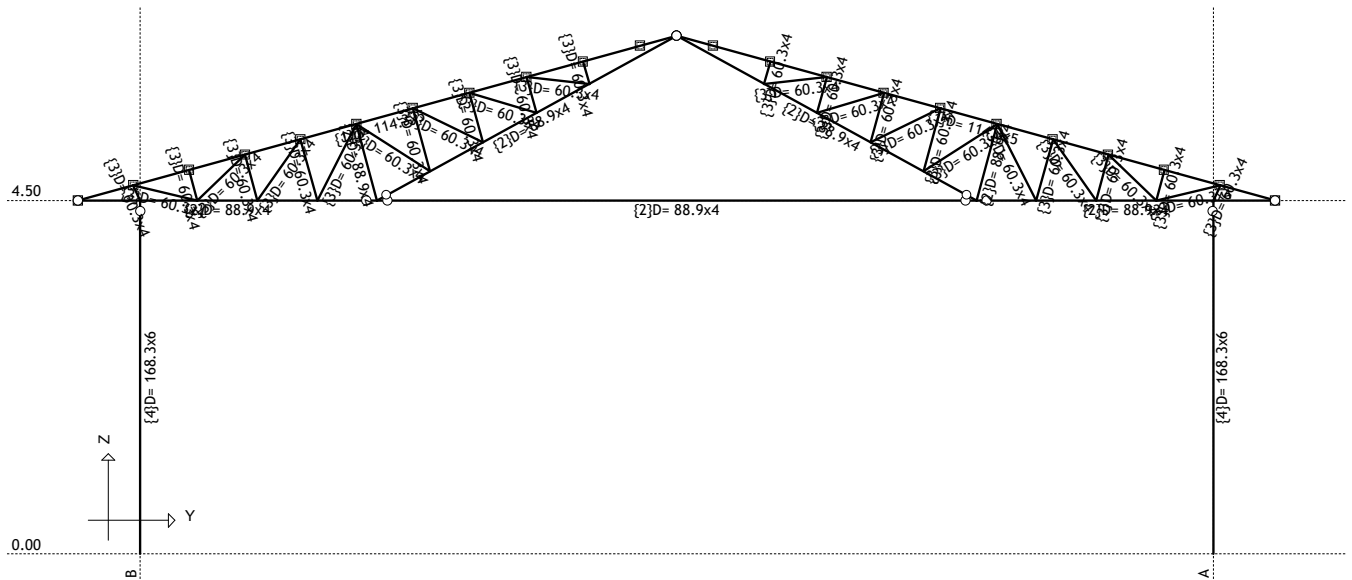
Input data - Structure



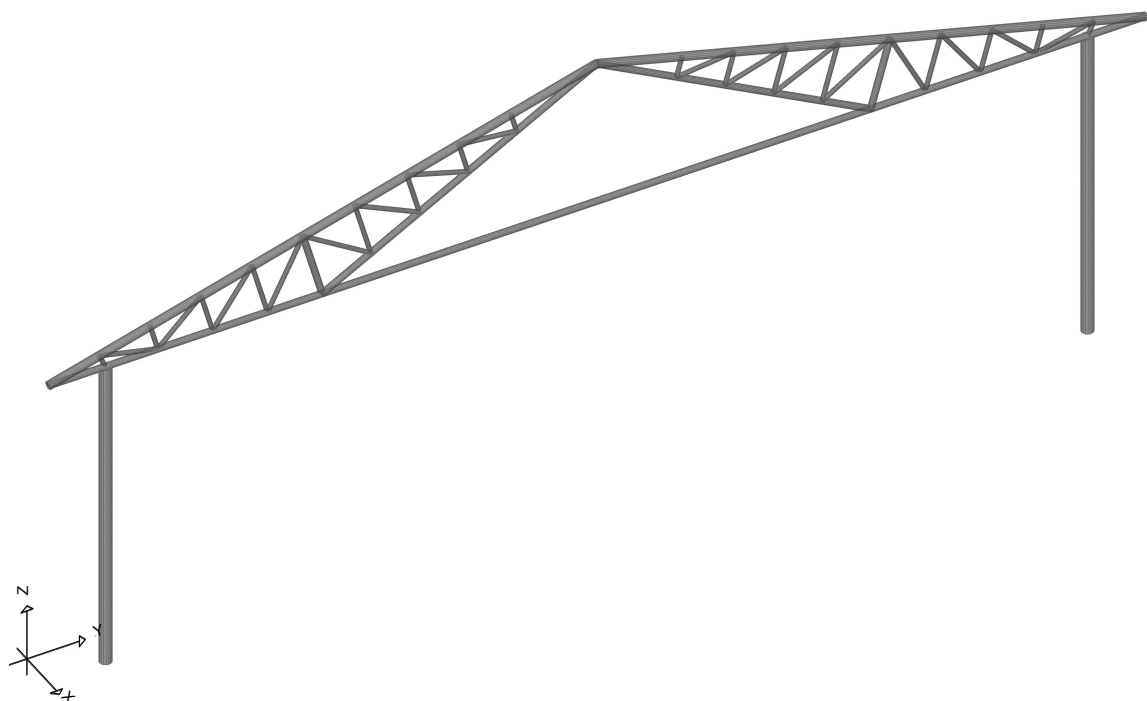
View: Strecha SO.04 - Group: SO.04



View: Strecha SO.04 (Group: SO.04)

Input data - Structure

Frame: V 3 - Group: SO.04

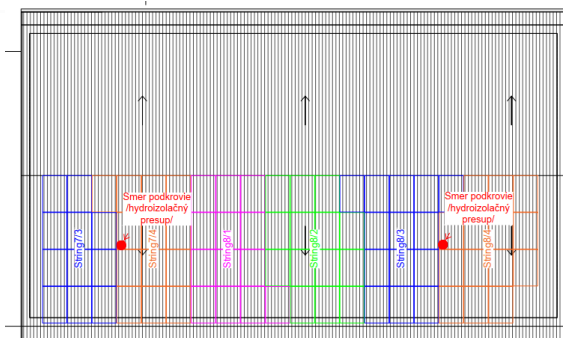


Frame: V 3 (Group: SO.04)

Input data - Load

Stále zaťaženia podľa STN EN 1991-1

- Vlastná tiaž nosnej konštrukcie je spočítaná výpočtovým programom
- Stále zaťaženie pôsobiace na konštrukciu tvorí tiaž sendvičových panelov (strešných a stenových), ktorá bola uvažovaná ako hodnota 0,14 kN/m²
- Novou zložkou stáleho zaťaženia je tiaž fotovoltaických panelov: prírastok 0,20 kN/m²

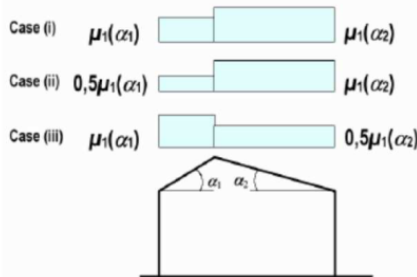


Obr.: Schéma rozmiestnenia panelov na streche objektu (podľa projektu FBB Electric)

Zaťaženie sedlovej strechy snehom - podľa STN EN 1991-1-3

Vstupné údaje:

Sklon strechy: 10 ° (α₁) 10 ° (α₂)
 Expozícia: normálna (Ce)
 Snehová oblasť: 1
 Nadmorská výška miesta stavby: 125 m.n.m (A)



Výpočet:

Charakteristické zaťaženie snehom s pôsobiace na strechu:

$$s_w := \mu_1 \cdot C_e \cdot C_t \cdot s_k$$

μ - tvarový súčiniteľ zaťaženia snehom (STN EN 1991-1-3)

$$\mu_{\alpha 1} = 0.80 \quad \mu_{\alpha 2} = 0.80$$

C_e - súčiniteľ podmienok expozície (STN EN 1991-1-3)

$$C_e = 1.00$$

C_t - teplotný súčiniteľ (STN EN 1991-1-3)

$$C_t = 1.00$$

s_k - charakteristická hodnota zaťaženia snehom na povrchu zeme (kN/m²) (STN EN 1991-1-3)

$$a = 0.454$$

$$A = 125$$

$$b = 970$$

$$s_k := a + \frac{A}{b}$$

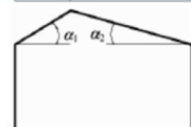
$$s_k = 0.58 \quad \text{kN/m}^2$$

Charakteristické zaťaženie snehom s pôsobiace na strechu: $s_w := \mu_1 \cdot C_e \cdot C_t \cdot s_k$

$$s_{I\mu 1 \alpha 1} := \mu_{1 \alpha 1} \cdot C_e \cdot C_t \cdot s_k = 0.466 \quad \text{kN/m}^2 \quad s_{I\mu 1 \alpha 2} := \mu_{1 \alpha 2} \cdot C_e \cdot C_t \cdot s_k = 0.466 \quad \text{kN/m}^2$$

$$s_{II\mu 1 \alpha 1} := 0.5 \mu_{1 \alpha 1} \cdot C_e \cdot C_t \cdot s_k = 0.233 \quad \text{kN/m}^2 \quad s_{II\mu 1 \alpha 2} := \mu_{1 \alpha 2} \cdot C_e \cdot C_t \cdot s_k = 0.233 \quad \text{kN/m}^2$$

$$s_{III\mu 1 \alpha 1} := \mu_{1 \alpha 1} \cdot C_e \cdot C_t \cdot s_k = 0.466 \quad \text{kN/m}^2 \quad s_{III\mu 1 \alpha 2} := 0.5 \mu_{1 \alpha 2} \cdot C_e \cdot C_t \cdot s_k = 0.233 \quad \text{kN/m}^2$$



Input data - Load**Governing load - EC2 (EN 1992-1-1:2004)**LFK für GebäudeLoad Case

- I vl. + st. (g) - <Permanent>(long-term)
II sn. - <Snow - <= 1000 m>(short-term)
III w.y - <Wind>(short-term)

09. [PT] $1.35 \times I$
10. [PT] $I + II + 0.60 \times III$
11. [PT] $I + 0.50 \times II + III$
12. [PT] $I + III$
13. [PT] $I + II$
14. [PT] $I + 0.20 \times III$
15. [PT] $I + 0.20 \times II$
16. [PT] I

Partial factors for materials[PT] Persistent and Transient: $\gamma_C = 1.50$, $\gamma_S = 1.15$ [SE] Seismic combinations: $\gamma_C = 1.50$, $\gamma_S = 1.15$ [AC] Accidental: $\gamma_C = 1.20$, $\gamma_S = 1.00$ Combinations for fissure and deflection calculation

(characteristic combinations - long-term)

1. I
2. I
3. I
4. I
5. I

User-defined load combinations

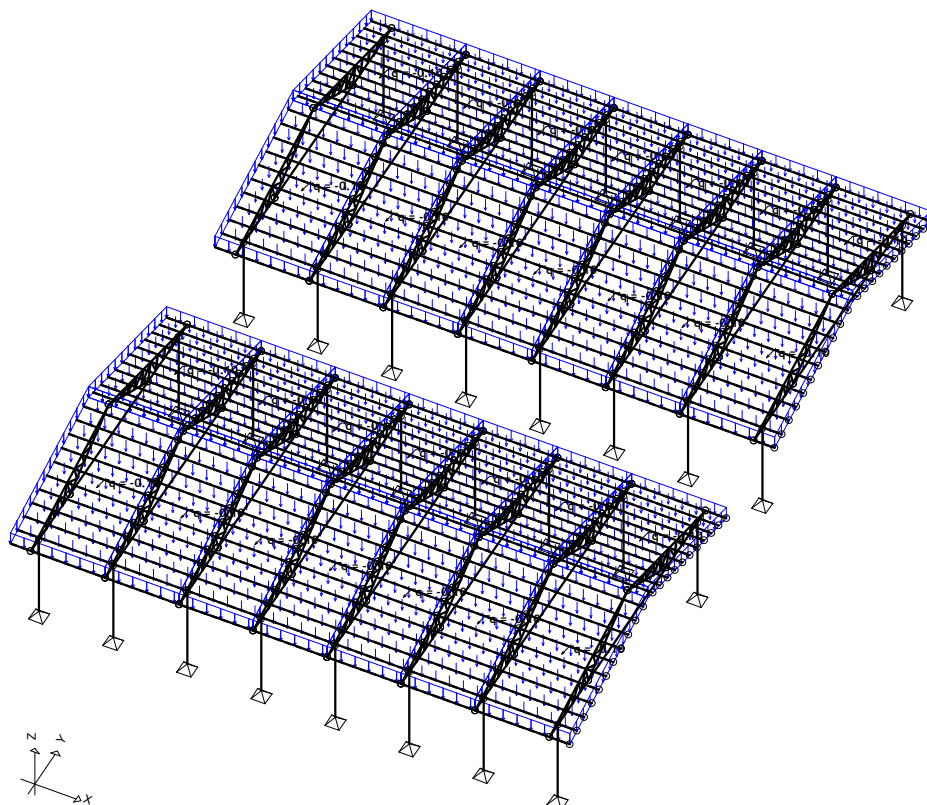
01. [PT] $1.35 \times I + 1.50 \times II + 0.90 \times III$
02. [PT] $1.35 \times I + 0.75 \times II + 1.50 \times III$
03. [PT] $I + 1.50 \times II + 0.90 \times III$
04. [PT] $I + 0.75 \times II + 1.50 \times III$
05. [PT] $1.35 \times I + 1.50 \times III$
06. [PT] $1.35 \times I + 1.50 \times II$
07. [PT] $I + 1.50 \times III$
08. [PT] $I + 1.50 \times II$

(characteristic combinations - short-term)

1. $II + 0.60 \times III$
2. $0.50 \times II + III$
3. III
4. II
5. ---

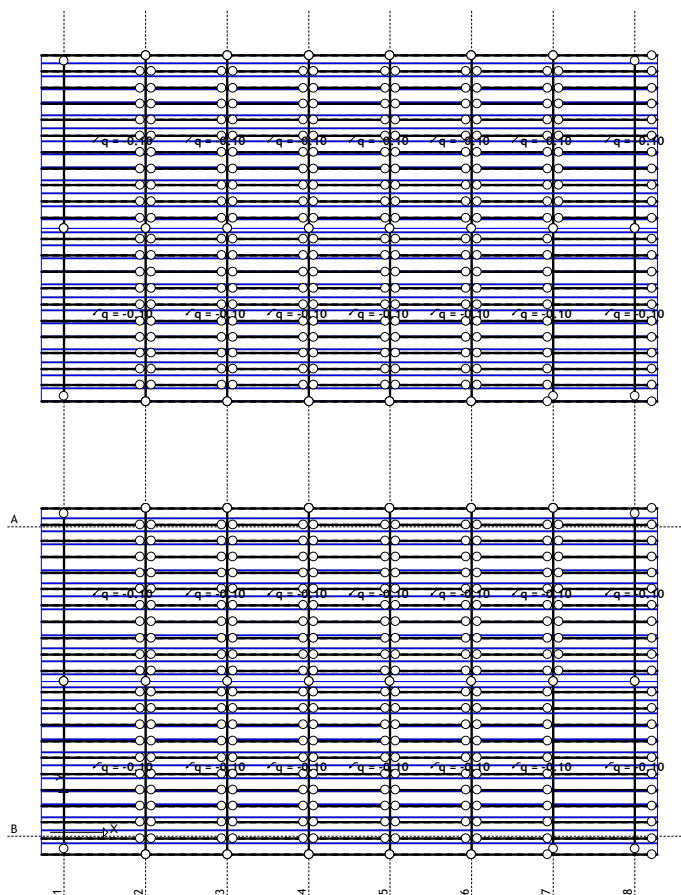
Input data - Load

Load 1: vl. + st. (g)



Isometric

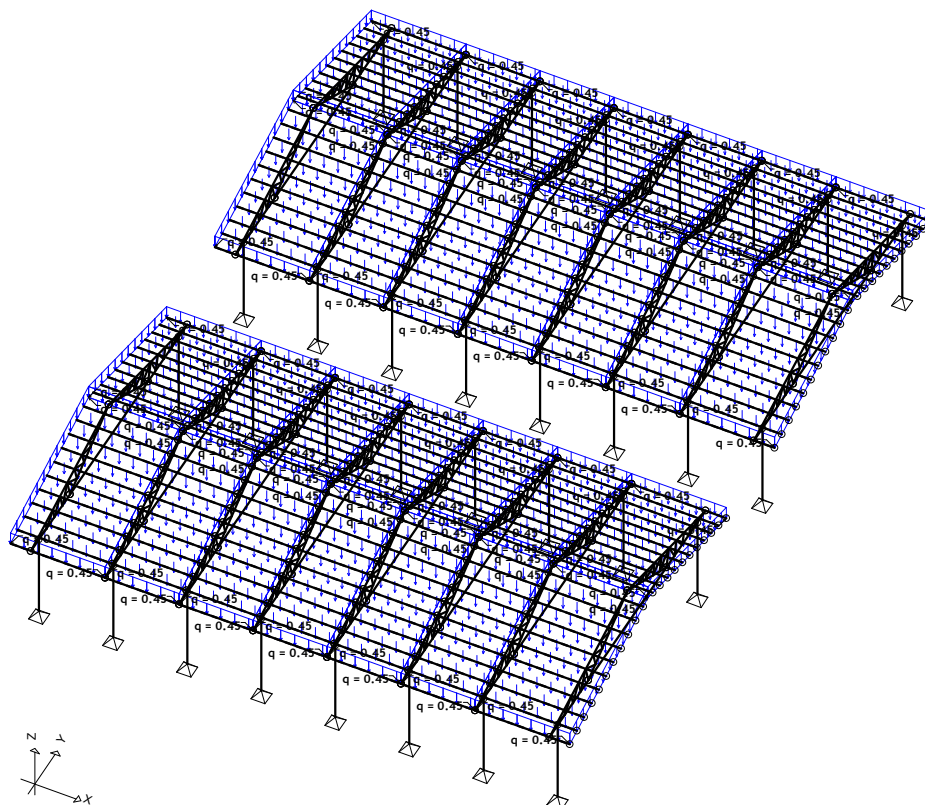
Load 1: vl. + st. (g)



View: Strecha SO.04

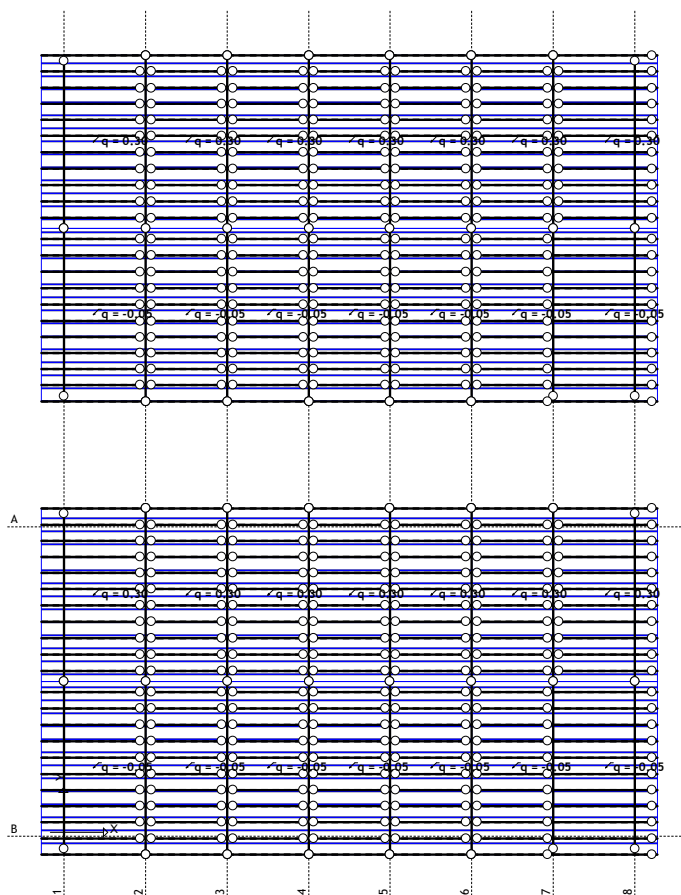
Input data - Load

Load 2: sn.



Isometric

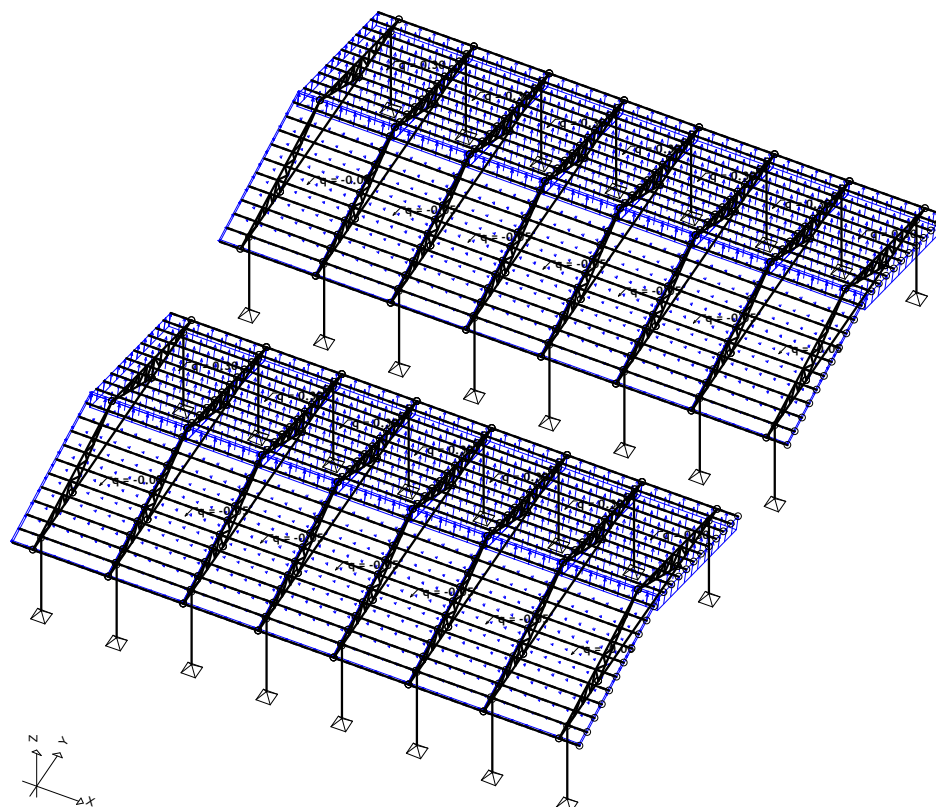
Load 3: w.y



View: Strecha SO.04

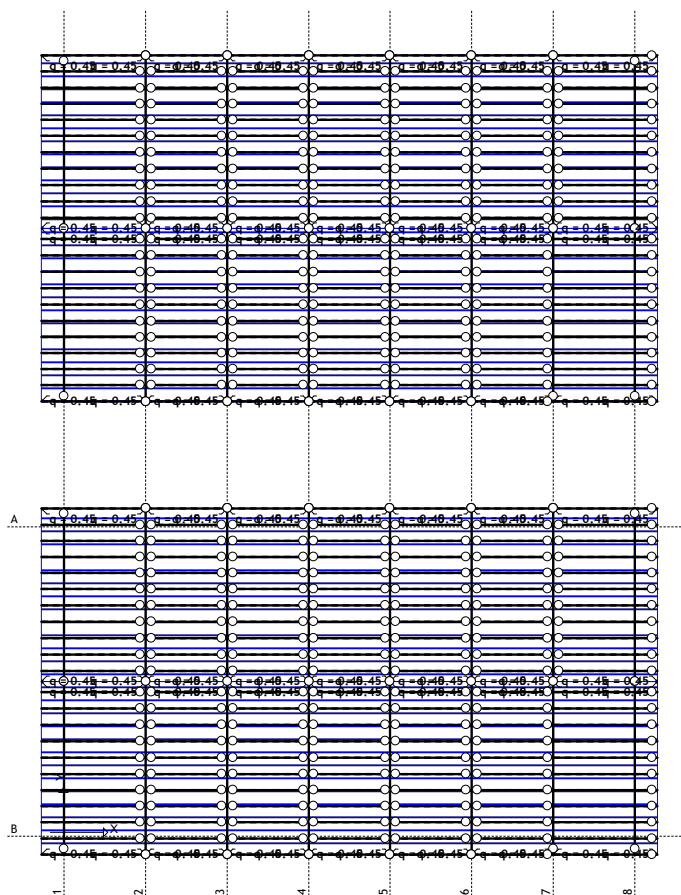
Input data - Load

Load 3: w.y



Isometric

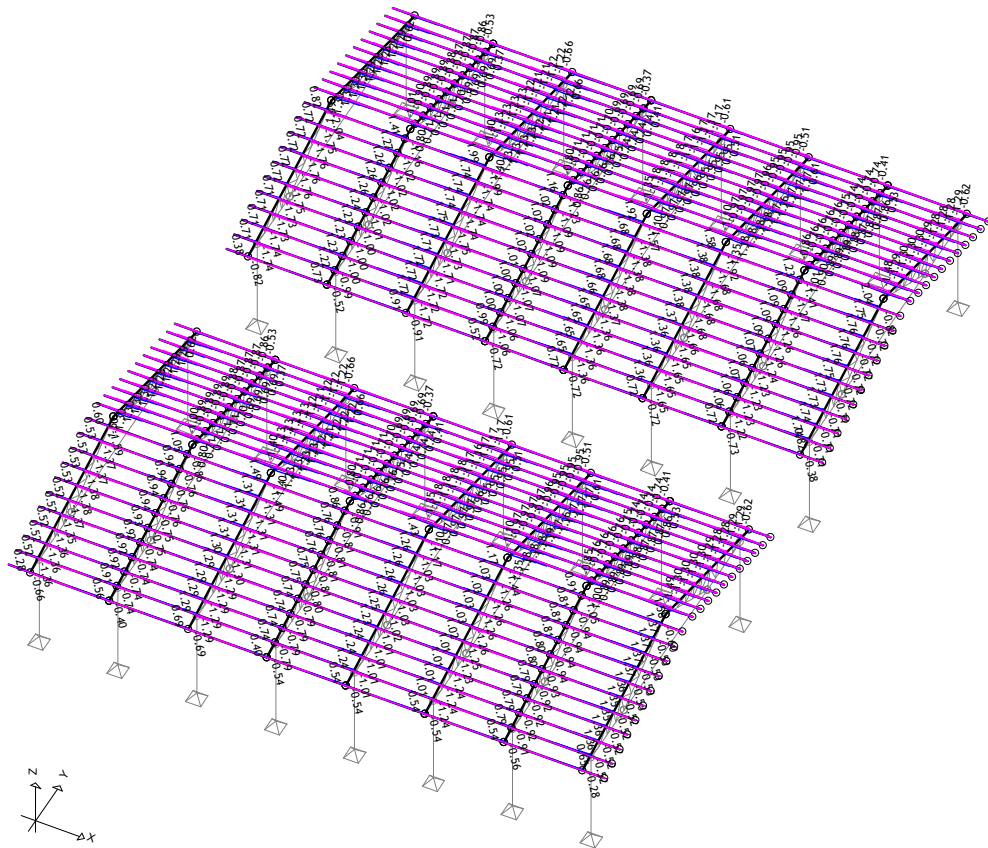
Load 2: sn.



View: Strecha SO.04

Strecha

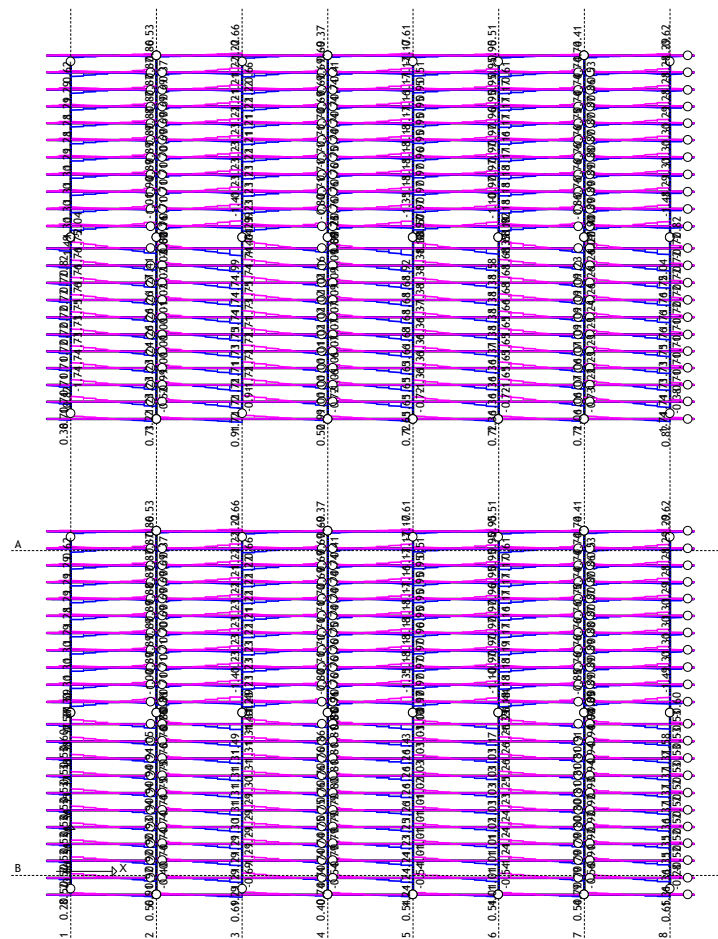
Load 20: [ULS] 4-12



Isometric (View: Strecha SO.04)

Beam Results: max V2= 2.04 / min V2= -2.04 kN

Load 20: [ULS] 4-12

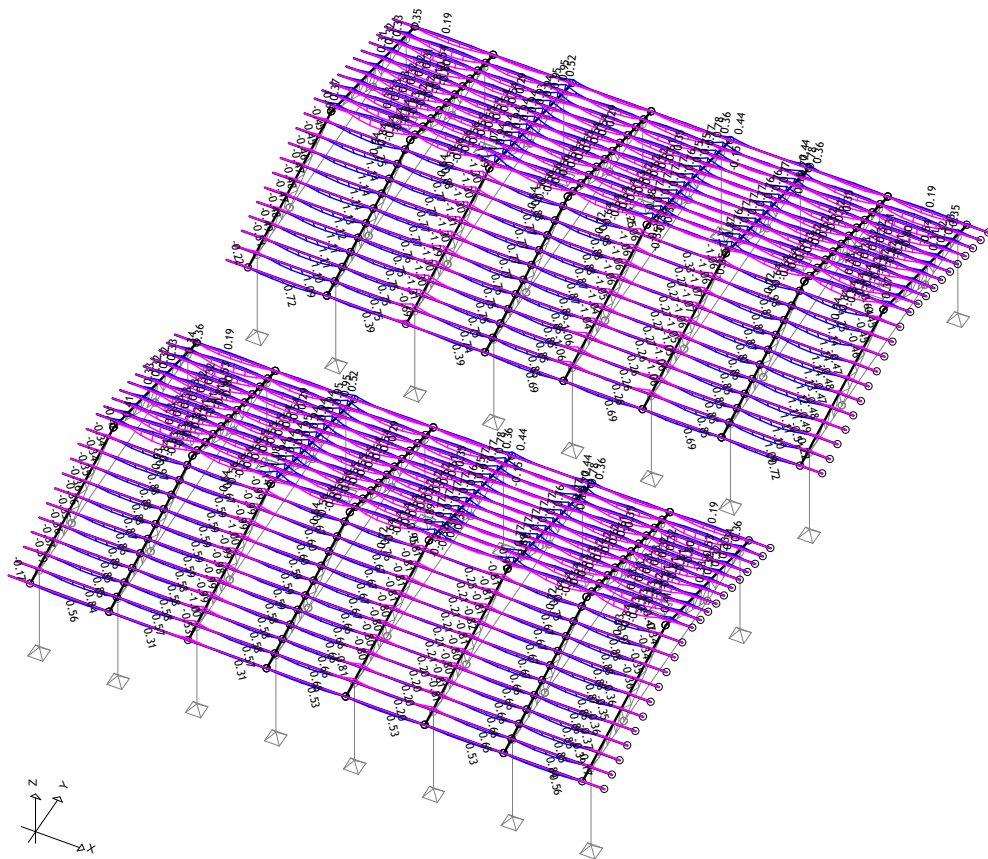


View: Strecha SO.04

Beam Results: max V2= 2.04 / min V2= -2.04 kN

Strecha

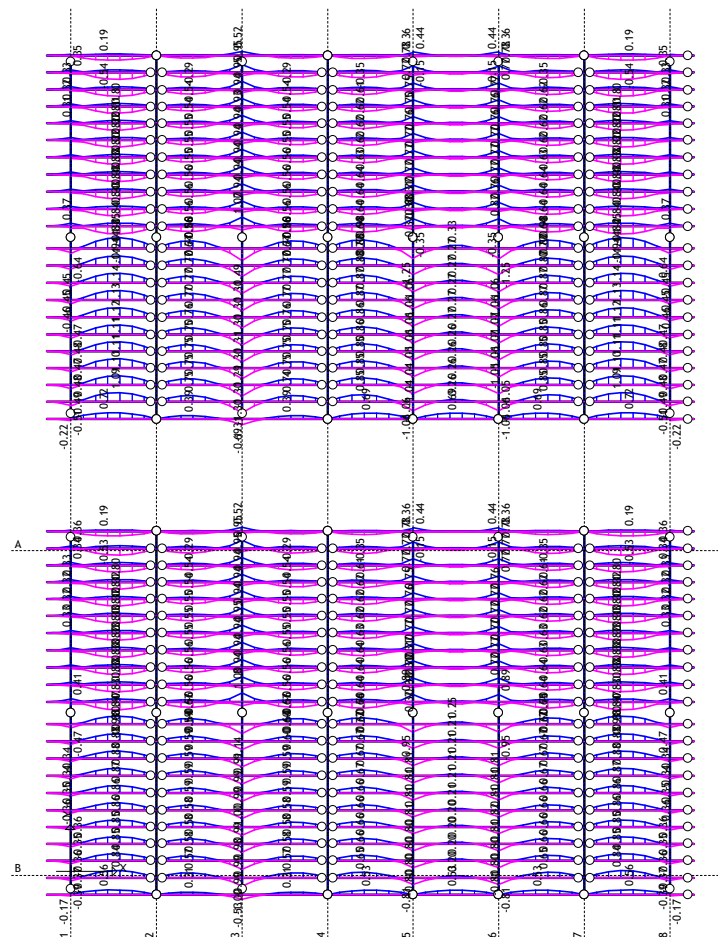
Load 20: [ULS] 4-12



Isometric (View: Strecha SO.04)

Beam Results: max M3= 1.25 / min M3= -1.49 kNm

Load 20: [ULS] 4-12

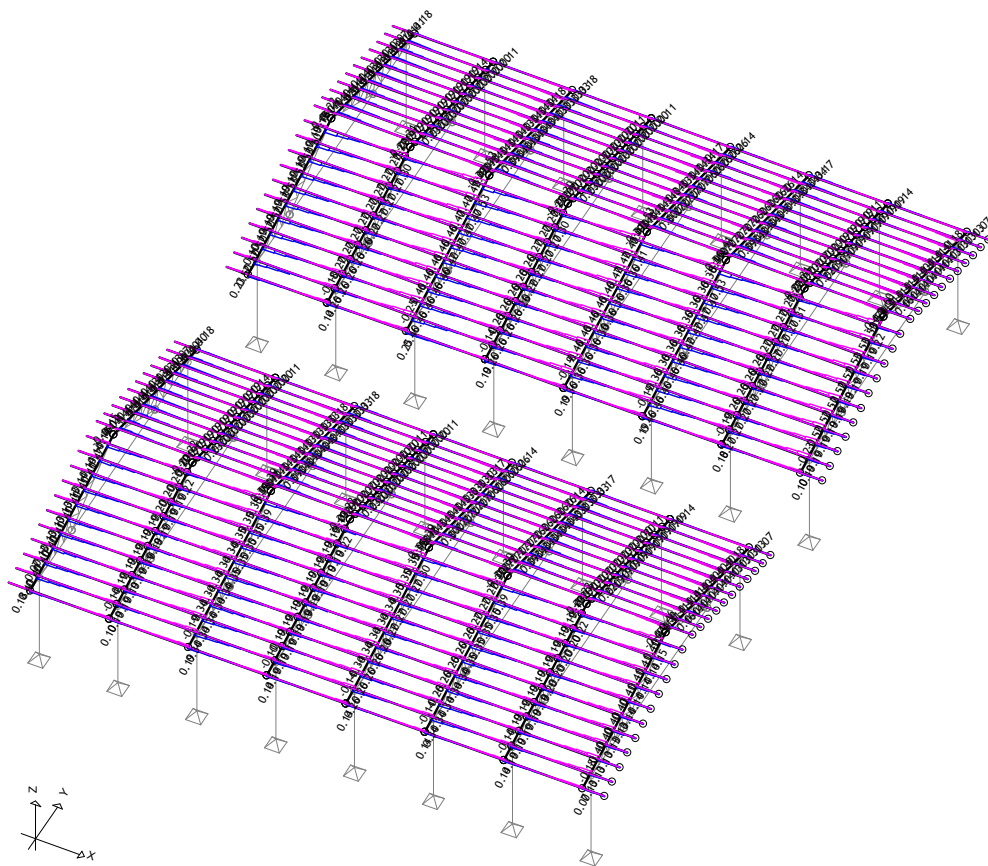


View: Strecha SO.04

Beam Results: max M3= 1.25 / min M3= -1.49 kNm

Strecha

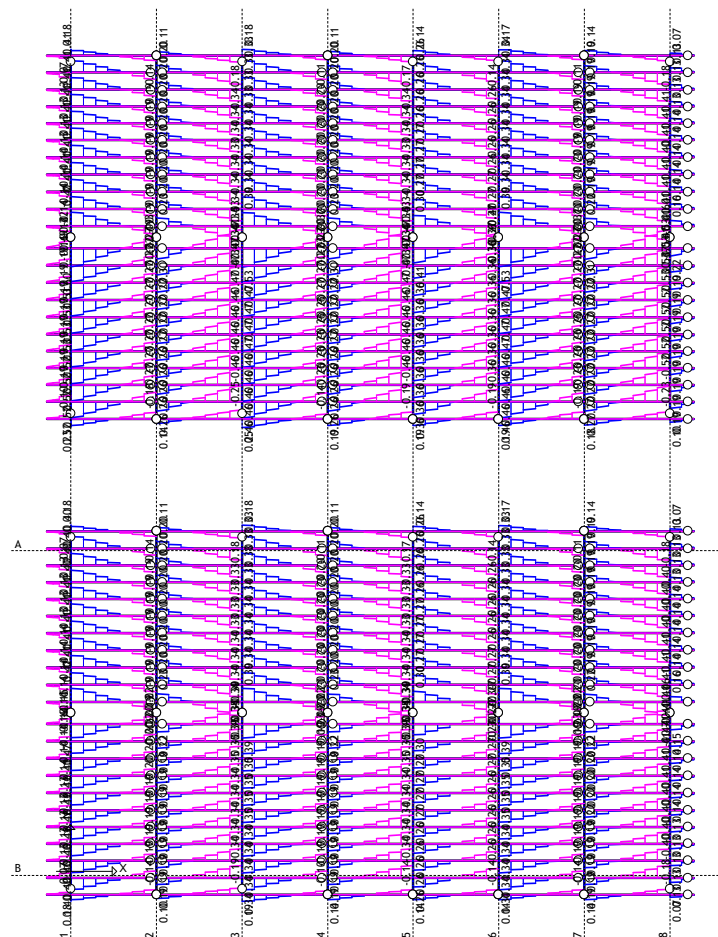
Load 20: [ULS] 4-12



Isometric (View: Strecha SO.04)

Beam Results: max V3= 0.60 / min V3= -0.60 kN

Load 20: [ULS] 4-12

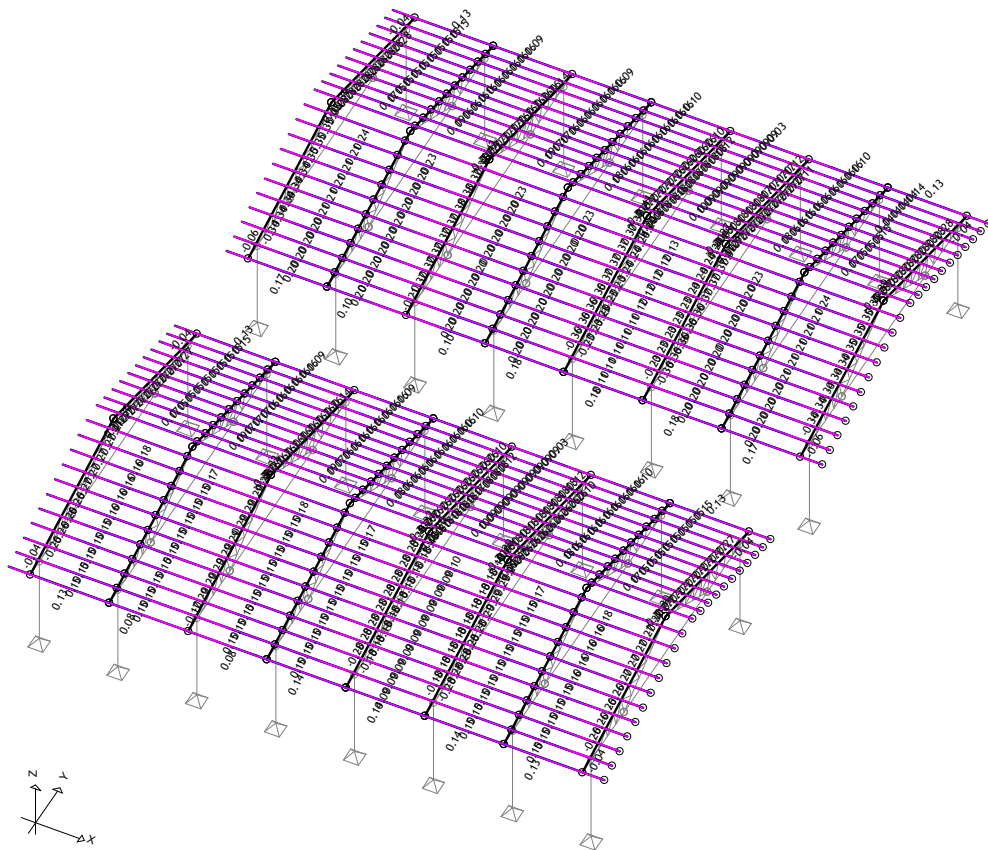


View: Strecha SO.04

Beam Results: max V3= 0.60 / min V3= -0.60 kN

Strecha

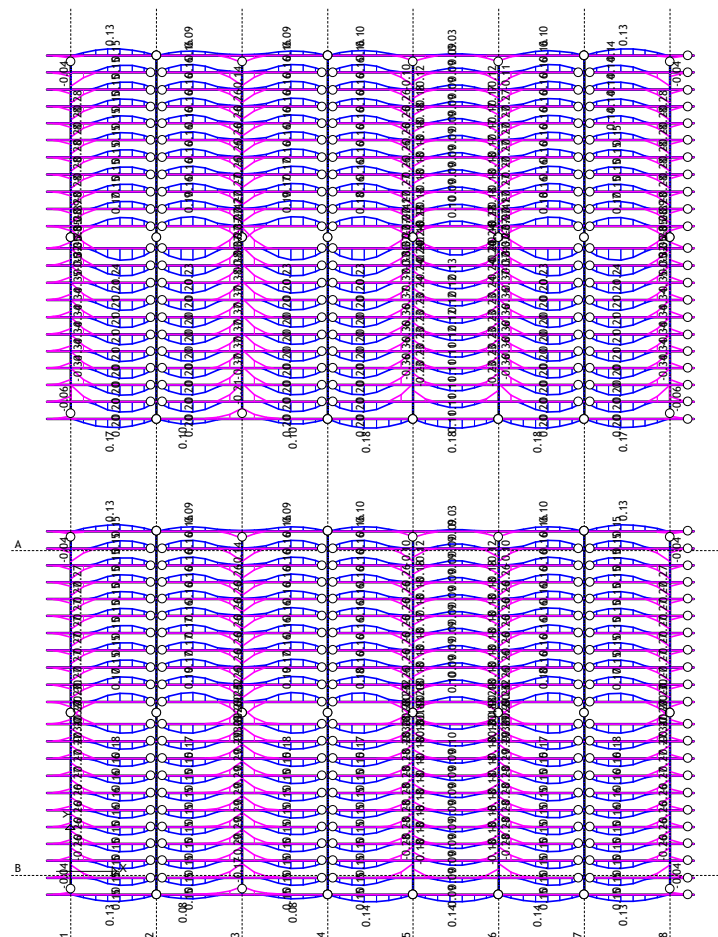
Load 20: [ULS] 4-12



Isometric (View: Strecha SO.04)

Beam Results: max M2= 0.24 / min M2= -0.42 kNm

Load 20: [ULS] 4-12

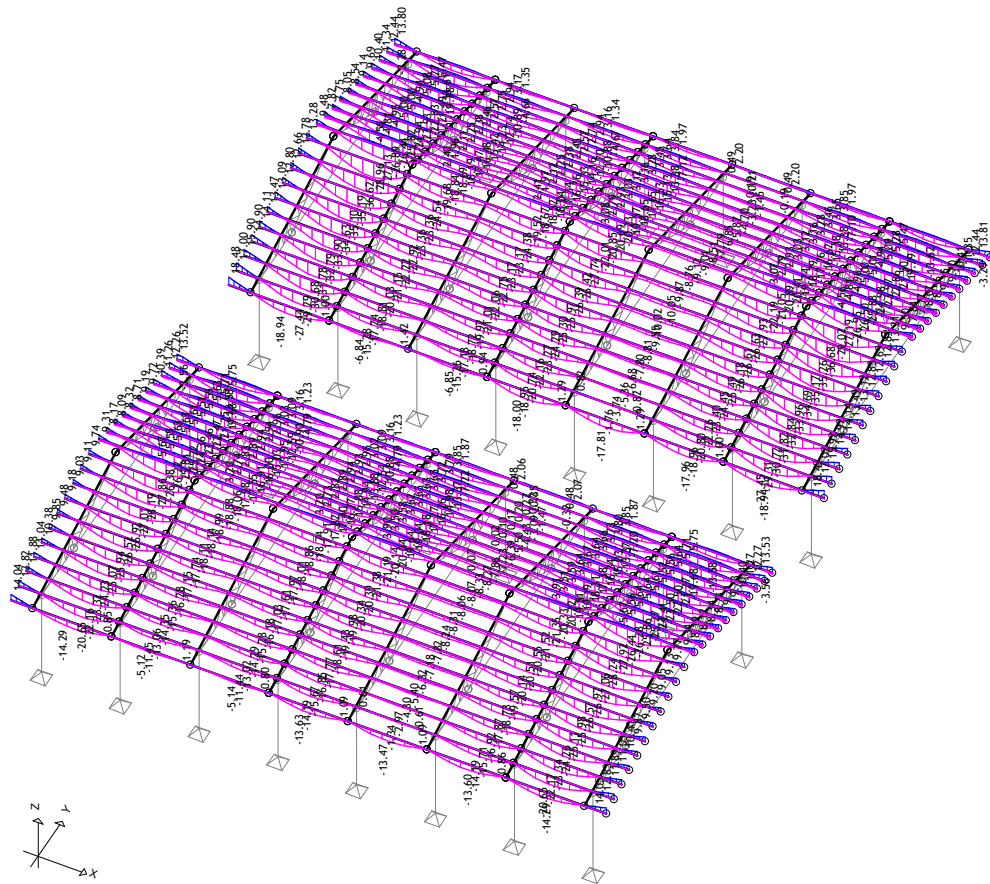


View: Strecha SO.04

Beam Results: max M2= 0.24 / min M2= -0.42 kNm

Strecha

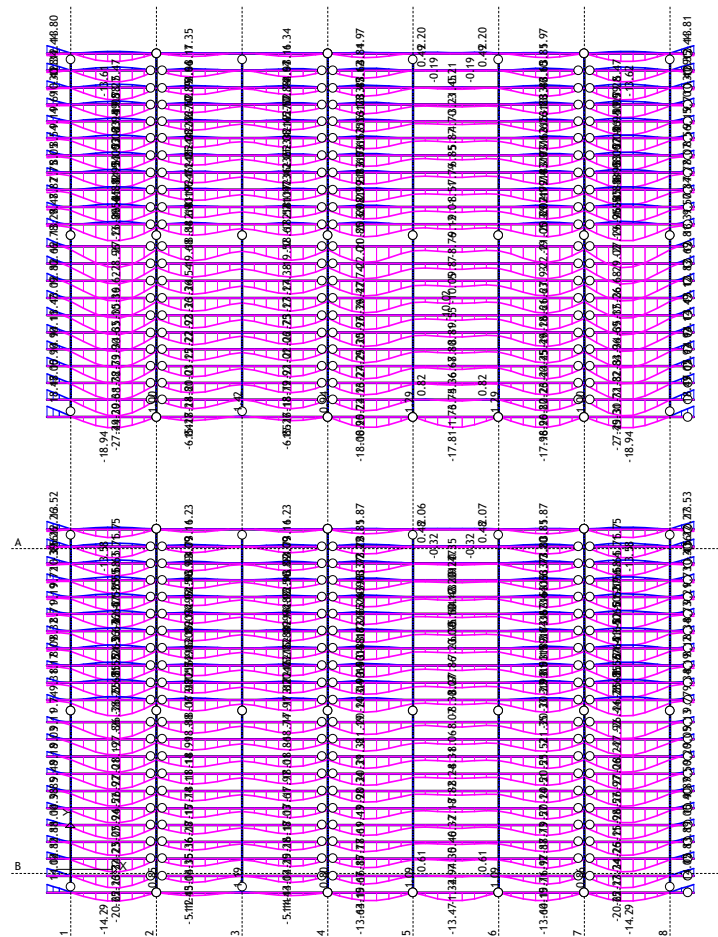
Load 21: [SLS_perm] 13-16



Isometric (View: Strecha SO.04)

Beam Results: max Zd= 18.49 / min Zd= -36.68 m / 1000

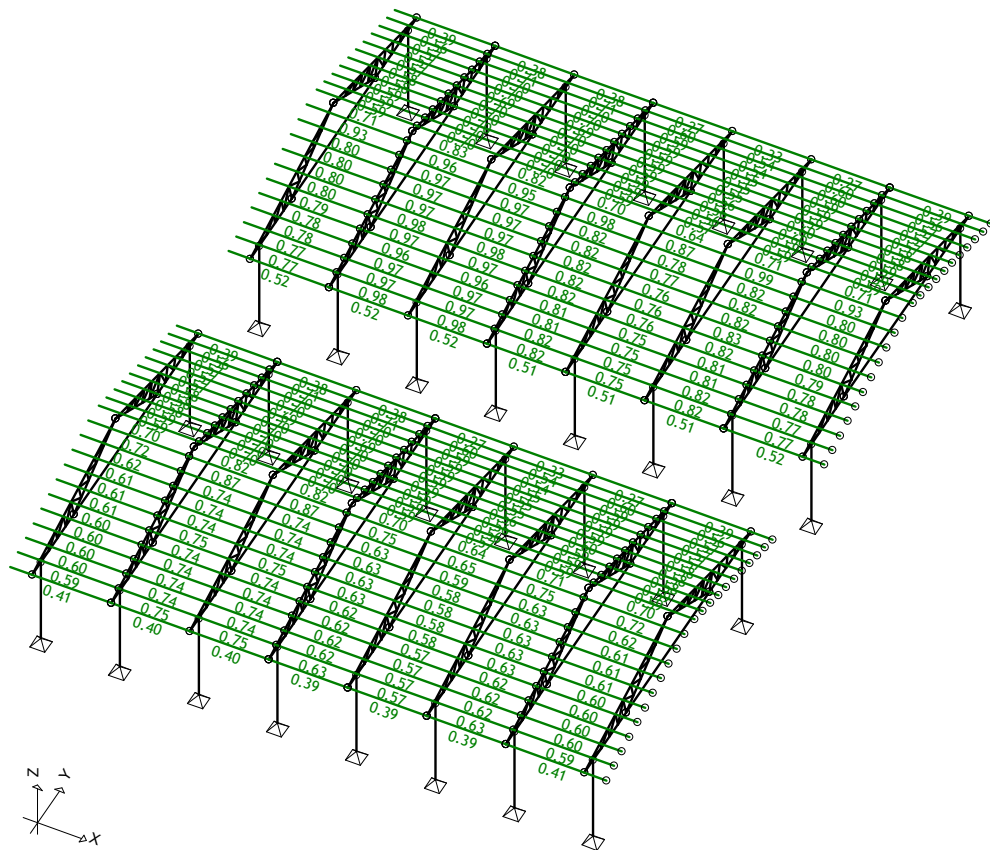
Load 21: [SLS_perm] 13-16



View: Strecha SO.04

Beam Results: max Zd= 18.49 / min Zd= -36.68 m / 1000

Strecha

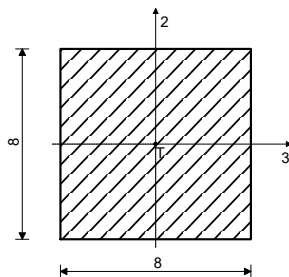


Isometric
Stability control

Posúdenie krokvy nepriťaženej panelmi FVE

BEAM 133-177

Solid timber - softwood - C27
Service class 2
EUROCODE (EN 1995-1-1)



[cm]

UTILISATION FACTORS FOR ALL LOAD CASE COMBINATIONS

4. $\gamma=0.62$	6. $\gamma=0.59$	9. $\gamma=0.59$
11. $\gamma=0.56$	13. $\gamma=0.42$	5. $\gamma=0.41$
16. $\gamma=0.40$	7. $\gamma=0.38$	14. $\gamma=0.28$
8. $\gamma=0.14$	18. $\gamma=0.12$	10. $\gamma=0.12$
15. $\gamma=0.10$	12. $\gamma=0.09$	17. $\gamma=0.08$
19. $\gamma=0.07$		

AXIAL AND SHEAR STRESSES CONTROL (load 4, end of the member)

Transversal Force in Axis 2 Direction	V2ed = 1.245 kN
Transversal Force in Axis 3 Direction	V3ed = 0.343 kN
Bending Moment around Axis 2	M2ed = -0.282 kNm
Bending Moment around Axis 3	M3ed = 0.806 kNm

STRESS CONTROL – BENDING

Load type: basic - medium-term
Rectification Coefficient
Partial factor for material properties

Kmod =	0.800
γ_m =	1.300

Depth factor - axis 2

Kh_2 = 1.134

Depth factor - axis 3

Kh_3 = 1.134

Factor considering re-distribution of bending stresses

km = 0.700

Characteristic bending strength

f_{m,k} = 27.000 MPa

Design bending strength

f_{m,d} = 18.841 MPa

Section modulus

W2 = 85.333 cm³

Axial Stress Bending around Axis 2

$\sigma_{m2,d}$ = 3.307 MPa

Section modulus

W3 = 85.333 cm³

Axial Stress Bending around Axis 3

$\sigma_{m3,d}$ = 9.450 MPa

$$km \times (\sigma_{m3,d} / f_{m,3,d}) + \sigma_{m2,d} / f_{m,2,d} \leq 1 \quad (0.527 \leq 1)$$

Section utilization is 52.7%

$$\sigma_{m3,d} / f_{m,3,d} + km \times (\sigma_{m2,d} / f_{m,2,d}) \leq 1 \quad (0.624 \leq 1)$$

Section utilization is 62.4%

STRESS CONTROL – SHEAR

Load type: basic - medium-term

Rectification Coefficient

Kmod = 0.800

Partial factor for material properties

γ_m = 1.300

Characteristic shear strength

f_{v,k} = 4.000 MPa

Design shear strength

f_{v,d} = 2.462 MPa

Cross Section Surface

A = 64.000 cm²

Actual Shear Stress(Axis 2)

$\tau_{2,d}$ = 0.292 MPa

Actual Shear Stress(Axis 3)

$\tau_{3,d}$ = 0.080 MPa

Influence Superposition from Transversal Force

(2)

$\tau_{2,d} / f_{v,d}$ = 0.119

(3)

$\tau_{3,d} / f_{v,d}$ = 0.033

$$(2)^2 + (3)^2 \leq 1 \quad (0.018 \leq 1)$$

Section utilization is 1.8%

STABILITY CONTROL

Load type: basic - medium-term

Rectification Coefficient

Kmod = 0.800

Partial factor for material properties

γ_m = 1.300

Length between lateral restr.points

l_{ef} = 180.00 cm

Strecha

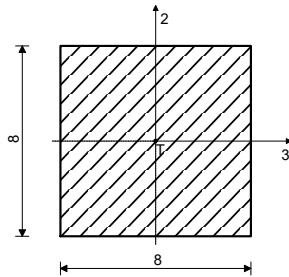
fifth percentile value of the modulus E parallel to the grain	E0.05 = 8000.0 MPa	Coefficient	k _{krit} = 1.000
fifth percentile value of shear modulus parallel to grain	G0.05 = 500.00 MPa	Axial Stress Bending around Axis 3	σ _{m,3,d} = 9.450 MPa
Torsional section modulus	I _{tor} = 576.90 cm ⁴	$\sigma_{m,3,d} \leq k_{krit} \times f_{m,3,d} \quad (9.450 \leq 18.841)$	
Moment of inertia	I ₂ = 341.33 cm ⁴	Section utilization is 50.2%	
Section modulus	W ₃ = 85.333 cm ³		
Critical bending stress	σ _{m,crit} = 181.52 MPa		
Relative buckling slenderness	λ _{rel} = 0.386		

Posúdenie krokvy priťaženej panelmi FVE**BEAM 425-500**

Solid timber - softwood - C27

Service class 2

EUROCODE (EN 1995-1-1)



[cm]

UTILISATION FACTORS FOR ALL LOAD CASE COMBINATIONS

4. γ=0.98	9. γ=0.93	6. γ=0.88
11. γ=0.84	5. γ=0.72	13. γ=0.68
16. γ=0.65	7. γ=0.63	14. γ=0.51
8. γ=0.44	12. γ=0.37	18. γ=0.35
10. γ=0.34	15. γ=0.32	17. γ=0.28
19. γ=0.28		

AXIAL AND SHEAR STRESSES CONTROL
(load 4, at the beginning of the member)

The axial force design value	N _{ed} ≈ 0.000 kN
Transversal Force in Axis 2 Direction	V _{2,ed} = -1.745 kN
Transversal Force in Axis 3 Direction	V _{3,ed} = -0.468 kN
Bending Moment around Axis 2	M _{2,ed} = -0.376 kNm
Bending Moment around Axis 3	M _{3,ed} = 1.306 kNm

STRESS CONTROL – BENDING

Load type: basic - medium-term	
Rectification Coefficient	K _{mod} = 0.800
Partial factor for material properties	γ _m = 1.300
Depth factor - axis 2	K _{h,2} = 1.134
Depth factor - axis 3	K _{h,3} = 1.134
Factor considering re-distribution of bending stresses	
	k _m = 0.700
Characteristic bending strength	f _{m,k} = 27.000 MPa
Design bending strength	f _{m,d} = 18.841 MPa
Section modulus	W ₂ = 85.333 cm ³
Axial Stress Bending around Axis 2	σ _{m,2,d} = 4.409 MPa

Section modulus	W ₃ = 85.333 cm ³
Axial Stress Bending around Axis 3	σ _{m,3,d} = 15.310 MPa

$$k_m \times (\sigma_{m,3,d} / f_{m,3,d}) + \sigma_{m,2,d} / f_{m,2,d} \leq 1 \quad (0.803 \leq 1)$$

Section utilization is 80.3%

$$\sigma_{m,3,d} / f_{m,3,d} + k_m \times (\sigma_{m,2,d} / f_{m,2,d}) \leq 1 \quad (0.976 \leq 1)$$

Section utilization is 97.6%

STRESS CONTROL – SHEAR

Load type: basic - medium-term	
Rectification Coefficient	K _{mod} = 0.800
Partial factor for material properties	γ _m = 1.300
Characteristic shear strength	f _{v,k} = 4.000 MPa
Design shear strength	f _{v,d} = 2.462 MPa
Cross Section Surface	A = 64.000 cm ²
Actual Shear Stress(Axis 2)	τ _{2,d} = 0.409 MPa
Actual Shear Stress(Axis 3)	τ _{3,d} = 0.110 MPa
Influence Superposition from Transversal Force	
(2)	τ _{2,d} / f _{v,d} = 0.166
(3)	τ _{3,d} / f _{v,d} = 0.045

$$(2)^2 + (3)^2 \leq 1 \quad (0.035 \leq 1)$$

Section utilization is 3.5%

STABILITY CONTROL

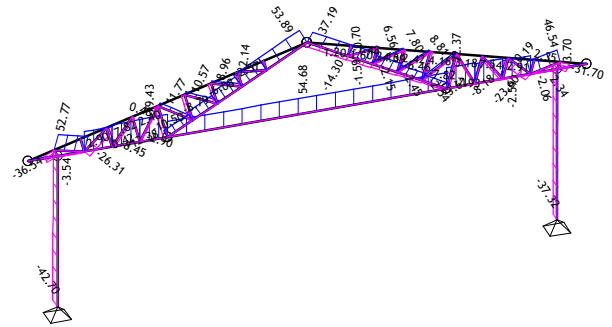
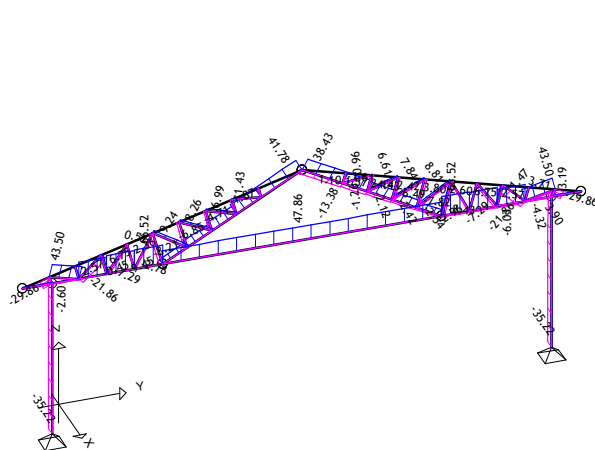
Load type: basic - medium-term	
Rectification Coefficient	K _{mod} = 0.800
Partial factor for material properties	γ _m = 1.300
Length between lateral restr.points	l _{ef} = 180.00 cm
fifth percentile value of the modulus E parallel to the grain	E0.05 = 8000.0 MPa
fifth percentile value of shear modulus parallel to grain	G0.05 = 500.00 MPa
Torsional section modulus	I _{tor} = 576.90 cm ⁴
Moment of inertia	I ₂ = 341.33 cm ⁴
Section modulus	W ₃ = 85.333 cm ³
Critical bending stress	σ _{m,crit} = 181.52 MPa
Relative buckling slenderness	λ _{rel} = 0.386
Coefficient	k _{krit} = 1.000
Axial Stress Bending around Axis 3	σ _{m,3,d} = 15.310 MPa

$$\sigma_{m,3,d} \leq k_{krit} \times f_{m,3,d} \quad (15.310 \leq 18.841)$$

Section utilization is 81.3%

Rám v osi 3 (V3)

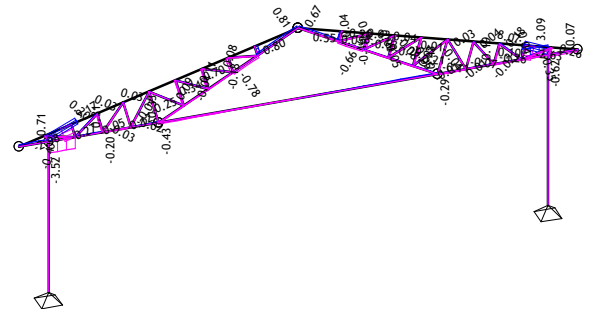
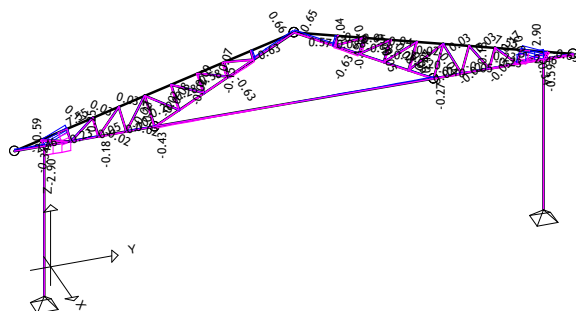
Load 20: [ULS] 4-12



Frame: V_3

Beam Results: max N1= 79.43 / min N1= -42.70 kN

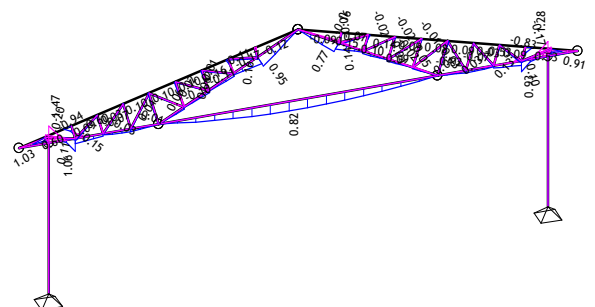
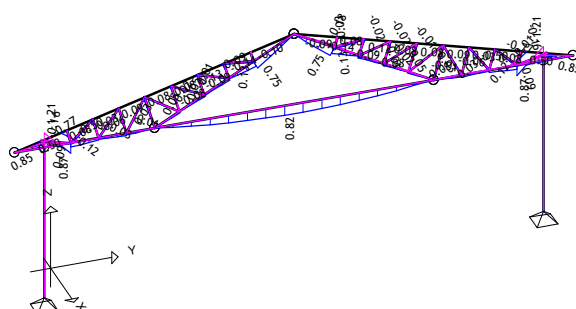
Load 20: [ULS] 4-12



Frame: V_3

Beam Results: max V2= 9.17 / min V2= -3.52 kN

Load 20: [ULS] 4-12

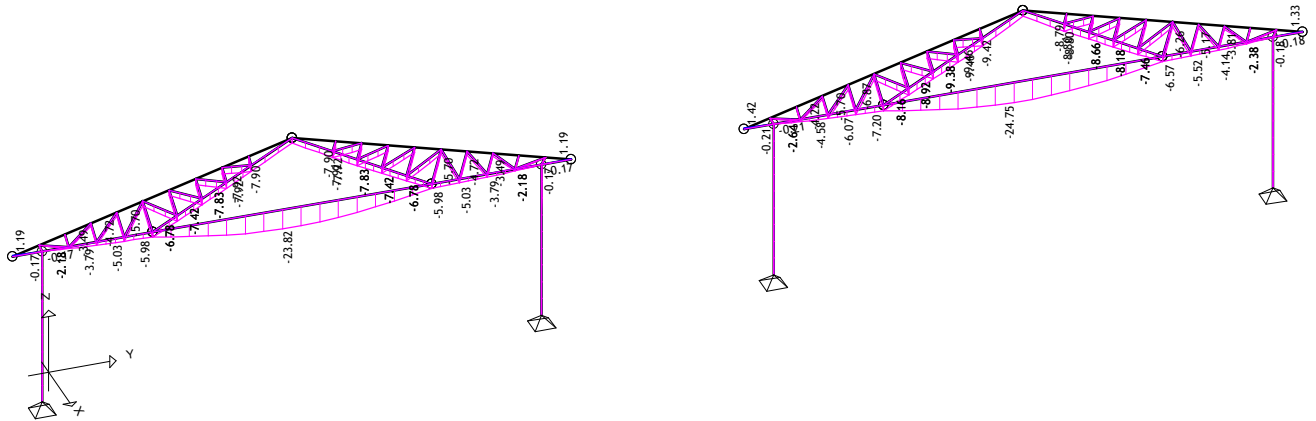


Frame: V_3

Beam Results: max M3= 1.06 / min M3= -1.47 kNm

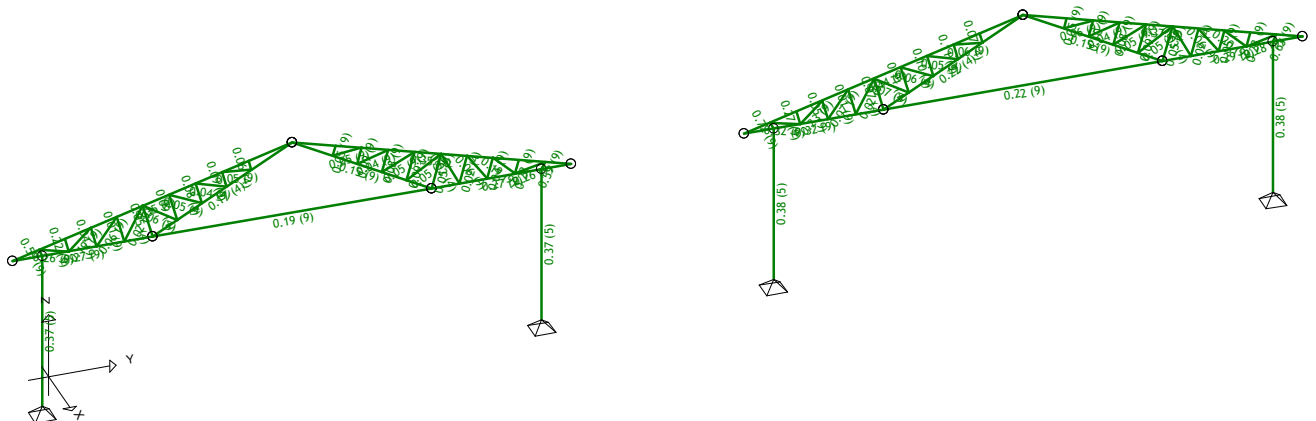
Rám v osi 3 (V3)

Load 21: [SLS_perm] 13-16



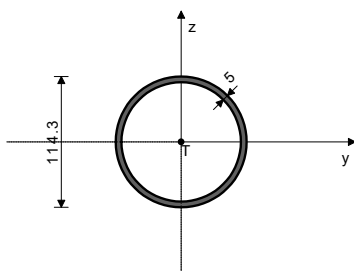
Frame: V_3

Beam Results: max Zd= 1.42 / min Zd= -24.75 m / 1000



Frame: V_3

Stress control

Posúdenie hornej pasnice priehradového väznika priťaženeho panelmi FVE**BEAM 310-515**CROSS-SECTION: Hollow [S 235] [Set: 1]
EUROCODE 3 (EN 1993-1-1:2005)**CROSS-SECTION PROPERTIES**

(fy = 23.5 kN/cm2, fu = 36.0 kN/cm2)

Ax =	17.170 cm2
Ay =	8.580 cm2
Az =	8.580 cm2
Ix =	513.58 cm4
Iy =	256.92 cm4
Iz =	256.92 cm4
Wy =	44.955 cm3
Wz =	44.955 cm3
Wy,pl =	59.774 cm3
Wz,pl =	59.774 cm3
γM0 =	1.000
γM1 =	1.000
γM2 =	1.250
Anet/A =	1.000

[mm]

6. γ=0.34

5. γ=0.27

12. γ=0.16

19. γ=0.12

10. γ=0.11

16. γ=0.27

7. γ=0.23

8. γ=0.15

17. γ=0.12

13. γ=0.27

14. γ=0.19

18. γ=0.15

15. γ=0.11

MEMBER SUBJECT TO AXIAL COMPRESSION AND BENDING
(load 9, at 48.5 cm from the start of the member)

The axial force design value

The shear force design value(z-z)

The bending mom.design value(y-y)

System length

N_{Ed} = -102.38 kNV_{Ed,z} = 0.145 kNM_{Ed,y} = 1.943 kNm

L = 791.37 cm

5.5 CLASSIFICATION OF CROSS-SECTIONS

Class 1 cross-sections

6.2 RESISTANCE OF CROSS-SECTIONS**6.2.4 Compression**

The design compression resistance

Requirement 6.9: N_{Ed} ≤ N_{c,Rd} (102.38 ≤ 403.50)N_{c,Rd} = 403.50 kN**6.2.5 Bending about the y-y axis**

Plastic section modulus

The design moment resistance

Requirement 6.12: M_{Ed,y} ≤ M_{c,Rd,y} (1.94 ≤ 14.05)W_{y,pl} = 59.774 cm3M_{c,Rd} = 14.047 kNm**UTILISATION FACTORS FOR ALL LOAD CASE COMBINATIONS**

9. γ=0.39

4. γ=0.39

11. γ=0.35

Rám v osi 3 (V3)

6.2.6 Shear

Design shear resistance $V_{pl,Rd,z} = 116.41 \text{ kN}$
 Design shear resistance $V_{c,Rd,z} = 116.41 \text{ kN}$

Requirement 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (0.15 ≤ 116.41)

6.2.10 Bending, shear and axial force

No reduction need be made in the resistance moment

Requirement: $V_{Ed,z} \leq 50\%V_{pl,Rd,z}$

6.2.9 Bending and axial force

Ratio $N_{Ed} / N_{pl,Rd}$ 0.254
 The reduced design pl.resist.mom. $M_{N,y,Rd} = 13.143 \text{ kNm}$
 Ratio $M_{Ed,y} / M_{N,y,Rd}$ 0.148

Requirement 6.41: (0.15 ≤ 1)

6.3 BUCKLING RESISTANCE OF MEMBERS

6.3.1.1 Buckling resistance

Buckling length y-y $l_y = 100.00 \text{ cm}$
 Relative slenderness y-y $\lambda_y = 0.275$
 Buckling curve for axis y-y: A $\alpha = 0.210$
 Elastic critical force $N_{cr,y} = 5325.0 \text{ kN}$
 The reduction factor $\chi_y = 0.983$
 The design buckling resistance $N_{b,Rd,y} = 396.72 \text{ kN}$

Requirement 6.46: $N_{Ed} \leq N_{b,Rd,y}$ (102.38 ≤ 396.72)

Buckling length z-z $l_z = 100.00 \text{ cm}$
 Relative slenderness z-z $\lambda_z = 0.275$
 Buckling curve for axis z-z: A $\alpha = 0.210$
 The reduction factor $\chi_z = 0.983$
 The design buckling resistance $N_{b,Rd,z} = 396.72 \text{ kN}$

Requirement 6.46: $N_{Ed} \leq N_{b,Rd,z}$ (102.38 ≤ 396.72)

6.3.3 Uniform members in bending and axial compression

Values of interaction factors obtained from Annex B

(alternative method 2)

The equiv.unif.mom.fact.flex.buck. $C_{my} = 0.950$
 The equiv.unif.mom.fact.flex.buck. $C_{mz} = 1.000$
 The equiv.unif.mom.fact.flex.buck. $C_{mLT} = 0.950$
 Interaction factors $k_{yy} = 0.968$
 Interaction factors $k_{yz} = 0.612$
 Interaction factors $k_{zy} = 0.581$
 Interaction factors $k_{zz} = 1.019$

The reduction factor $\chi_y = 0.983$
 $N_{Ed} / (\chi_y N_{Rk} / \gamma_{M1})$ 0.258
 $k_{yy} * (M_{yEd} + \Delta M_{yEd}) / \dots$ 0.134

Requirement 6.61: (0.39 ≤ 1)

The reduction factor $\chi_z = 0.983$
 $N_{Ed} / (\chi_z N_{Rk} / \gamma_{M1})$ 0.258
 $k_{zy} * (M_{yEd} + \Delta M_{yEd}) / \dots$ 0.080

Requirement 6.62: (0.34 ≤ 1)

Check of the shear resistance

(load 9, at 717.8 cm from the start of the member)

The axial force design value	$N_{Ed} = -51.178 \text{ kN}$
The shear force design value(z-z)	$V_{Ed,z} = 5.824 \text{ kN}$
The bending mom.design value(y-y)	$M_{Ed,y} = 2.527 \text{ kNm}$
System length	$L = 791.37 \text{ cm}$

6.2 RESISTANCE OF CROSS-SECTIONS

6.2.6 Shear

Design shear resistance $V_{pl,Rd,z} = 116.41 \text{ kN}$
 Design shear resistance $V_{c,Rd,z} = 116.41 \text{ kN}$

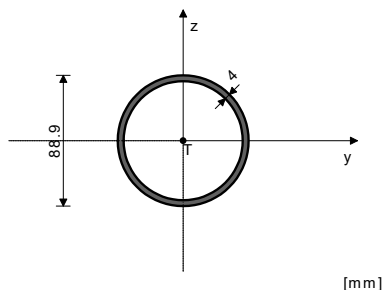
Requirement 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (5.82 ≤ 116.41)

Posúdenie dolnej pasnice priehradového väznika priťaženeho panelmi FVE

BEAM 389-310

CROSS-SECTION: Hollow [S 235] [Set: 2]
 EUROCODE 3 (EN 1993-1-1:2005)

CROSS-SECTION PROPERTIES



$A_x = 10.670 \text{ cm}^2$
 $A_y = 5.332 \text{ cm}^2$
 $A_z = 5.332 \text{ cm}^2$
 $I_x = 192.58 \text{ cm}^4$
 $I_y = 96.340 \text{ cm}^4$
 $I_z = 96.340 \text{ cm}^4$
 $W_y = 21.674 \text{ cm}^3$
 $W_z = 21.674 \text{ cm}^3$
 $W_{y,pl} = 28.853 \text{ cm}^3$
 $W_{z,pl} = 28.853 \text{ cm}^3$
 $\gamma_{M0} = 1.000$
 $\gamma_{M1} = 1.000$
 $\gamma_{M2} = 1.250$
 $A_{net}/A = 1.000$

(fy = 23.5 kN/cm², fu = 36.0 kN/cm²)

UTILISATION FACTORS FOR ALL LOAD CASE COMBINATIONS

9. $\gamma=0.32$	4. $\gamma=0.30$	11. $\gamma=0.28$
6. $\gamma=0.27$	16. $\gamma=0.22$	13. $\gamma=0.21$
5. $\gamma=0.20$	7. $\gamma=0.17$	14. $\gamma=0.14$
12. $\gamma=0.13$	18. $\gamma=0.12$	8. $\gamma=0.11$
19. $\gamma=0.10$	17. $\gamma=0.09$	15. $\gamma=0.08$
10. $\gamma=0.08$		

MEMBER SUBJECT TO AXIAL TENSION AND BENDING

(load 9, at 305.3 cm from the start of the member)

The axial force design value	$N_{Ed} = 79.429 \text{ kN}$
The shear force design value(z-z)	$V_{Ed,z} = 0.241 \text{ kN}$
The bending mom.design value(y-y)	$M_{Ed,y} = 0.217 \text{ kNm}$
System length	$L = 381.50 \text{ cm}$

5.5 CLASSIFICATION OF CROSS-SECTIONS

Class 1 cross-sections

6.2 RESISTANCE OF CROSS-SECTIONS

6.2.3 Tension

The design pl.resist.mom.(gross sect.) $N_{pl,Rd} = 250.75 \text{ kN}$
 The design ult.resist.(net sect.) $N_{u,Rd} = 276.57 \text{ kN}$
 The design tension resistance $N_{t,Rd} = 250.75 \text{ kN}$

Requirement 6.5: $N_{Ed} \leq N_{t,Rd}$ (79.43 ≤ 250.75)

6.2.5 Bending about the y-y axis

Plastic section modulus $W_{y,pl} = 28.853 \text{ cm}^3$
 The design moment resistance $M_{c,Rd} = 6.781 \text{ kNm}$

Requirement 6.12: $M_{Ed,y} \leq M_{c,Rd,y}$ (0.22 ≤ 6.78)

6.2.6 Shear

Design shear resistance $V_{pl,Rd,z} = 72.339 \text{ kN}$
 Design shear resistance $V_{c,Rd,z} = 72.339 \text{ kN}$

Requirement 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (0.24 ≤ 72.34)

6.2.10 Bending, shear and axial force

No reduction need be made in the resistance moment

Requirement: $V_{Ed,z} \leq 50\%V_{pl,Rd,z}$

6.2.9 Bending and axial force

Ratio $N_{Ed} / N_{pl,Rd}$ 0.317
 The reduced design pl.resist.mom. $M_{N,y,Rd} = 6.100 \text{ kNm}$
 Ratio $M_{Ed,y} / M_{N,y,Rd}$ 0.036

Requirement 6.41: (0.04 ≤ 1)

Check of the shear resistance

(load 9, at 80.0 cm from the start of the member)

The axial force design value	$N_{Ed} = -3.541 \text{ kN}$
The shear force design value(z-z)	$V_{Ed,z} = 3.521 \text{ kN}$
The bending mom.design value(y-y)	$M_{Ed,y} = 1.469 \text{ kNm}$
System length	$L = 381.50 \text{ cm}$

6.2 RESISTANCE OF CROSS-SECTIONS

6.2.6 Shear

Design shear resistance $V_{pl,Rd,z} = 72.339 \text{ kN}$
 Design shear resistance $V_{c,Rd,z} = 72.339 \text{ kN}$

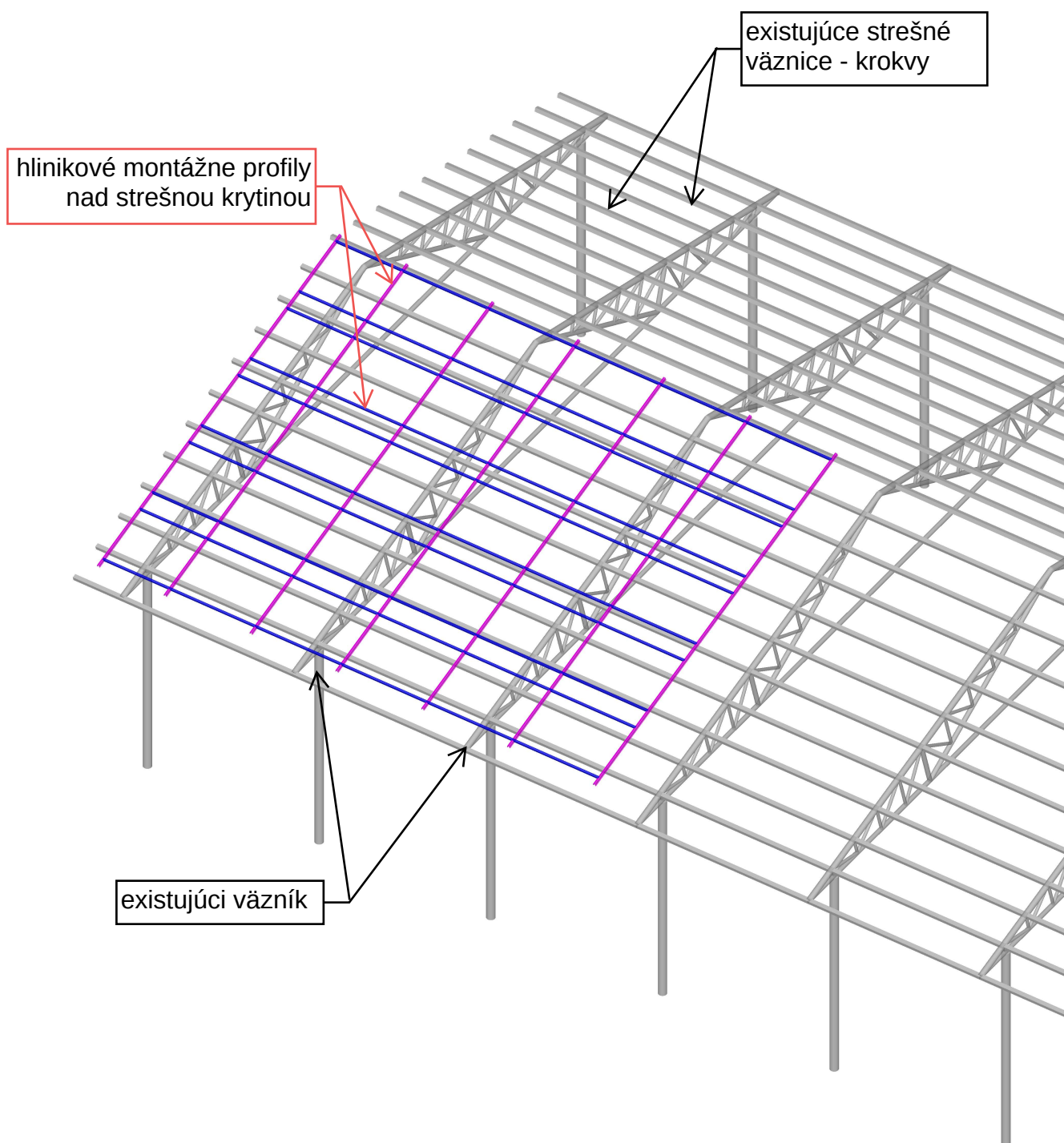
Requirement 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (3.52 ≤ 72.34)

Záver

Záver:

Konštrukcia strechy je spôsobilá na osadenie fotovoltických panelov.

Nadstrešná hliníková konštrukcia

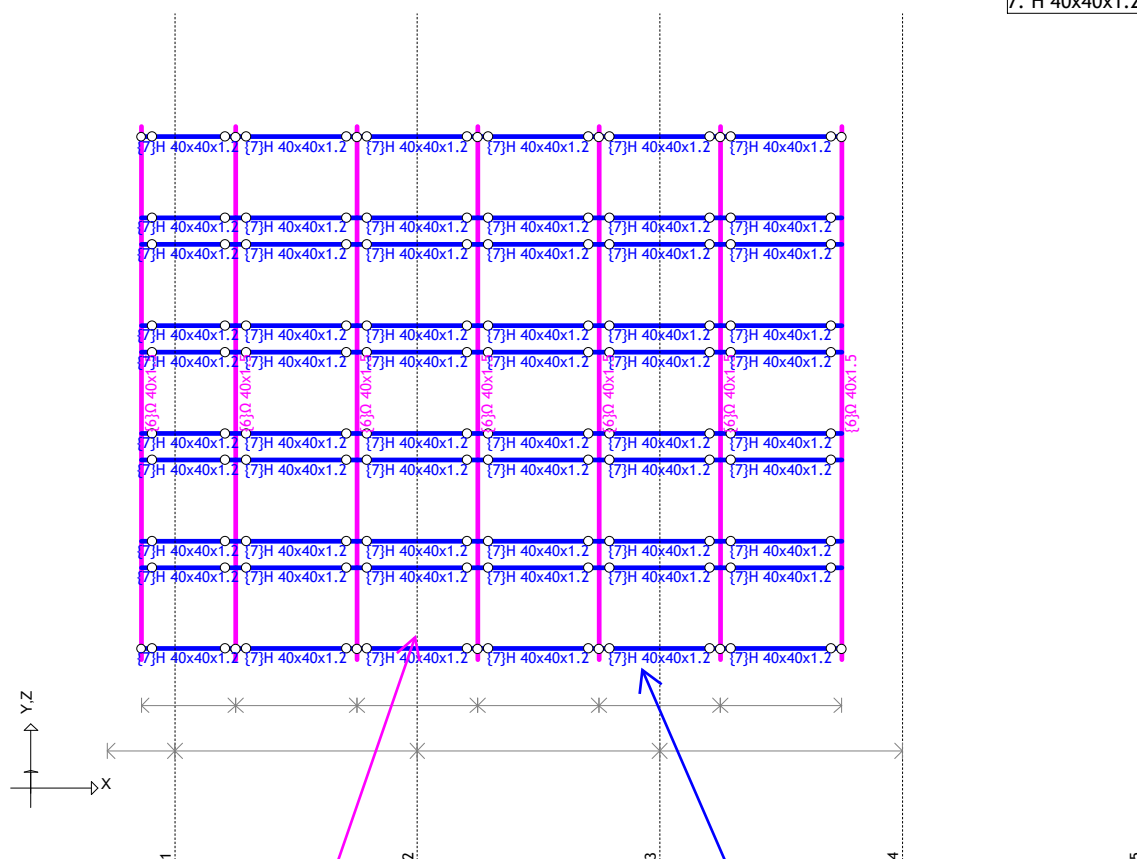


Nadstrešná hliníková konštrukcia

<no name>

Beam

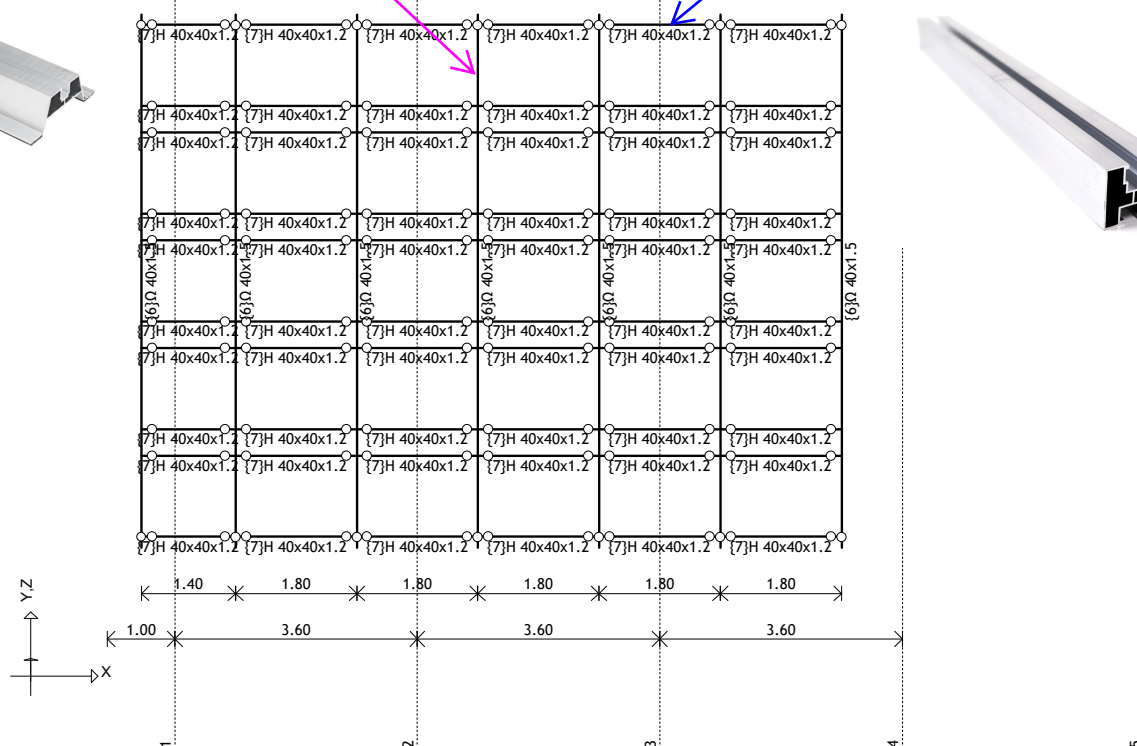
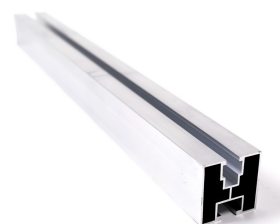
6. Ω 40x1.5 (Mont. trap. profil) ■
 7. H 40x40x1.2 (Mont. H profil) ■



Numerical data set
 Beam (6.7)

hliníkové podkladné
 trapézové profily
 v smere spádu strechy

hliníkové montážne
 profily H40x40x1,2
 kolmo na spád strechy



<no name>