



PROJEKTO PAVADINIMAS: Mokslo paskirties pastato, Smilties Pylimo g. 14, Klaipėdoje, rekonstravimo projektas

ADRESAS: Smilties Pylimo g. 14, Klaipėda

SKLYPO KADASTRINIS NR.: 2101/0003:403

UŽSAKOVAS: Klaipėdos technologijų mokymo centras

STATINIO KATEGORIJA: Ypatingasis statinys

STATYBOS RŪŠIS: Rekonstravimas

STATINIO NAUDOJIMO PASKIRTIS: Mokslo paskirties pastatas

PROJEKTAVIMO DARBŲ STADIJA: Techninis projektas

PROJEKTO DALIS Konstrukcijų. Sprendinių detalieji skaičiavimai

LAIDA 0

BYLA: IN2324-01-TP-SK-S

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**PROJEKTO SUDĖTIES ŽINIARAŠTIS**

Eil. Nr.	Projekto dalies pavadinimas	Raidinis žymėjimas
1.	Bendroji	BD
2.	Architektūros (statinio architektūra)	SA
3.	Konstrukcijų (statinio konstrukcijos)	SK
4.	Vandentiekio ir nuotekų šalinimo	VN
5.	Šildymo, vėdinimo ir oro kondicionavimo	ŠVOK
6.	Elektrotechnikos	E
7.	Elektroninių ryšių (telekomunikacijos)	ER
8.	Apsauginės signalizacijos	AS
9.	Gaisro aptikimo ir signalizavimo	GSS
10.	Šilumos gamybos ir tiekimo	ŠT
11.	Gaisrinės saugos	GS
12.	Pasirengimo statybai ir statybos darbų organizavimo	SO
13.	Statybos skaičiuojamosios kainos nustatymo	KS
14.	Interjero	I



PROJEKTO DALIES BYLŲ (SEGTUVŲ) SUDĖTIES ŽINIARAŠTIS

Eil. Nr.	Bylos (segtuvo) žymuo	Laida	Pavadinimas	Pastabos
1.	IN2324-01-TP-SK	0	Konstrukcijų (statinio konstrukcijos)	
3.	IN2324-01-TP-SK-S	0	Konstrukcijų. Sprendinių detalieji skaičiavimai	

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	3	87	0



2. KONSTRUKCIJŲ SKAIČIAVIMAS

Laikančių konstrukcijų skaičiavimai atlikti baigtinių elementų skaičiavimo programa Autodesk Robot Structural Analysis Professional 2023.

2.1. Lifo šachtos pado projektavimas

Projektuojama nauja lifto šachta pastato viduje. Monolitinis lifto šachtos padas ant tampraus pagrindo ir monolitinės lifto šachtos prieduobės sienos standžiai sujungtos su padu. Tarpaukštinės sienos mūrinės. Ant lifto šachtos sienų atremiamos esamos aukštų perdangos, kurios suvaržo šachtą iš plokštumos.

Tampriojo pagrindo elastinio koeficiento skaičiavimas:

Soil elastic coefficient

Soil layers

Layer	Name	Level (m)	Thickness (m)	IL/ID	Consolidation symbol	Moisture type
1	well graded gravels	0.00	0.30	0.00	---	---
2	clayey sands	-0.30	0.40	0.00	---	---
3	sandy clays	-0.70	1.00	0.00	---	---
4	silty clays	-1.70	---	0.00	---	---

Other soil parameters:

Layer	Name	Cohesion (MPa)	Friction angle (Deg)	Unit weight (kG/m3)	Mo (MPa)	M (MPa)
1	well graded gravels	0.00	42.0	2242.58	199.50	199.50
2	clayey sands	0.07	23.0	2050.36	36.20	36.20
3	sandy clays	0.09	20.0	2082.40	24.13	24.13
4	silty clays	0.09	25.0	1762.03	24.13	24.13

Average elastic coefficient for layered soil

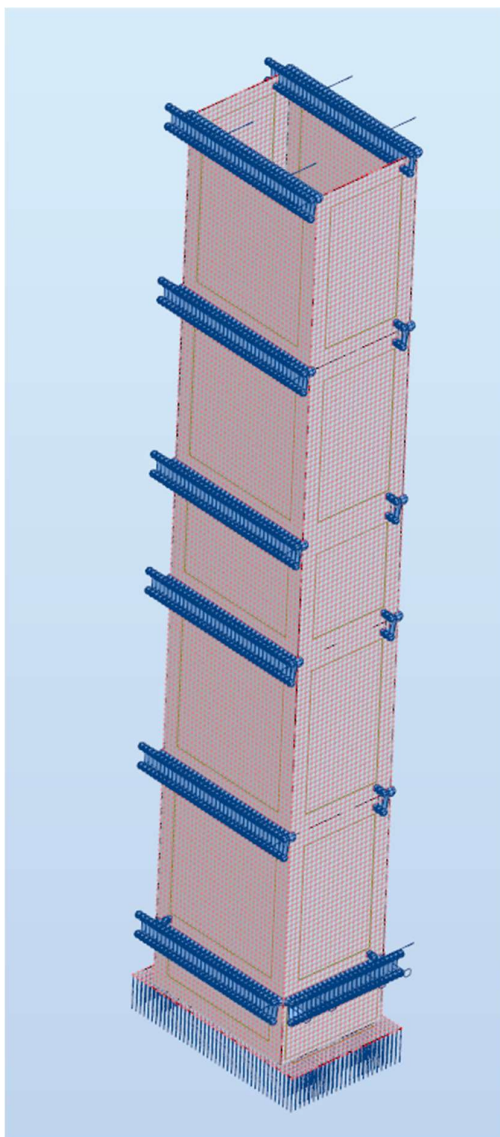
K = 8990.52 (kN/m3)

Equivalent elastic coefficient

For raft foundation which dimensions are **3.36 * 2.4 (m)**
with estimated foundation load: **210 (kPa)**
KZ = 8990.52 (kN/m3)

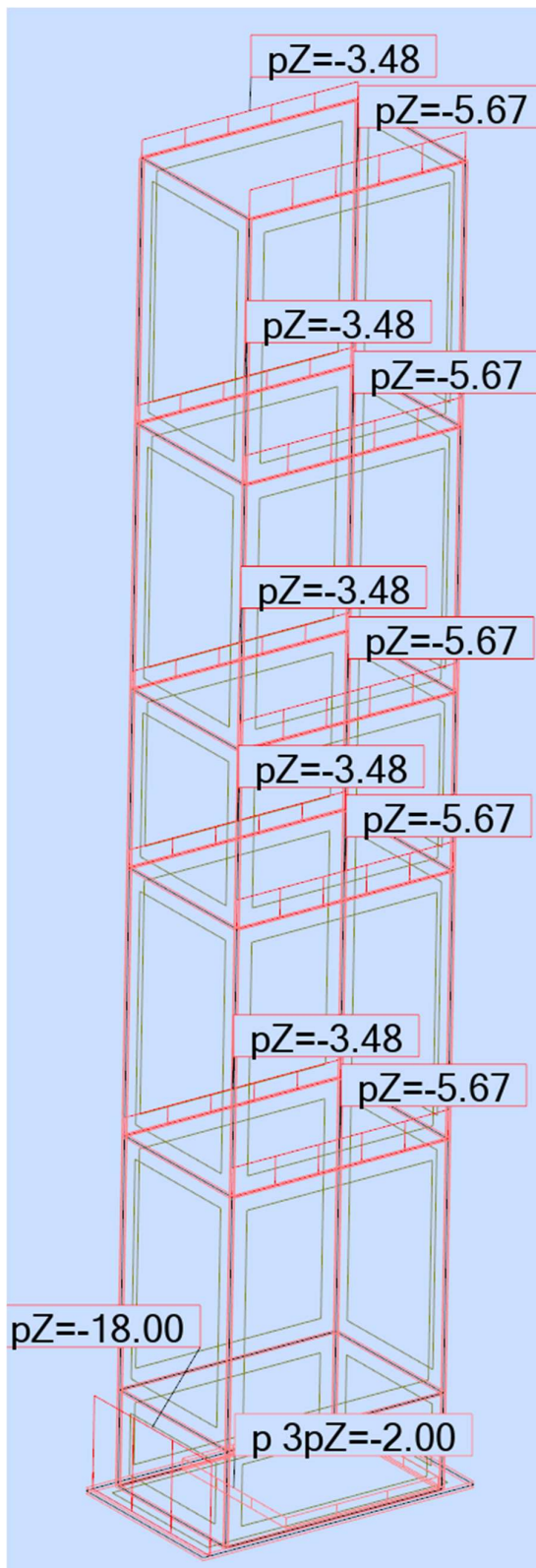
Lifo šachtos skaičiuojamoji schema:

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	4	87	0



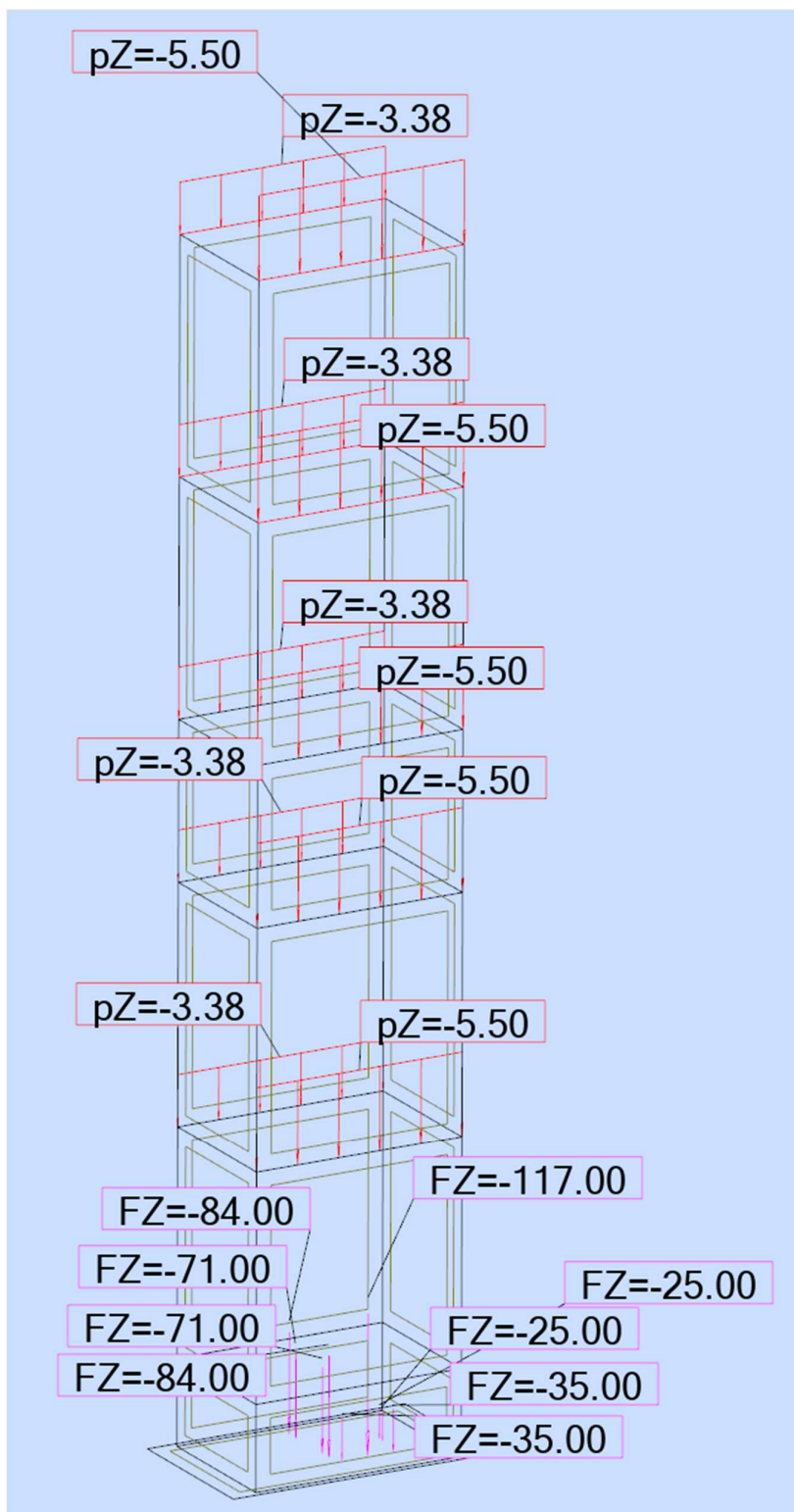
Veikiančios apkrovos:

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	5	87	0



Pav. 1 Nuolatinės apkrovos

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	6	87	0

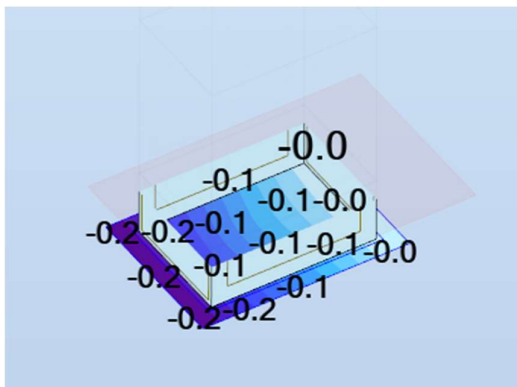


Pav. 2 Naudojimo apkrovos

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	7	87	0

Tinkamumo ribinis būvis.

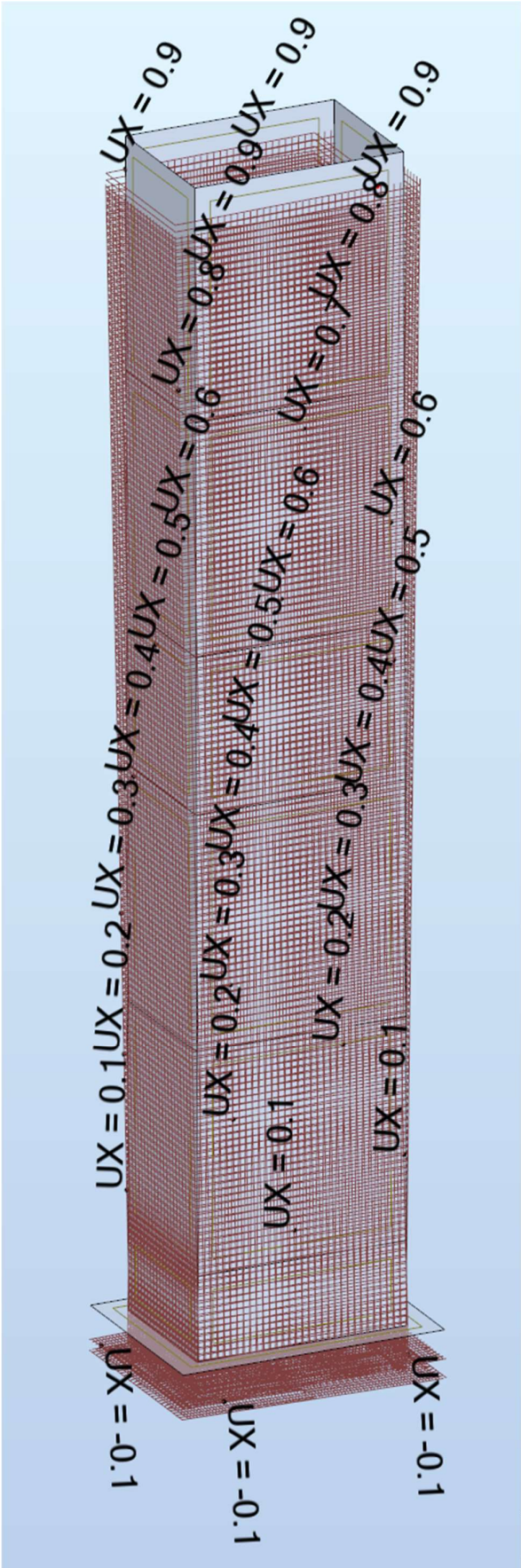
Pado išlinkis:



Išvada: $0,2\text{cm} < L/150 = 3,2/150 = 2,1\text{cm}$ sąlyga tenkinama

Lifto šachtos poslinkis:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	8	87	0



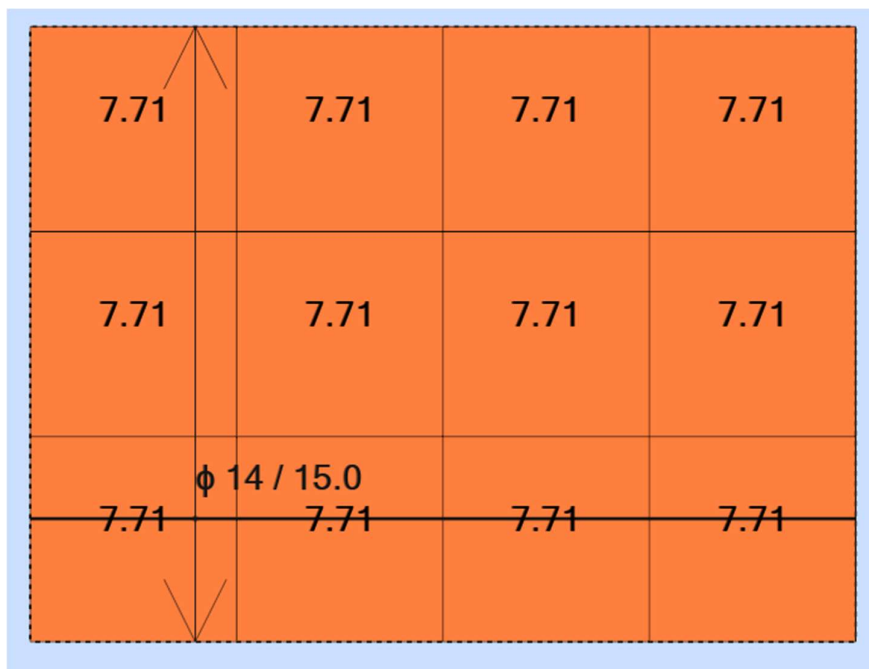
2324-01-TP-SK-S	Lapas	Lapų	Laida
	9	87	0

	UX (cm)	UY (cm)	UZ (cm)	RX (Rad)	RY (Rad)	RZ (Rad)
MAX	0.9	0.0	-1.3	0.000	0.001	0.000
Node	12958	1386	6645	1886	14312	859
Case	16 (C)	16 (C)	16 (C)	16 (C)	16 (C)	16 (C)
MIN	-0.7	-0.0	-2.1	-0.000	-0.001	-0.000
Node	12928	602	6632	14664	14409	1506
Case	14 (C)	16 (C)	14 (C)	16 (C)	14 (C)	16 (C)

Išvada: Šachtos horizontalus poslinkis $0,9\text{cm} < h/500 = 17,5/500 = 3,4$ cm. Horizontalus poslinkis neviršija leistino.

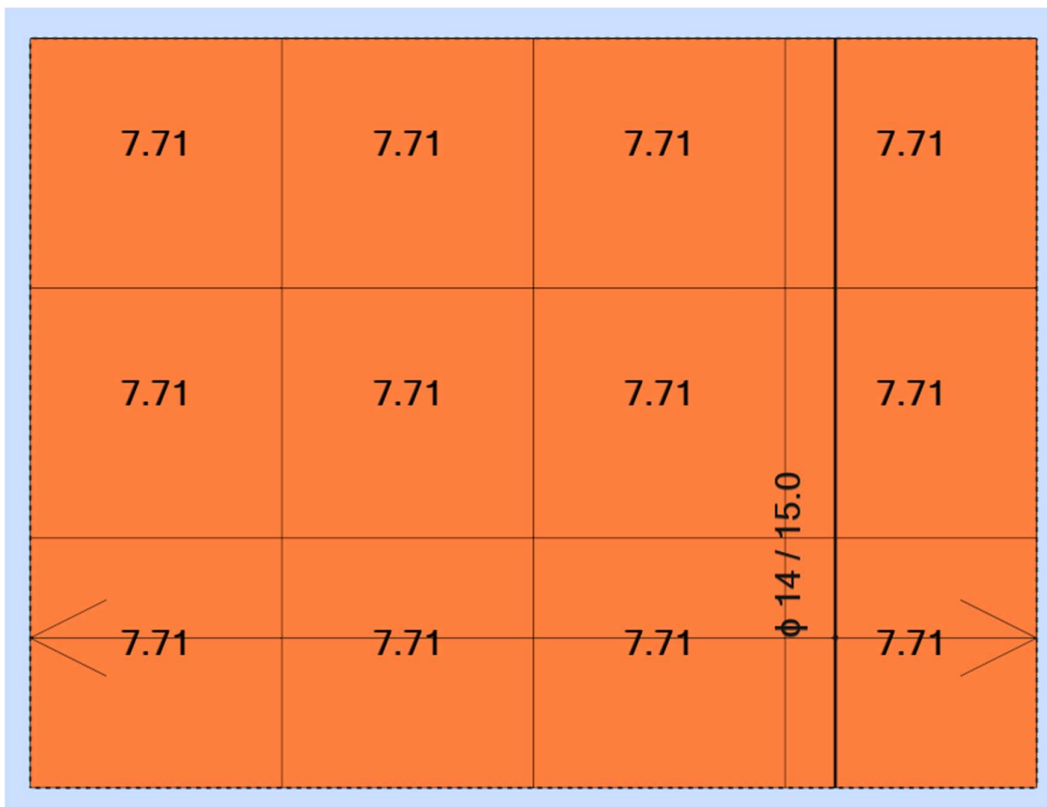
Reikalingas pado armavimas.

Apatinis armavimas X kryptimi:

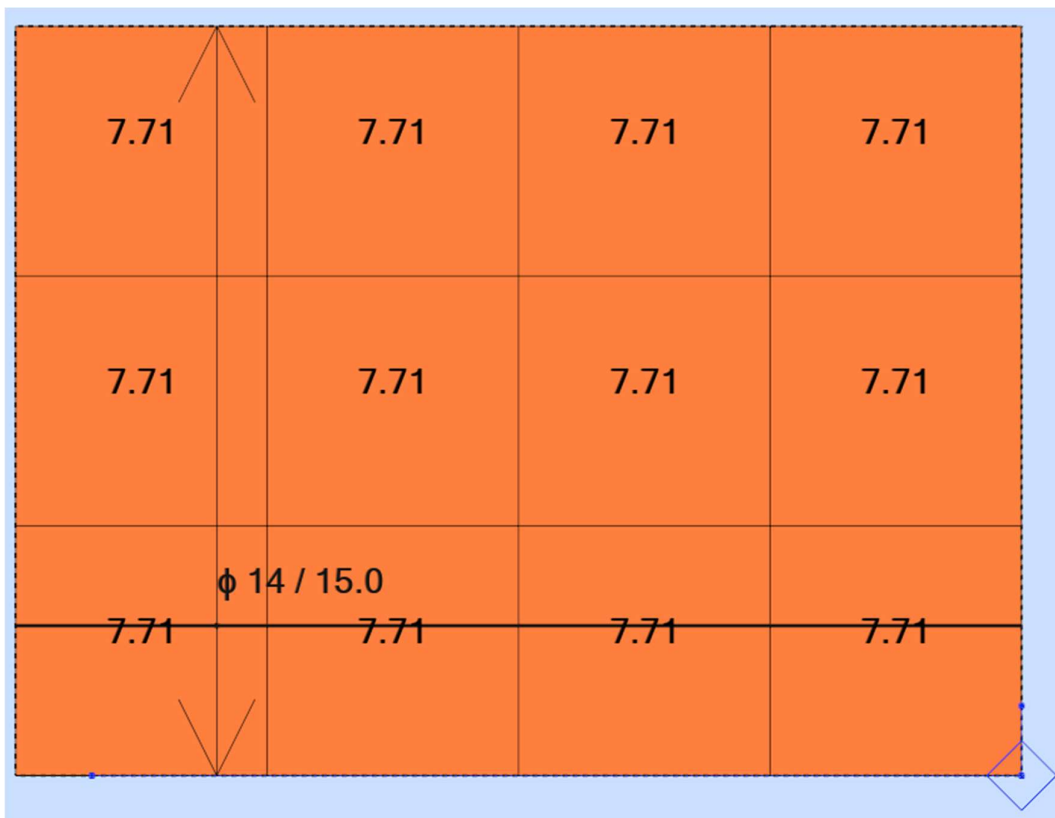


Apatinis armavimas Y kryptimi:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	10	87	0

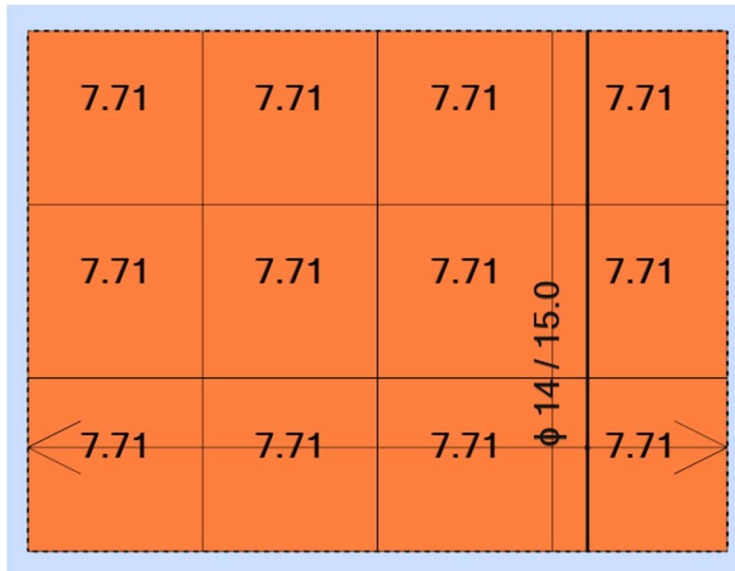


Viršutinis armavimas X kryptimi:



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	11	87	0

Viršutinis armavimas Y kryptimi:



1. Slab: Slab1 - Panel no. 1

1.1. Reinforcement:

- Type : Perdanga
- Main reinforcement direction : 0°
- Main reinforcement grade : B500B; Characteristic strength = 500.00 MPa
Horizontal branch of the stress-strain diagram
- Ductility class : B
- Bar diameters
bottom d1 = 1.2 (cm) d2 = 1.2 (cm)
top d1 = 1.2 (cm) d2 = 1.2 (cm)
- Cover
bottom c1 = 7.0 (cm)
top c2 = 3.0 (cm)
- Cover deviations
Cdev = 1.0(cm), Cdur = 0.0(cm)

1.2. Concrete

- Class : C30/37; Characteristic strength = 30.00 MPa
Rectangular stress distribution [3.1.7(3)]
- Density : 2501.36 (kg/m³)
- Concrete creep coefficient : 1.32
- Cement class : N

1.3. Hypothesis

- Calculations according to : EN 1992-1-1:2004/A1:2014
- Method of reinforcement area calculations : analytical
- Allowable cracking width
- upper layer : 0.30 (mm)
- lower layer : 0.30 (mm)
- Allowable deflection : 2.5 (cm)
- Verification of punching : no
- Exposure : XC2
- upper layer

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	12	87	0



- lower layer : XC2
 • Calculation type : simple bending
 • Structure class : S4
 Modified partial coefficients:
 $a_{cc} = 0.9$ 1992-1-1 3.1.6 (1)P

1.4. Slab geometry

Thickness 0.400 (m)

Contour:

edge	beginning		end		length
	x1	y1	x2	y2	(m)
1	0.000	-2.950	3.960	-2.950	3.960
2	3.960	-2.950	3.960	0.000	2.950
3	3.960	0.000	0.000	0.000	3.960
4	0.000	0.000	0.000	-2.950	2.950

Support:

n°	Name	dimensions (m)	coordinates		edge
			x	y	
0	linear	2.200 / 0.250	0.400	-1.475	
0	linear	0.250 / 3.160	1.980	-2.575	
0	linear	0.250 / 3.160	1.980	-0.375	
0	linear	2.200 / 0.250	3.560	-1.475	

* - head present

1.5. Calculation results:

1.5.1. Maximum moments + reinforcement for bending

	Ax(+)	Ax(-)	Ay(+)	Ay(-)
Provided reinforcement (cm2/m):				
	10.26	10.26	10.26	10.26
Modified required reinforcement (cm2/m):				
	7.71	7.71	7.71	7.71
Original required reinforcement (cm2/m):				
	7.71	7.71	7.71	7.71
Coordinates (m):				
	2.028;-2.861	2.028;-2.861	1.980;-2.950	2.028;-
	2.861			

1.5.2. Maximum moments + reinforcement for bending

	Ax(+)	Ax(-)	Ay(+)	Ay(-)
Symbol: required area/provided area				
Ax(+) (cm2/m)	7.71/10.26	7.71/10.26	7.71/10.26	
Ax(-) (cm2/m)	7.71/10.26	7.71/10.26	7.71/10.26	
Ay(+) (cm2/m)	7.71/10.26	7.71/10.26	7.71/10.26	
Ay(-) (cm2/m)	7.71/10.26	7.71/10.26	7.71/10.26	

	SLS			
Mxx (kN*m/m)	-3.86	-3.86	-3.76	-3.86

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Myy (kN*m/m)	-1.16	-1.16	0.17	-1.16
Mxy (kN*m/m)	-1.14	-1.14	-0.50	-1.14
Nxx (kN/m)	18.33	18.33	17.96	18.33
Nyy (kN/m)	-0.52	-0.52	0.52	-0.52
Nxy (kN/m)	0.52	0.52	0.15	0.52
ULS				
Mxx (kN*m/m)	-5.19	-5.19	-5.23	-5.19
Myy (kN*m/m)	-1.57	-1.57	0.26	-1.57
Mxy (kN*m/m)	-1.53	-1.53	-0.65	-1.53
Nxx (kN/m)	26.57	26.57	26.10	26.57
Nyy (kN/m)	-0.75	-0.75	0.70	-0.75
Nxy (kN/m)	0.74	0.74	0.20	0.74
Coordinates (m)	2.028;-2.861	2.028;-2.861	1.980;-2.950	2.028;-2.861
Coordinates* (m)	1.728;-0.186;0.000	1.728;-0.186;0.000	1.680;-0.275;0.000	1.728;-0.186;0.000

* - Coordinates in the structure global coordinate system

1.5.4. Deflection

|f(+)| = 0.0 (cm) <= fdop(+) = 2.5 (cm)

|f(-)| = 0.2 (cm) <= fdop(-) = 2.5 (cm)

1.5.5. Cracking

upper layer

ax = 0.00 (mm) <= adop = 0.30 (mm)

ay = 0.00 (mm) <= adop = 0.30 (mm)

lower layer

ax = 0.00 (mm) <= adop = 0.30 (mm)

ay = 0.00 (mm) <= adop = 0.30 (mm)

3. Results - detailing

List of solutions:

Reinforcement: bars

Solution no.	Reinforcement range Diameter / Weight	Total weight (kG)
1	-	376.57

Results for the solution no. 1

Reinforcement zones

Bottom reinforcement

Name	coordinates Ar				Provided reinforcement At	
	x1	y1	x2	y2	φ (mm) / (cm)	(cm2/m)
1/1- Ax Main	0.000	-2.950	3.960	0.000	14.0 / 15.0	7.71 <
	10.26					
1/2- Ay Perpendicular	0.000	-2.950	3.960	0.000	14.0 / 15.0	7.71 <
	10.26					

Top reinforcement

Name	coordinates Ar	Provided reinforcement At
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	14	87	0



	x1 (cm2/m)	y1	x2	y2	φ (mm) / (cm)	(cm2/m)
1/3+ Ax Main	0.000 10.26	-2.950	3.960	0.000	14.0 / 15.0	7.71 <
1/4+ Ay Perpendicular	0.000 10.26	-2.950	3.960	0.000	14.0 / 15.0	7.71 <

4. Material survey

- Concrete volume = 4.673 (m3)
- Formwork = 11.682 (m2)
- Slab circumference = 13.820 (m)
- Area of openings = 0.000 (m2)

- Steel B500B
- Total weight = 352.11 (kG)
- Density = 75.35 (kG/m3)
- Average diameter = 14.0 (mm)
- Survey according to diameters:

Diameter	Length (m)	Number of identical elements:
14	2.810	52
14	3.820	38

Išvada: laikomoji galia pakankama

2.2.Sekliojo pamato pagrindo skaičiavimas

Tikrinamo lifto pado pagrindo laikomoji galia.

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Veikiančios įrašos:

Įrašos atvejui A1:

$$N_{Ed,1} := 2324 \text{ kN}$$

$$V_{Ed,x,1} := 0.1 \text{ kN}$$

$$V_{Ed,y,1} := 0.1 \text{ kN}$$

$$M_{Ed,x,1} := 0.1 \text{ kNm}$$

$$M_{Ed,y,1} := 0.1 \text{ kNm}$$

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$$\gamma_{\varphi,1} := 1$$

$$\gamma_{c,1} := 1$$

$$\gamma_{cu,1} := 1$$

$$\gamma_{qu,1} := 1$$

$$\gamma_{\gamma} := 1$$

Daliniai medžiagų patikimumo koef. atvejui M2:

$$\gamma_{\varphi,2} := 1.25$$

$$\gamma_{c,2} := 1.25$$

$$\gamma_{cu,2} := 1.4$$

$$\gamma_{qu,2} := 1.4$$

$$\gamma_{\gamma} := 1$$

Daliniai stiprumo koeficientai:

	Atvejui R1:	Atvejui R2:	Atvejui R3:
Gniuždymui :	$\gamma_{R,v,1} := 1$	$\gamma_{R,v,2} := 1.4$	$\gamma_{R,v,3} := 1$
Kirpimui :	$\gamma_{R,h,1} := 1$	$\gamma_{R,h,2} := 1.1$	$\gamma_{R,h,3} := 1$

Grunto rodikliai:

$$\rho := 21.2 \frac{\text{kN}}{\text{m}^3}$$

$$E := 38 \text{ MPa}$$

Sankiba :

$$c_c := 0 \text{ kPa}$$

$$q_c := 7.1 \text{ MPa}$$

$$\varphi := 37$$

Geometriniai rodikliai:

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$$h_1 := 1.25 \quad \text{m}$$

$$h := 0.4 \quad \text{m}$$

$$L := 4.1 \quad \text{m}$$

$$B := 3.2 \quad \text{m}$$

Posvyrio kampas (radianais):

$$\alpha := 0$$

Pamato svoris:

$$q_p := L \cdot B \cdot h \cdot 2500 = 1.312 \times 10^4 \quad \text{kg}$$

$$q_{pd} := q_p \cdot 10 \cdot 10^{-3} = 131.2 \quad \text{kN}$$

Preliminarūs pado matmenys:

$$M_1 := V_{Ed,x,1} \cdot h + M_{Ed,y,1} = 0.14 \quad \text{kNm}$$

$$M_2 := V_{Ed,y,1} \cdot h + M_{Ed,x,1} = 0.14 \quad \text{kNm}$$

$$e_1 := \frac{M_1}{N_{Ed,1}} = 6.024 \times 10^{-5} \quad \frac{L}{6} = 0.683$$

$$e_2 := \frac{M_2}{N_{Ed,1}} = 6.024 \times 10^{-5} \quad \frac{B}{6} = 0.533$$

Efektyvusis pado plotas:

$$L_{ef} := L - 2 \cdot e_1 = 4.1 \quad \text{m}$$

$$B_{ef} := B - 2e_2 = 3.2 \quad \text{m}$$

$$A_{ef} := B_{ef} \cdot L_{ef} = 13.119 \quad \text{m}^2$$

Laikomoji galia:

$$R := 1 \cdot 1.3 \cdot 0.1 \cdot q_c = 0.923 \quad \text{MPa}$$

Reikalingas plotas:

$$A_r := \frac{N_{Ed,1}}{R \cdot 10^3} = 2.518 \quad \text{m}^2 \quad A_{ef} = 13.119 \text{ Gerai!}$$

Pirmas projektavimo atvejis:

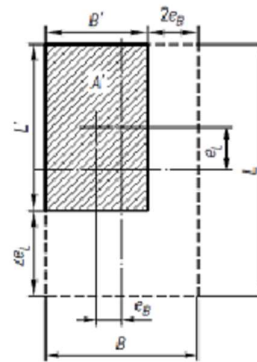
A1+M1+R1

Drenuojančios sąlygos:

Efektyvioji sankiba:

$$c_1 := \frac{c}{\gamma_{c,1}} = 0 \quad \text{kPa}$$

Priekrovos svoris:



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$$q := h_1 \cdot \rho \cdot 1.35 = 35.775 \text{ kPa}$$

Efektivusis grunto slėgis:

$$q = 35.775 \text{ kPa}$$

Vienetinis svoris:

$$\gamma_1 := \frac{\rho}{\gamma_\gamma} = 21.2$$

Vidinės trinties kampo tangentas:

$$\tan \varphi := \frac{\tan(\varphi \cdot \text{deg})}{\gamma_{\varphi,1}} = 0.754$$

$$e = 2.718$$

Bedimensiniai koeficientai:

Laikomosios galios:

$$N_{q,1} := e^{\pi \cdot \tan \varphi} \cdot \left[\tan \left[\left(45 + \frac{\varphi}{2} \right) \cdot \text{deg} \right] \right]^2 = 42.92$$

$$N_{c,1} := (N_{q,1} - 1) \cdot \frac{\cos(\varphi \cdot \text{deg})}{\sin(\varphi \cdot \text{deg})} = 55.63$$

$$N_{\gamma,1} := 2 \cdot (N_{q,1} - 1) \cdot \tan \varphi = 63.178$$

Pamato pado posvyrio:

$$b_{q,1} := (1 - \alpha \cdot \tan \varphi)^2 = 1$$

$$b_{c,1} := b_{q,1} - \frac{(1 - b_{q,1})}{N_{c,1} \cdot \tan \varphi} = 1$$

$$b_{\gamma,1} := b_{q,1} = 1$$

Pamato pado formos:

$$s_{q,1} := 1 + \frac{B_{ef}}{L_{ef}} \cdot \sin(\varphi \cdot \text{deg}) = 1.47$$

$$s_{\gamma,1} := 1 - 0.3 \cdot \frac{B_{ef}}{L_{ef}} = 0.766$$

$$s_{c,1} := \frac{s_{q,1} \cdot N_{q,1} - 1}{N_{q,1} - 1} = 1.481$$

Apkrovos posvyrio:

$$m_L := \frac{2 + \frac{L_{ef}}{B_{ef}}}{1 + \frac{L_{ef}}{B_{ef}}} = 1.438$$

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$$m_B := \frac{2 + \frac{B_{ef}}{L_{ef}}}{1 + \frac{B_{ef}}{L_{ef}}} = 1.562$$

$$\phi := \text{atan}\left(\frac{V_{Ed,x,1}}{V_{Ed,y,1}}\right) \cdot \frac{180}{\pi} = 45$$

Horizontalios jėgos koef.:

$$V_{Ed} := \sqrt{V_{Ed,x,1}^2 + V_{Ed,y,1}^2} = 0.141$$

$$m := m_L \cdot \cos(\phi \cdot \text{deg})^2 + m_B \cdot \sin(\phi \cdot \text{deg})^2 = 1.5$$

$$i_{q,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^m = 1$$

$$i_{c,1} := i_{q,1} - \frac{1 - i_{q,1}}{N_{c,1} \cdot \tan \varphi} = 1$$

$$i_{\gamma,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^{(m+1)} = 1$$

$$R_{2,1} := c_1 \cdot N_{c,1} \cdot b_{c,1} \cdot s_{c,1} \cdot i_{c,1} + q \cdot N_{q,1} \cdot b_{q,1} \cdot s_{q,1} \cdot i_{q,1} + 0.5 \cdot \gamma_1 \cdot B \cdot N_{\gamma,1} \cdot b_{\gamma,1} \cdot s_{\gamma,1} \cdot i_{\gamma,1} = 3.897 \times 10^3$$

$$A_{2,1} := \frac{N_{Ed,1}}{R_{2,1}} = 0.596 \quad A_{ef} = 13.119 \quad \text{Gerai!}$$

$$\frac{A_{2,1}}{A_{ef}} \cdot 100 = 4.545$$

Išvada: Pagrindo išnaudojimas drenuojančiomis sąlygomis 5%, laikomoji galia pakankama.

Pagrindo nuosėdžių skaičiavimas.

Nuosėdžiai skaičiuojami sumavimo metodu.

Eil. Nr.	d, m	γ , kN/m ³	σ_{zg} , kPa	$0.2\sigma_{zg}$, kPa	z, m	$\xi=2z/b$	$\eta=l/b$	K	σ_{zp} , kPa	$\sigma_{zp,vis}$, kPa	H_i , m	E, Mpa	S_i , m
1	1.25	21.2	26.5	5.3	0	0	1.28	1	150.63		0.64		
2	1.55	21.2	32.86	6.572	0.3	0.188	1.28	0.972	146.42	148.5	0.3	150	0.0003
3	1.95	21.2	41.34	8.268	0.7	0.438	1.28	0.848	127.74	137.1	0.4	38	0.0014
4	2.45	21.2	51.94	10.39	1.2	0.75	1.28	0.682	102.73	115.2	0.5	7	0.0082
5	2.95	21.2	62.54	12.51	1.7	1.063	1.28	0.532	80.137	91.43	0.5	7	0.0065
6	3.59	21.7	76.43	15.29	2.34	1.463	1.28	0.414	62.363	71.25	0.64	19	0.0024
6	4.23	21.7	90.32	18.06	2.98	1.863	1.28	0.325	48.956	55.66	0.64	19	0.0019
6	4.87	21.7	104.2	20.84	3.62	2.263	1.28	0.26	39.165	44.06	0.64	19	0.0015
6	5.51	21.7	118.1	23.62	4.26	2.663	1.28	0.21	31.633	35.4	0.64	19	0.0012
6	6.15	21.7	132	26.4	4.9	3.063	1.28	0.173	26.06	28.85	0.64	19	0.001
													$\Sigma S_i = 0.0244$

0,2 $\sigma_{zg} > \sigma_{zp}$

Ned 2324
B 3.2
L 4.1
A 13.12

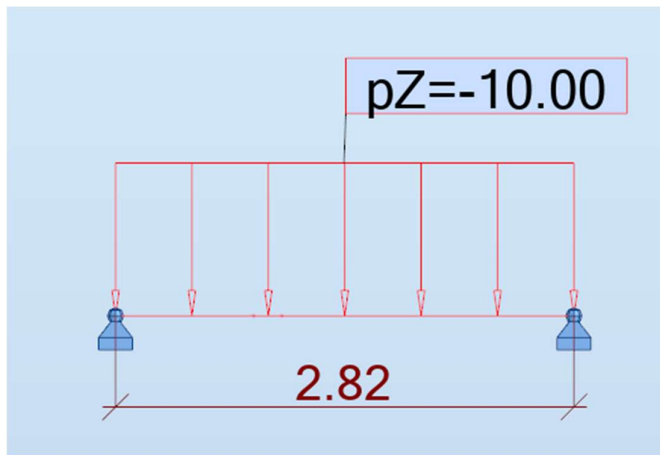
IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	19	87	0

Išvada: $2,4\text{cm} < 2,5\text{cm}$ nuosėdžiai neviršija ribinių

2.3. Metalinės sąramos skaičiavimas

Projektuojama metalinė sąrama angos įrengimui laikančioje sienoje. Skaičiuojamasis didžiausias tarpatramis $2,82\text{m}$ (mūrinės sienos dalies demontavimas priedubės įrengimui, demontuojama lifto pado pločio mūro sienos dalis, laiptų aikštelė išramstoma, jos apkrova nevertinama). Naudojamas lovinis profilis, plieno klasė S355J2.

Skaičiuojamoji schema su veikiančiomis apkrovomis:



Sąramos skaičiavimas

CODE: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 1 Simple member_1 **POINT:** 1

COORDINATE: $x = 0.36 L = 1.02\text{m}$

LOADS:

Governing Load Case: $3 \text{ ULS}/1 = 1 \cdot 1.35 + 2 \cdot 1.30 \quad 1 \cdot 1.35 + 2 \cdot 1.30$

MATERIAL:

S 355 (S 355) $f_y = 355.00 \text{ MPa}$



SECTION PARAMETERS: UPE 180

$h = 18.0 \text{ cm}$

$gM0 = 1.10$

$gM1 = 1.10$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	20	87	0

b=7.5 cm
tw=0.5 cm
tf=1.1 cm

Ay=17.68 cm²
Iy=1353.00 cm⁴
Wply=173.00 cm³

Az=11.19 cm²
Iz=144.00 cm⁴
Wplz=51.20 cm³

Ax=25.10 cm²
Ix=6.99 cm⁴

INTERNAL FORCES AND CAPACITIES:

My,Ed = 12.69 kN*m
My,pl,Rd = 55.83 kN*m
My,c,Rd = 55.83 kN*m
Mb,Rd = 44.75 kN*m

Vz,Ed = 5.33 kN
Vz,c,Rd = 208.45 kN

Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00
Lcr,upp=2.82 m

Mcr = 101.07 kN*m
Lam_LT = 0.78

Curve,LT - d
fi,LT = 0.87

XLT = 0.70
XLT,mod = 0.80

BUCKLING PARAMETERS:



About y axis:



About z axis:

VERIFICATION FORMULAS:

Section strength check:

My,Ed/My,c,Rd = 0.23 < 1.00 (6.2.5.(1))

Vz,Ed/Vz,c,Rd = 0.03 < 1.00 (6.2.6.(1))

Global stability check of member:

My,Ed/Mb,Rd = 0.28 < 1.00 (6.3.2.1.(1))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

uy = 0.0 cm < uy max = L/150.00 = 1.9 cm

Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00

uz = 0.3 cm < uz max = L/150.00 = 1.9 cm

Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00



Displacements (GLOBAL SYSTEM): Not analyzed

Section OK !!!

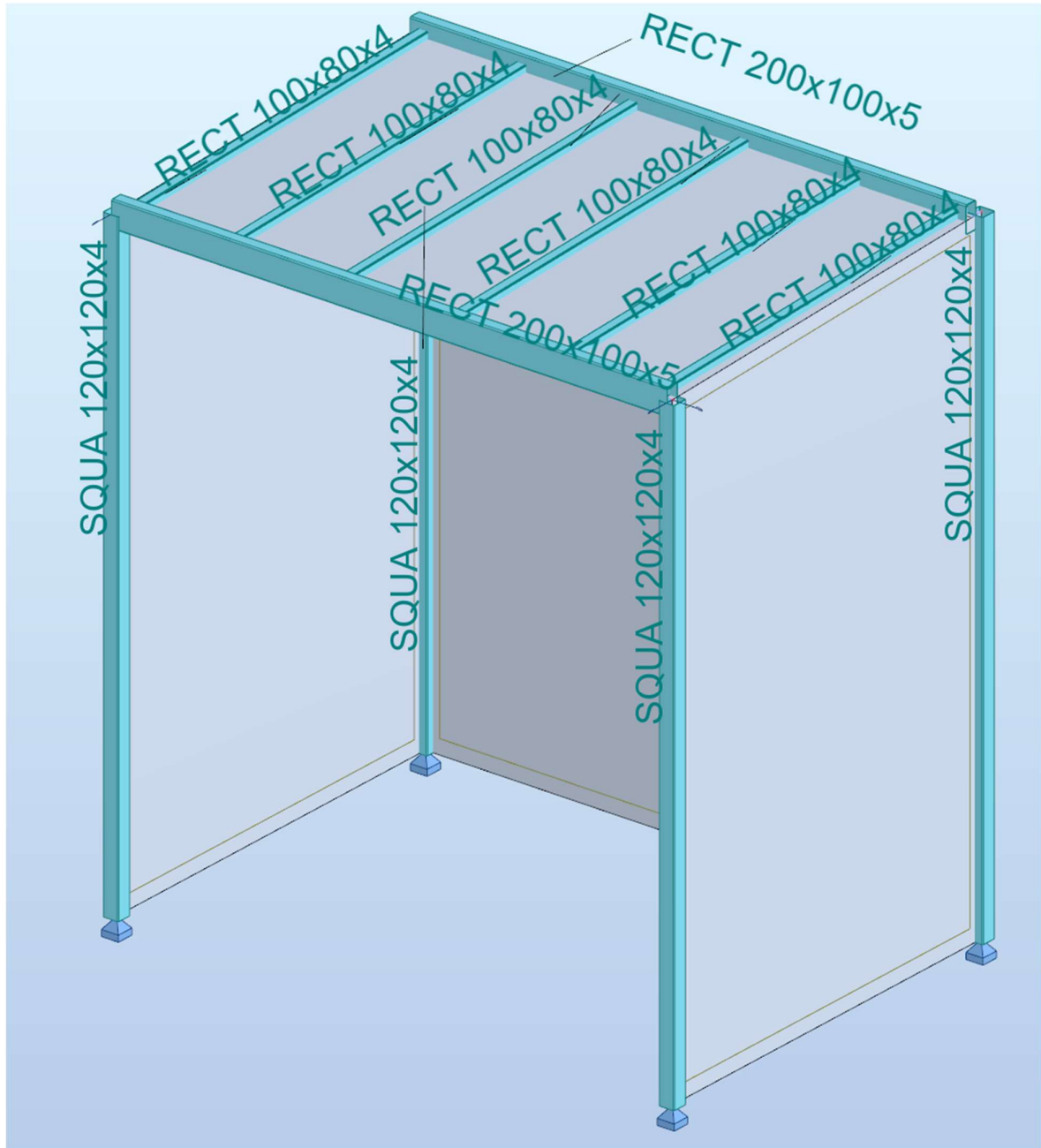
Išvada: sąlyga tenkinama

2.4. Stiklinio tamburo metalinių konstrukcijų projektavimas

Projektuojamas stiklinis tamburas iš metalinių konstrukcijų karkaso, prie kurio tvirtinama aliuminio konstrukcijų fasadinė sistema. Metalinės konstrukcijos iš dėžinio skerspjuvio profilių, viršuje tarpusavyje suvirinti, kolonų bazės lankstinės. Rėmas galuose lanksčiai tvirtinamas prie esamo pastato sienos.

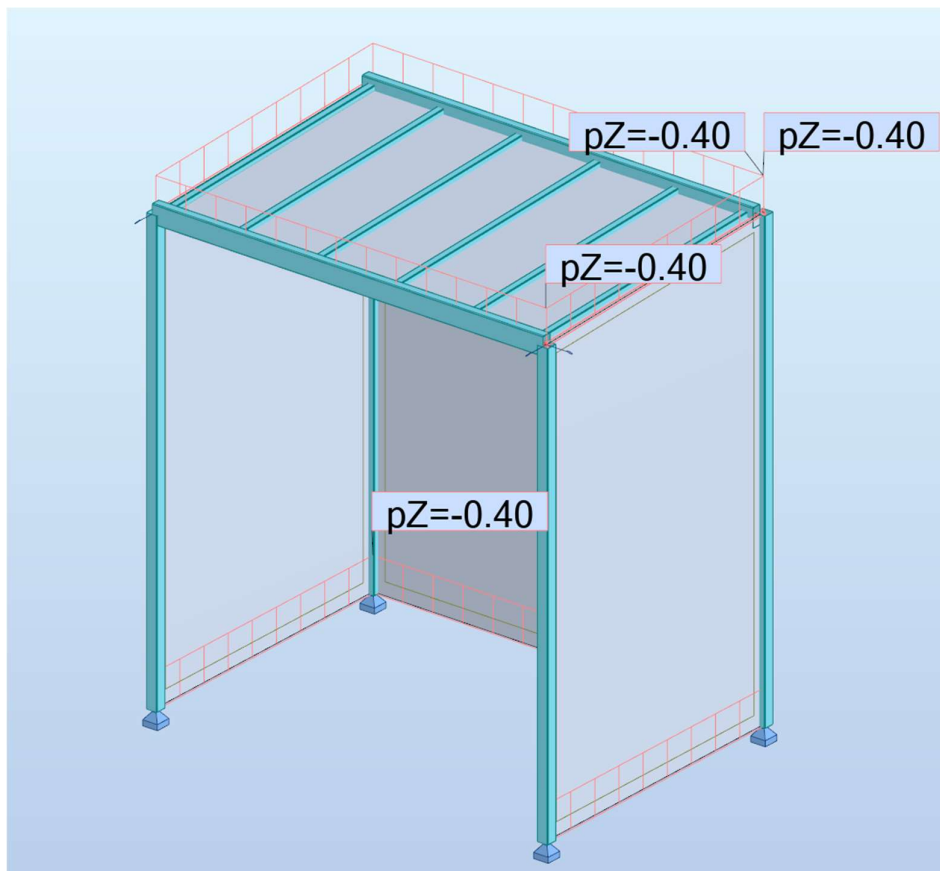
Skaičiuojamoji schema:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	21	87	0

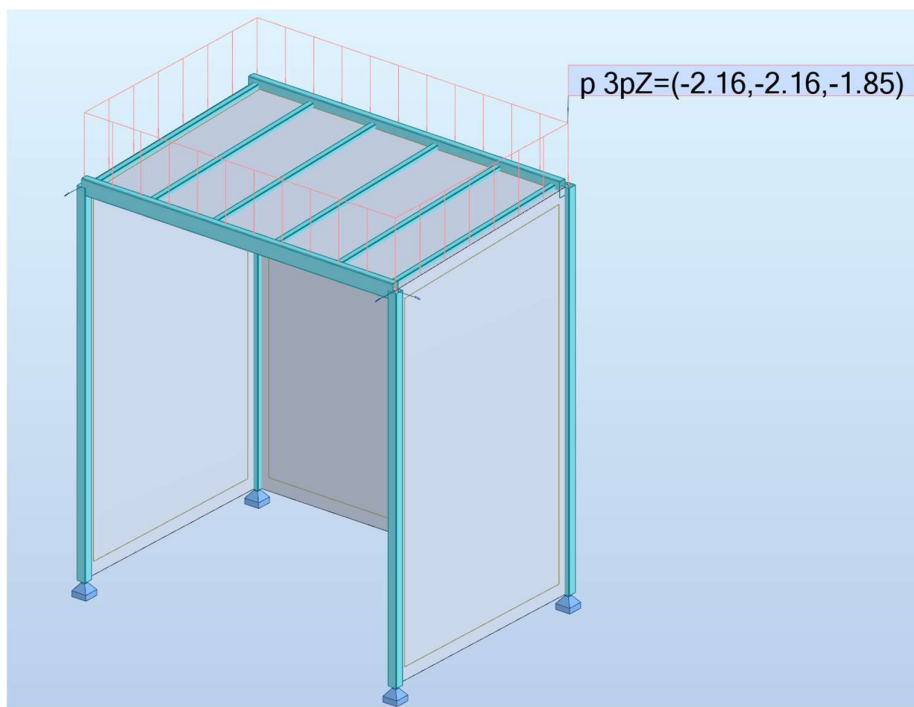


Veikiančios apkrovos:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	22	87	0

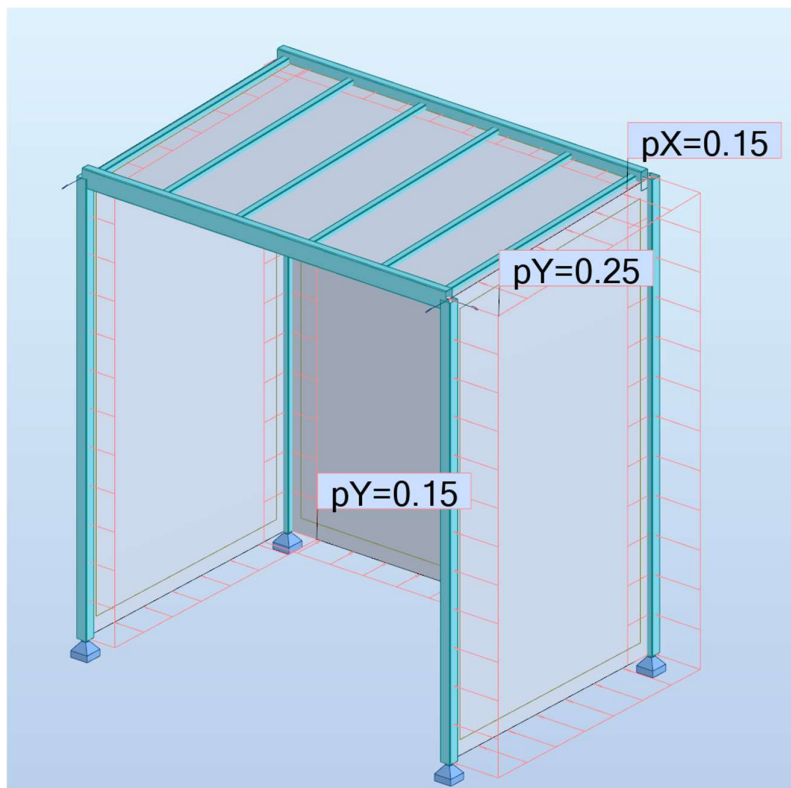


Pav. 1 Nuolatinės apkrovos

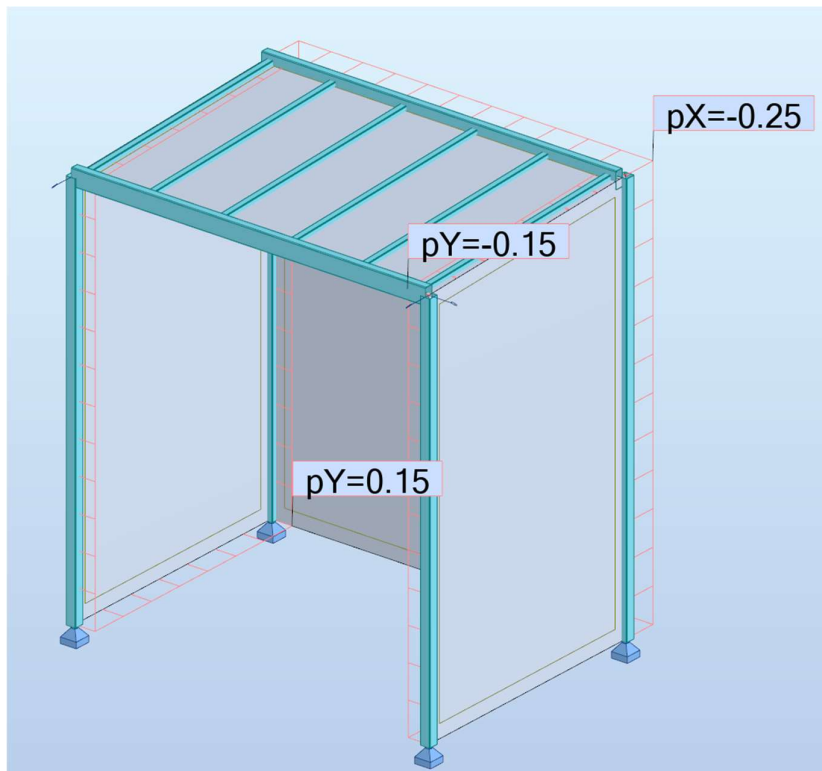


Pav. 2 Sniego apkrovos

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	23	87	0



Pav. 3 Vėjo apkrovos WIND1



Pav. 4 Vėjo apkrovos WIND2

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	24	87	0

Kolono projektavimas

CODE: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 3 Column_3
m

POINT: 2

COORDINATE: x = 0.50 L = 2.43

LOADS:

Governing Load Case: 17 ULS/13=1*1.35 + 4*0.78 + 2*1.30 1*1.35+4*0.78+2*1.30

MATERIAL:

S 355 (S 355) $f_y = 355.00$ MPa



SECTION PARAMETERS: SQUA 120x120x4

h=12.0 cm
b=12.0 cm
tw=0.4 cm
tf=0.4 cm

gM0=1.10
Ay=9.07 cm²
Iy=402.28 cm⁴
Wply=78.33 cm³

gM1=1.10
Az=9.07 cm²
Iz=402.28 cm⁴
Wplz=78.33 cm³

Ax=18.15 cm²
Ix=625.35 cm⁴

INTERNAL FORCES AND CAPACITIES:

N_{Ed} = 16.46 kN
N_{c,Rd} = 585.69 kN
N_{b,Rd} = 260.14 kN

My_{Ed} = 0.26 kN*m
My_{Ed,max} = 2.67 kN*m
My_{c,Rd} = 25.28 kN*m
MN_{y,Rd} = 25.28 kN*m

Mz_{Ed} = -1.51 kN*m
Mz_{Ed,max} = -2.07 kN*m
Mz_{c,Rd} = 25.28 kN*m
MN_{z,Rd} = 25.28 kN*m

Vy_{Ed} = 0.41 kN
Vy_{c,Rd} = 169.07 kN
Vz_{Ed} = 0.60 kN
Vz_{c,Rd} = 169.07 kN
Class of section = 1



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About y axis:

L_y = 4.85 m
L_{cr,y} = 4.85 m
L_{amy} = 103.01
L_{my} = 1.35
X_y = 0.44
k_{yy} = 0.80



About z axis:

L_z = 4.85 m
L_{cr,z} = 4.85 m
L_{amz} = 103.01
L_{mz} = 1.35
X_z = 0.44
k_{yz} = 0.49

VERIFICATION FORMULAS:

Section strength check:

N_{Ed}/N_{c,Rd} = 0.03 < 1.00 (6.2.4.(1))
My_{Ed}/MN_{y,Rd} = 0.01 < 1.00 (6.2.9.1.(2))
Mz_{Ed}/MN_{z,Rd} = 0.06 < 1.00 (6.2.9.1.(2))
(My_{Ed}/MN_{y,Rd})^{1.66} + (Mz_{Ed}/MN_{z,Rd})^{1.66} = 0.01 < 1.00 (6.2.9.1.(6))
Vy_{Ed}/Vy_{c,Rd} = 0.00 < 1.00 (6.2.6.(1))
Vz_{Ed}/Vz_{c,Rd} = 0.00 < 1.00 (6.2.6.(1))

Global stability check of member:

L_{lambda,y} = 103.01 < L_{lambda,max} = 120.00 L_{lambda,z} = 103.01 < L_{lambda,max} = 120.00 STABLE
N_{Ed}/(X_y*N_{Rk}/gM1) + k_{yy}*My_{Ed,max}/(XLT*My_{Rk}/gM1) + k_{yz}*Mz_{Ed,max}/(Mz_{Rk}/gM1) = 0.19 < 1.00 (6.3.3.(4))
N_{Ed}/(X_z*N_{Rk}/gM1) + k_{zy}*My_{Ed,max}/(XLT*My_{Rk}/gM1) + k_{zz}*Mz_{Ed,max}/(Mz_{Rk}/gM1) = 0.18 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM): Not analyzed

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	25	87	0

**Displacements (GLOBAL SYSTEM):** $v_x = 0.0 \text{ cm} < v_{x \text{ max}} = L/150.00 = 3.2 \text{ cm}$

Verified

Governing Load Case: 24 SLS:CHR/4=1*1.00 + 4*1.00 + 2*0.70 (1+4)*1.00+2*0.70 $v_y = 0.2 \text{ cm} < v_{y \text{ max}} = L/150.00 = 3.2 \text{ cm}$

Verified

Governing Load Case: 23 SLS:CHR/3=1*1.00 + 3*1.00 (1+3)*1.00**Section OK !!!****Išvada: sąlyga tenkinama****Išilginės sijos projektavimas****CODE:** EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 6 Sija1_6**POINT:** 2**COORDINATE:** x = 0.50 L = 2.14

m

LOADS:**Governing Load Case:** 17 ULS/13=1*1.35 + 4*0.78 + 2*1.30 1*1.35+4*0.78+2*1.30**MATERIAL:**S 355 (S 355) $f_y = 355.00 \text{ MPa}$ **SECTION PARAMETERS: RECT 200x100x5**

h=20.0 cm

gM0=1.10

gM1=1.10

b=10.0 cm

Ay=9.45 cm²Az=18.91 cm²Ax=28.36 cm²

tw=0.5 cm

Iy=1459.25 cm⁴Iz=496.94 cm⁴Ix=1185.78 cm⁴

tf=0.5 cm

Wply=181.37 cm³Wplz=112.09 cm³**INTERNAL FORCES AND CAPACITIES:**N_{Ed} = 0.19 kNM_{y,Ed} = 11.41 kN*mM_{z,Ed} = 0.03 kN*mV_{y,Ed} = 0.00 kNN_{c,Rd} = 915.25 kNM_{y,Ed,max} = 11.41 kN*mM_{z,Ed,max} = -0.18 kN*mV_{y,T,Rd} = 176.14 kNN_{b,Rd} = 738.10 kNM_{y,c,Rd} = 58.53 kN*mM_{z,c,Rd} = 36.17 kN*mV_{z,Ed} = -0.00 kNM_{N,y,Rd} = 58.53 kN*mM_{N,z,Rd} = 36.17 kN*mV_{z,T,Rd} = 352.27 kNM_{b,Rd} = 58.53 kN*mT_{t,Ed} = 0.00 kN*m

Class of section = 1

**LATERAL BUCKLING PARAMETERS:**

z = 1.00

M_{cr} = 3709.31 kN*m

Curve,LT - d

X_{LT} = 1.00L_{cr,upp} = 0.85 mL_{am_LT} = 0.13f_{i,LT} = 0.40X_{LT,mod} = 1.00**BUCKLING PARAMETERS:**

About y axis:

L_y = 4.28 mL_{am_y} = 0.78L_{cr,y} = 4.28 mX_y = 0.81L_{am_y} = 59.67k_{yy} = 1.00

About z axis:

L_z = 0.85 mL_{am_z} = 0.27L_{cr,z} = 0.85 mX_z = 0.99L_{am_z} = 20.31k_{yz} = 0.57**VERIFICATION FORMULAS:****Section strength check:**N_{Ed}/N_{c,Rd} = 0.00 < 1.00 (6.2.4.(1))

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	26	87	0



$$\begin{aligned} M_{y,Ed}/M_{N,y,Rd} &= 0.19 < 1.00 \quad (6.2.9.1.(2)) \\ M_{z,Ed}/M_{N,z,Rd} &= 0.00 < 1.00 \quad (6.2.9.1.(2)) \\ (M_{y,Ed}/M_{N,y,Rd})^{1.66} + (M_{z,Ed}/M_{N,z,Rd})^{1.66} &= 0.07 < 1.00 \quad (6.2.9.1.(6)) \\ V_{y,Ed}/V_{y,T,Rd} &= 0.00 < 1.00 \quad (6.2.6-7) \\ V_{z,Ed}/V_{z,T,Rd} &= 0.00 < 1.00 \quad (6.2.6-7) \\ \tau_{ty,Ed}/(\tau_y/(\sqrt{3} \cdot g_{M0})) &= 0.00 < 1.00 \quad (6.2.6) \\ \tau_{tz,Ed}/(\tau_z/(\sqrt{3} \cdot g_{M0})) &= 0.00 < 1.00 \quad (6.2.6) \end{aligned}$$

Global stability check of member:

$$\begin{aligned} \lambda_{y,Ed} &= 59.67 < \lambda_{y,max} = 150.00 \quad \lambda_{z,Ed} = 20.31 < \lambda_{z,max} = 150.00 \quad \text{STABLE} \\ M_{y,Ed,max}/M_{b,Rd} &= 0.19 < 1.00 \quad (6.3.2.1.(1)) \\ N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) &= 0.20 < 1.00 \quad (6.3.3.(4)) \\ N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(XLT \cdot M_{y,Rk}/g_{M1}) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) &= 0.13 < 1.00 \quad (6.3.3.(4)) \end{aligned}$$

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

$$\begin{aligned} u_y &= 0.0 \text{ cm} < u_{y,max} = L/700.00 = 0.6 \text{ cm} \quad \text{Verified} \\ \text{Governing Load Case: } 22 \text{ SLS:CHR/2} &= 1 \cdot 1.00 + 3 \cdot 1.00 + 2 \cdot 0.70 \quad (1+3) \cdot 1.00 + 2 \cdot 0.70 \\ u_z &= 0.5 \text{ cm} < u_{z,max} = L/700.00 = 0.6 \text{ cm} \quad \text{Verified} \\ \text{Governing Load Case: } 28 \text{ SLS:CHR/8} &= 1 \cdot 1.00 + 4 \cdot 0.60 + 2 \cdot 1.00 \quad (1+2) \cdot 1.00 + 4 \cdot 0.60 \end{aligned}$$

**Displacements (GLOBAL SYSTEM):** Not analyzed**Section OK !!!****Išvada: sąlyga tenkinama****Skersinės sijos projektavimas****CODE:** EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 13 Sija_13**POINT:** 2**COORDINATE:** x = 0.50 L = 1.50 m**LOADS:***Governing Load Case:* 16 ULS/12=1*1.35 + 3*0.78 + 2*1.30 1*1.35+3*0.78+2*1.30**MATERIAL:**S 355 (S 355) $f_y = 355.00 \text{ MPa}$ **SECTION PARAMETERS: RECT 100x80x4**

$$\begin{aligned} h &= 10.0 \text{ cm} & g_{M0} &= 1.10 & g_{M1} &= 1.10 \\ b &= 8.0 \text{ cm} & A_y &= 5.93 \text{ cm}^2 & A_z &= 7.42 \text{ cm}^2 & A_x &= 13.35 \text{ cm}^2 \\ t_w &= 0.4 \text{ cm} & I_y &= 189.47 \text{ cm}^4 & I_z &= 134.17 \text{ cm}^4 & I_x &= 248.32 \text{ cm}^4 \\ t_f &= 0.4 \text{ cm} & W_{ply} &= 45.62 \text{ cm}^3 & W_{plz} &= 39.15 \text{ cm}^3 \end{aligned}$$

INTERNAL FORCES AND CAPACITIES:

$$\begin{aligned} N_{Ed} &= -0.08 \text{ kN} & M_{y,Ed} &= 2.30 \text{ kN} \cdot \text{m} & M_{z,Ed} &= -0.00 \text{ kN} \cdot \text{m} & V_{y,Ed} &= -0.22 \text{ kN} \\ N_{t,Rd} &= 430.84 \text{ kN} & M_{y,pl,Rd} &= 14.72 \text{ kN} \cdot \text{m} & M_{z,pl,Rd} &= 12.63 \text{ kN} \cdot \text{m} & V_{y,T,Rd} &= 110.33 \text{ kN} \\ & & M_{y,c,Rd} &= 14.72 \text{ kN} \cdot \text{m} & M_{z,c,Rd} &= 12.63 \text{ kN} \cdot \text{m} & V_{z,Ed} &= 0.00 \text{ kN} \end{aligned}$$

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	27	87	0



$$\begin{aligned}
 M_{N,y,Rd} &= 14.72 \text{ kN}\cdot\text{m} & M_{N,z,Rd} &= 12.63 \text{ kN}\cdot\text{m} & V_{z,T,Rd} &= 137.91 \text{ kN} \\
 M_{b,Rd} &= 14.72 \text{ kN}\cdot\text{m} & & & T_{t,Ed} &= 0.02 \text{ kN}\cdot\text{m} \\
 & & & & \text{Class of section} &= 1
 \end{aligned}$$

**LATERAL BUCKLING PARAMETERS:**

$$z = 1.00$$

$$L_{cr,upp} = 2.99 \text{ m}$$

$$M_{cr} = 267.62 \text{ kN}\cdot\text{m}$$

$$\lambda_{m,LT} = 0.25$$

$$\text{Curve}_{LT-d}$$

$$\phi_{LT} = 0.46$$

$$X_{LT} = 1.00$$

$$X_{LT,mod} = 1.00$$

BUCKLING PARAMETERS:

About y axis:



About z axis:

VERIFICATION FORMULAS:**Section strength check:**

$$N_{Ed}/N_{t,Rd} = 0.00 < 1.00 \quad (6.2.3.(1))$$

$$M_{y,Ed}/M_{N,y,Rd} = 0.16 < 1.00 \quad (6.2.9.1.(2))$$

$$M_{z,Ed}/M_{N,z,Rd} = 0.00 < 1.00 \quad (6.2.9.1.(2))$$

$$(M_{y,Ed}/M_{N,y,Rd})^{1.66} + (M_{z,Ed}/M_{N,z,Rd})^{1.66} = 0.05 < 1.00 \quad (6.2.9.1.(6))$$

$$V_{y,Ed}/V_{y,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$V_{z,Ed}/V_{z,T,Rd} = 0.00 < 1.00 \quad (6.2.6-7)$$

$$\tau_{ty,Ed}/(\phi_y/(\sqrt{3}) \cdot g_{M0}) = 0.00 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(\phi_z/(\sqrt{3}) \cdot g_{M0}) = 0.00 < 1.00 \quad (6.2.6)$$

Global stability check of member:

$$M_{y,Ed}/M_{b,Rd} = 0.16 < 1.00 \quad (6.3.2.1.(1))$$

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

$$u_y = 0.0 \text{ cm} < u_{y,max} = L/700.00 = 0.4 \text{ cm}$$

Verified

$$\text{Governing Load Case: } 23 \text{ SLS: } CHR/3 = 1 \cdot 1.00 + 3 \cdot 1.00 \quad (1+3) \cdot 1.00$$

$$u_z = 0.4 \text{ cm} < u_{z,max} = L/700.00 = 0.4 \text{ cm}$$

Verified

$$\text{Governing Load Case: } 27 \text{ SLS: } CHR/7 = 1 \cdot 1.00 + 3 \cdot 0.60 + 2 \cdot 1.00 \quad (1+2) \cdot 1.00 + 3 \cdot 0.60$$

**Displacements (GLOBAL SYSTEM):** Not analyzed**Section OK !!!****Išvada: sąlyga tenkinama****2.5. Pamatų po nauja laiptine projektavimas**

Projektuojami poliniai pamatai po skersinėmis sienomis. Poliai 600mm skersmens, maksimalus atstumas tarp polių 1m. Poliai remiami į abs. Alt +3.5 (IGS 9), polių skaičiuotinis ilgis 7.6m (nuo esamų pamatų apačios). Mažiausias grunto kūginis stipris $q_c = 1.6 \text{ MPa}$; šoninė trintis $f_s = 19-73 \text{ kPa}$ pagal sluoksnius.

Reakcijos po sienomis pateiktos pamatų plane.

Gniuždomo poliaus po skersinėmis sienomis skaičiavimas:

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	28	87	0

**Veikiančios jėgos:**

$$N_{Ed,1} := 324 \cdot 10^{-3} = 0.324 \quad \text{MN}$$

$$N_{Ed,2} := 255 \cdot 10^{-3} = 0.255 \quad \text{MN}$$

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$$\gamma_{\varphi,1} := 1$$

$$\gamma_{c,1} := 1$$

$$\gamma_{cu,1} := 1$$

$$\gamma_{qu,1} := 1$$

$$\gamma_{\gamma,1} := 1$$

Daliniai medžiagų patikimumo koef. atvejui M2:

$$\gamma_{\varphi,2} := 1.25$$

$$\gamma_{c,2} := 1.25$$

$$\gamma_{cu,2} := 1.4$$

$$\gamma_{qu,2} := 1.4$$

$$\gamma_{\gamma,2} := 1$$

Daliniai koeficientai CFA polių pagrindo atsparumui

	R1	R2	R3	R4
Polio pado laikomoji galia	$\gamma_{b1} := 1.1$	$\gamma_{b2} := 1.1$	$\gamma_{b3} := 1.0$	$\gamma_{b4} := 1.45$
Polio kamieno šoninio paviršiaus aikomoji galia gniuždymui	$\gamma_{s1} := 1.0$	$\gamma_{s2} := 1.1$	$\gamma_{s3} := 1.0$	$\gamma_{s4} := 1.30$
Polio pado suminis atsparumas gniuždymui	$\gamma_{t1} := 1.1$	$\gamma_{t2} := 1.1$	$\gamma_{t3} := 1.0$	$\gamma_{t4} := 1.40$
Polio laikomoji galia tempimui	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$
	$\alpha_p := 0.5$			

Grunto rodikliai: $\xi_3 := 1.4$

$$\rho := 21 \frac{\text{kN}}{\text{m}^3}$$

$$q_c := 1.6 \quad \text{MPa}$$

$$f_{s1} := 0.019 \text{ MPa} \quad f_{s2} := 0.042 \text{ MPa} \quad f_{s3} := 0.073 \text{ MPa} \quad f_{s4} := 0.024 \text{ MPa} \quad f_{s5} := 0.032 \text{ MPa} \quad f_{s6} := 0.017 \text{ MPa} \quad f_{s7} := 0.035 \text{ MPa}$$

Geometriniai rodikliai: $f_{s8} := 0.0 \quad \text{MPa}$

$$h_1 := 0.3 \text{ m} \quad h_2 := 0.6 \text{ m} \quad h_3 := 0.3 \text{ m} \quad h_4 := 0.2 \text{ m} \quad h_5 := 0.4 \text{ m} \quad h_6 := 1.3 \text{ m} \quad h_7 := 4.5 \text{ m} \quad h_8 := 0.0 \text{ m}$$

$$d := 0.6 \quad \text{m}$$

$$A_p := \frac{\pi \cdot d^2}{4} = 0.283 \quad \text{m}^2$$

$$A_{s1} := \pi \cdot d \cdot h_1 = 0.565 \quad \text{m}^2$$

$$A_{s4} := \pi \cdot d \cdot h_4 = 0.377 \quad \text{m}^2$$

$$A_{s7} := \pi \cdot d \cdot h_7 = 8.482 \quad \text{m}^2$$

$$A_{s2} := \pi \cdot d \cdot h_2 = 1.131 \quad \text{m}^2$$

$$A_{s5} := \pi \cdot d \cdot h_5 = 0.754 \quad \text{m}^2$$

$$A_{s8} := \pi \cdot d \cdot h_8 = 0 \quad \text{m}^2$$

$$A_{s3} := \pi \cdot d \cdot h_3 = 0.565 \quad \text{m}^2$$

$$A_{s6} := \pi \cdot d \cdot h_6 = 2.45 \quad \text{m}^2$$

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	29	87	0

Pirmas projektavimo atvejis: A1+M1+R1

$$q_b := \alpha_b \cdot q_c = 0.8 \quad \text{MPa}$$

$$R_b := q_b \cdot A_p = 0.226 \quad \text{MN}$$

$$R_s := f_{s1} \cdot A_{s1} + f_{s2} \cdot A_{s2} + f_{s3} \cdot A_{s3} + f_{s4} \cdot A_{s4} + f_{s5} \cdot A_{s5} + f_{s6} \cdot A_{s6} + f_{s7} \cdot A_{s7} + f_{s8} \cdot A_{s8} = 0.471$$

$$R_{c,cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.677 \quad \text{MN}$$

$$R_{c,k1} := \frac{R_{c,cal1}}{\xi_3} = 0.483 \quad \text{MN}$$

$$R_{c,d1} := \frac{R_{c,k1}}{\gamma_{t1}} = 0.44 \quad \text{MN}$$

$$\frac{N_{Ed,1}}{R_{c,d1}} = 0.737$$

Antras projektavimo atvejis: A2+M1+R4

$$R_{c,cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.518 \quad \text{MN}$$

$$R_{c,k2} := \frac{R_{c,cal2}}{\xi_3} = 0.37 \quad \text{MN}$$

$$R_{c,d2} := \frac{R_{c,k2}}{\gamma_{t4}} = 0.265 \quad \text{MN}$$

$$\frac{N_{Ed,2}}{R_{c,d2}} = 0.964$$

Išvada: pavojingiausias polių projektavimo atvejis antras. Gniuždomo poliaus išnaudojimas 0,96. Polių laikomoji galia pakankama

Projektuojami poliniai pamatai po išilgine siena. Poliai 400mm skersmens, maksimalus atstumas tarp polių 1,2 m. Poliai remiami į abs. Alt +7.0 (IGS 9), polių skaičiuotinis ilgis 4,1m (nuo esamų pamatų apačios). Mažiausias grunto kūginis stipris $q_c=1.6\text{MPa}$; šoninė trintis $f_s=19-73 \text{ kPa}$ pagal sluoksnius.

Reakcijos po sienomis pateiktos pamatų plane.

Gniuždomo poliaus po išilgine siena skaičiavimas:

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	30	87	0

**Veikiančios įrašos:**

$$N_{Ed,1} := 114 \cdot 10^{-3} = 0.114 \quad \text{MN}$$

$$N_{Ed,2} := 86 \cdot 10^{-3} = 0.086 \quad \text{MN}$$

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$$\gamma_{p,1} := 1$$

$$\gamma_{c,1} := 1$$

$$\gamma_{ex,1} := 1$$

$$\gamma_{qu,1} := 1$$

$$\gamma_{\gamma,1} := 1$$

Daliniai medžiagų patikimumo koef. atvejui M2:

$$\gamma_{p,2} := 1.25$$

$$\gamma_{c,2} := 1.25$$

$$\gamma_{ex,2} := 1.4$$

$$\gamma_{qu,2} := 1.4$$

$$\gamma_{\gamma,2} := 1$$

Daliniai koeficientai CFA polių pagrindo atsparumui

	R1	R2	R3	R4
Polio pado laikomoji galia	$\gamma_{b1} := 1.1$	$\gamma_{b2} := 1.1$	$\gamma_{b3} := 1.0$	$\gamma_{b4} := 1.45$
Polio kamieno šoninio paviršiaus alikomoji galia gniuždymui	$\gamma_{s1} := 1.0$	$\gamma_{s2} := 1.1$	$\gamma_{s3} := 1.0$	$\gamma_{s4} := 1.30$
Polio pado suminis atsparumas gniuždymui	$\gamma_{t1} := 1.1$	$\gamma_{t2} := 1.1$	$\gamma_{t3} := 1.0$	$\gamma_{t4} := 1.40$
Polio laikomoji galia tempimui	$\gamma_{st1} := 1.25$	$\gamma_{st2} := 1.15$	$\gamma_{st3} := 1.1$	$\gamma_{st4} := 1.60$
	$\alpha_b := 0.5$			

Grunto rodikliai: $\xi_3 := 1.4$

$$\rho := 21 \frac{\text{kN}}{\text{m}^3}$$

$$q_c := 1.6 \quad \text{MPa}$$

$$f_{s1} := 0.019 \text{ MPa} \quad f_{s2} := 0.042 \text{ MPa} \quad f_{s3} := 0.073 \text{ MPa} \quad f_{s4} := 0.024 \text{ MPa} \quad f_{s5} := 0.032 \text{ MPa} \quad f_{s6} := 0.017 \text{ MPa} \quad f_{s7} := 0.035 \text{ MPa}$$

Geometriniai rodikliai: $f_{s8} := 0.0 \text{ MPa}$

$$h_1 := 0.3 \text{ m} \quad h_2 := 0.6 \text{ m} \quad h_3 := 0.3 \text{ m} \quad h_4 := 0.2 \text{ m} \quad h_5 := 0.4 \text{ m} \quad h_6 := 1.3 \text{ m} \quad h_7 := 1 \text{ m} \quad h_8 := 0.0 \text{ m}$$

$$d := 0.4 \text{ m}$$

$$A_p := \frac{\pi \cdot d^2}{4} = 0.126 \quad \text{m}^2$$

$$A_{s1} := \pi \cdot d \cdot h_1 = 0.377 \quad \text{m}^2$$

$$A_{s4} := \pi \cdot d \cdot h_4 = 0.251 \quad \text{m}^2$$

$$A_{s7} := \pi \cdot d \cdot h_7 = 1.257 \quad \text{m}^2$$

$$A_{s2} := \pi \cdot d \cdot h_2 = 0.754 \quad \text{m}^2$$

$$A_{s5} := \pi \cdot d \cdot h_5 = 0.503 \quad \text{m}^2$$

$$A_{s8} := \pi \cdot d \cdot h_8 = 0 \quad \text{m}^2$$

$$A_{s3} := \pi \cdot d \cdot h_3 = 0.377 \quad \text{m}^2$$

$$A_{s6} := \pi \cdot d \cdot h_6 = 1.634 \quad \text{m}^2$$

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	31	87	0

Pirmas projektavimo atvejis: A1+M1+R1

$$q_b := \alpha_b \cdot q_c = 0.8 \quad \text{MPa}$$

$$R_b := q_b \cdot A_p = 0.101 \quad \text{MN}$$

$$R_s := f_{s1} \cdot A_{s1} + f_{s2} \cdot A_{s2} + f_{s3} \cdot A_{s3} + f_{s4} \cdot A_{s4} + f_{s5} \cdot A_{s5} + f_{s6} \cdot A_{s6} + f_{s7} \cdot A_{s7} + f_{s8} \cdot A_{s8} = 0.16$$

$$R_{c,cal1} := \frac{R_b}{\gamma_{b1}} + \frac{R_s}{\gamma_{s1}} = 0.252 \quad \text{MN}$$

$$R_{c,k1} := \frac{R_{c,cal1}}{\xi_3} = 0.18 \quad \text{MN}$$

$$R_{c,d1} := \frac{R_{c,k1}}{\gamma_{t1}} = 0.163 \quad \text{MN}$$

$$\frac{N_{Ed,1}}{R_{c,d1}} = 0.698$$

Antras projektavimo atvejis: A2+M1+R4

$$R_{c,cal2} := \frac{R_b}{\gamma_{b4}} + \frac{R_s}{\gamma_{s4}} = 0.193 \quad \text{MN}$$

$$R_{c,k2} := \frac{R_{c,cal2}}{\xi_3} = 0.138 \quad \text{MN}$$

$$R_{c,d2} := \frac{R_{c,k2}}{\gamma_{t4}} = 0.098 \quad \text{MN}$$

$$\frac{N_{Ed,2}}{R_{c,d2}} = 0.875$$

Išvada: pavojingiausias polių projektavimo atvejis antras. Gniuždomo poliaus išnaudojimas 0,87. Polių laikomoji galia pakankama.

2.6. Esamų konstrukcijų laikomosios galios tikrinimas

2.6.1. Esamų kolonų, perdangų ir rygelių vertinimas

Palėpėje vėdinimo įrenginys atremiamas per metalinį rėmą tiesiai į vidines kolonas. Į palėpės perdangas ir rygelius naujos apkrovos nepersiduoda, naudojimo paskirtis nekeičiama, tūrio ir planiniai sprendiniai nekeičiami, statinio tyrimo metu konstrukcijose deformacijų ir defektų neaptikta, todėl jų laikomoji galia nenagrinėjama.

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	32	87	0

Esamų trumpinamų perdangų tarp ašių A-B ir 8.1-9 tikrinimas

Keičiami tūrio ir planiniai preidiniai prie naujo lifto įrengimo, todėl tikrinamos esamos trumpinamos perdangos tarp ašių A-B ir 8.1-9.

Buvusios perdangos 6 m ilgio. Priimama mažiausia galima perdangos skaičiuojamoji laikomoji galia 780 kg/m^2 (450 kg/m^2 be perdangos savojo svorio) pagal perdangos markę PK59-16.

Tikrinama nupjautos esamos perdangos laikomoji galia veikiant apkrovoms po rekonstrukcijos.

Veikiančios apkrovos po rekonstrukcijos (žr. AR 1.4 lentelę):

Nuolatinė apkrova po rekonstrukcijos: $1,69 \cdot 1,35 = 2,28 \text{ kPa}$

Nudėjimo apkrova po rekonstrukcijos koridoriuose: $5,0 \cdot 1,3 = 6,5 \text{ kPa}$

Bendra skaičiuotinė apkrova po rekonstrukcijos q_2 : $2,28 + 6,5 = 8,78 \text{ kPa}$.

Buvusios 6 m ilgio perdangos skaičiuojamasis laikomasis momentas:

$$M_{rd,1} = \frac{q_1 \cdot l^2}{8} = \frac{4,5 \cdot 6^2}{8} = 20,25 \text{ kNm}.$$

Nupjautos ilgesnės perdangos dalies skaičiuojamasis momentas veikiant apkrovoms po rekonstrukcijos:

$$M_{rd,2} = \frac{q_2 \cdot l^2}{8} = \frac{8,78 \cdot 2,46^2}{8} = 6,64 \text{ kNm}.$$

Išvada: $M_{rd,1} = 20,25 \text{ kNm} > M_{rd,2} = 6,64 \text{ kNm}$. Sąlyga tenkinama. Esamos nupjautos perdangos laikomoji galia pakankama.

Esamų klasių perdangų tikrinimas

Esamos perdangos 6 m ilgio. Priimama perdangos skaičiuojamoji laikomoji galia pagal apkrovas veikiančias iki rekonstrukcijos.

Veikiančios apkrovos iki rekonstrukcijos (žr. AR 1.3 lentelę):

Nuolatinė apkrova iki rekonstrukcijos: $1,49 \cdot 1,2 = 1,79 \text{ kPa}$

Nudėjimo apkrova iki rekonstrukcijos klasėse: $3,0 \cdot 1,3 = 3,9 \text{ kPa}$

Bendra skaičiuotinė apkrova iki rekonstrukcijos: $1,79 + 3,9 = 5,69 \text{ kPa}$.

Perdnagos skaičiuotinė laikomoji galia 1125 kg/m^2 (795 kg/m^2 be perdangos savojo svorio) pagal perdangos markę PTK59-12.

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	33	87	0

Tikrinama nupjautos esamos perdangos laikomoji galia veikiant apkrovoms po rekonstrukcijos.

Veikiančios apkrovos po rekonstrukcijos (žr. AR 1.4 lentelę):

Nuolatinė apkrova po rekonstrukcijos: $1,49 \cdot 1,35 = 2,01 \text{ kPa}$

Nudėjimo apkrova po rekonstrukcijos koridoriuose: $3,0 \cdot 1,3 = 3,9 \text{ kPa}$

Bendra skaičiuotinė apkrova po rekonstrukcijos: $2,01 + 3,9 = 5,91 \text{ kPa}$.

Išvada: $5,91 \text{ kPa} < 7,95 \text{ kPa}$ perdangos laikomoji galia pakankama, tačiau DP metu numatomas klasės perdangos laikomosios galios vertinimas ir esant neatitikimams numatomas perdangų stiprinimas.

Esamų holo ir koridoriaus perdangų tikrinimas

Esamos perdangos 2,4 m ilgio. Priimama mažiausia galima perdangos skaičiuojamoji laikomoji galia 1125 kg/m^2 (795 kg/m^2 be perdangos savojo svorio) pagal perdangos markę PTK24-12.

Tikrinama nupjautos esamos perdangos laikomoji galia veikiant apkrovoms po rekonstrukcijos.

Veikiančios apkrovos po rekonstrukcijos (žr. AR 1.4 lentelę):

Nuolatinė apkrova po rekonstrukcijos: $1,49 \cdot 1,35 = 2,01 \text{ kPa}$

Nudėjimo apkrova po rekonstrukcijos koridoriuose: $5,0 \cdot 1,3 = 6,5 \text{ kPa}$

Bendra skaičiuotinė apkrova po rekonstrukcijos: $2,01 + 6,5 = 8,51 \text{ kPa}$.

$8,78 \text{ kPa} > 7,95 \text{ kPa}$ projektuojama apkrova didesnė už priimtą perdangos laikomąją galią, numatomas perdangos stiprinimas anglies pluošto juostomis.

Lenkimo momentas, kurį gali atlaikyti PTK24-12 perdanga:

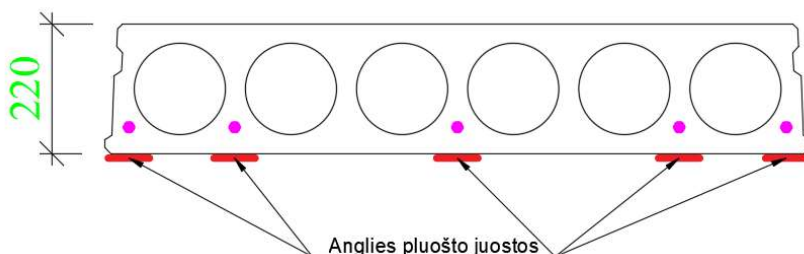
$$M_0 = \frac{q \cdot l^2}{8} = \frac{11,25 \cdot 2,4^2}{8} = 8,01 \text{ kNm}.$$

Skaičiuojamas perdangą veikiantis momentas, kurį turi atlaikyti sustiprinta perdanga:

$$M_1 = \frac{q \cdot l^2}{8} = \frac{(8,51 + 3,0 \cdot 1,35) \cdot 2,4^2}{8} = 9,04 \text{ kNm}.$$

Principinė anglies pluošto juostų išdėstymo schema:

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	34	87	0



Išvada: $8,78\text{kPa} > 7,95\text{kPa}$ perdangos laikomoji galia viršija priimtą, todėl numatomas perdangos stiprinimas anglies pluošto juostomis. Skaičiuotinis momentas, kurį turi atlaikyti perdanga $9,04\text{ kNm}$. Juostos išdėstomos po armatūros strypais. Juostos padengiamos ugniai atspariu mišiniu, užtikrinančiu R45 atsparumą ugniai. DP metu numatomas koridoriaus perdangos laikomosios galios vertinimas ir pagal gamintojo skaičiavimus tikslinamas stiprinimo sprendinys.

Vidinės mūrinės kolonos tikrinimas

Tikrinamas vidinės mūrinės kolonos liaunis pusrūsio aukšte. Kolonos aukštis $3,87\text{m}$, mažiausios kolonos skerspjūvis $720 \times 630\text{mm}$.

STULPŲ AUKŠČIO IR STORIO LEISTINIEJI SANTYKIAI

Stulpo aukštis:

$$l_p = 3.87 \quad \text{m}$$

Stulpo storis:

$$h_p = 0.72 \quad \text{m}$$

Stulpo plotis:

$$b_p = 0.63 \quad \text{m}$$

Stulpo aukščio ir storio santykis:

$$\beta_p = \frac{l_p}{h_p} = 5.375$$

Koeficientas iš 31 lentelės

$$k_p = 0.6$$

Leistina stulpo santykio reikšmė:

$$\beta_{p,leist} = 22 \cdot k_p = 13.2$$

$$\beta_p < \beta_{p,leist}$$

$$\text{if}(\beta_p < \beta_{p,leist}, \text{concat}("TINKA"), \text{concat}("NETINKA")) = "TINKA"$$

Išvada: Kolonos aukščio ir storio santykis tinkamas

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	35	87	0

Tikrinamas vidinės mūrinės armuotos kolonos atsparumas gniuždymui apatiniame pjūvyje ties pamatu. Vertinamas veikiantis momentas nuo didžiausio tarpatramių skirtumo:

Veikiantis momentas iš 5,66m tarpatramio pusės:

$$M_{e1} = F_1 \cdot e = 681 \cdot 0,59 = 402 \text{ kNm}.$$

Veikiantis momentas iš 5,36m tarpatramio pusės:

$$M_{e2} = F_2 \cdot e = 646 \cdot 0,59 = 381 \text{ kNm};$$

Koloną veikiantis momentas nuo tarpatramių skirtumo:

$$M = M_1 - M_2 = 402 - 381 = 21 \text{ kNm}.$$

Veikianti ašinė jėga:

$$N_{ed} = F_1 + F_2 + F_{g \text{ kolonos}} = 681 + 646 + 299,7 = 1626 \text{ kN}.$$

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	36	87	0

Ekscentriškai gniuždoma mūrinė siena

Kolonos aukštis

$$l := 3.87 \quad \text{m}$$

Kolonos plotis

$$l_{0s} := 0.72 \quad \text{m}$$

Kolonos storis

$$h := 0.63 \quad \text{m}$$

$$y := \frac{h}{2} = 0.315 \quad \text{m}$$

Veikianti ašinė jėga

$$N_{ed} := 1626 \quad \text{kN}$$

Veikiantis lenkimo momentas

$$M := 78 \quad \text{kNm}$$

Jėgos pridėjimo ekscentricitetas

$$e_0 := \frac{M}{N_{ed}} = 0.048 \quad \text{m}$$

Kai $e_0 < 0.7y$ plyšių atsivėrimo mūro siūlėse tikrinti nereikia

Skaičiuojamasis elemento aukštis

$$l_0 := l = 3.87 \quad \text{m}$$

Santykis

$$\lambda_h := \frac{l_0}{h} = 6.143$$

Klumpo koeficientas iš 19 lentelės

$$\varphi := 0.95$$

Gniuždomos zonos aukštis

$$h_c := h - 2 \cdot e_0 = 0.534$$

Gniuždomos zonos santykis

$$\lambda_{hc} := \frac{1}{h_c} = 7.246$$

Gniuždomos zonos klumpo koeficientas iš 19 lentelės

$$\varphi_c := 0.92$$

$$\varphi_1 := \frac{\varphi + \varphi_c}{2} = 0.935$$

Elemento skerspjūvio plotas

Arm atūros charakteristikos

$$f_{yk} := 275 \quad \text{MPa}$$

$$f_{yd} := \frac{f_{yk}}{1.15} = 239.13 \quad \text{MPa}$$

Arm atūros d5 skerspjūvio plotas

$$A_{st} := 0.196 \cdot 10^{-4} \quad \text{m}^2$$

Atstumas tarp tinklų

$$a_1 := 0.120 \quad \text{m}$$

Tinklelio akis

$$a := 0.05 \quad \text{m}$$

Mūro charakteristikos

Mūro tamprumo charakteristika (iš 16 lentelės)

$$\alpha := 750$$

Skaičiuojamasis mūro gniuždomasis stipris

$$f_d := 3.7 \quad \text{MPa}$$

Armavimo koeficientas, kai armuojama tinkleliu

$$\rho_w := \frac{2 \cdot A_{st}}{a \cdot a_1} \cdot 100 = 0.653 \quad \%$$

$$\rho_{wmax} := \frac{50 \cdot f_d}{\left(1 - \frac{2 \cdot e_0}{y}\right) \cdot f_{yd}} = 1.112 \quad \%$$

$$\text{if}(\rho_w < \rho_{wmax}, "TINKA", "NETINKA") = "TINKA"$$

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	37	87	0

$$A_w := h \cdot l_{0s} = 0.454 \quad \text{m}^2$$

$$A_c := A \cdot \left(1 - \frac{2 \cdot e_0}{5}\right) = 0.277$$

$$m_{lt} := 1 \quad \text{kai } h \geq 300 \text{ mm}$$

$$\omega := 1 + \frac{e_0}{h} = 1.076 \quad \text{iš 20 lentelės}$$

Ekscentriškai gniuždomo armuoto mūro skaičiuojamasis gniuždomasis stipris

$$f_{skd} := f_d + \frac{2 \cdot \rho_w \cdot f_{yd}}{100} \cdot \left(1 - \frac{2 \cdot e_0}{y}\right) = 5.873 \quad \text{MPa}$$

$$N_{Rd} := m_{lt} \cdot \varphi_1 \cdot f_{skd} \cdot A_c \cdot \omega \cdot 10^3 = 1.634 \times 10^3 \quad \text{kN}$$

$$\frac{N_{ed}}{N_{Rd}} = 0.995$$

Išvada: sąlyga tenkinama. DP metu atidengti kolonos siūlės ir nustatyti siūlių armavimą, atlikti mūro plytų kolonoje laikomosios galios patikrą. Jeigu pamatuotas mūro skaičiuojamasis stipris bus mažesnis už priimtą skaičiavimuose DP metu numatyti stiprinimą metaliniais kampuočiais.

2.6.2. Esamo medinio stogo konstrukcijų tikrinimas

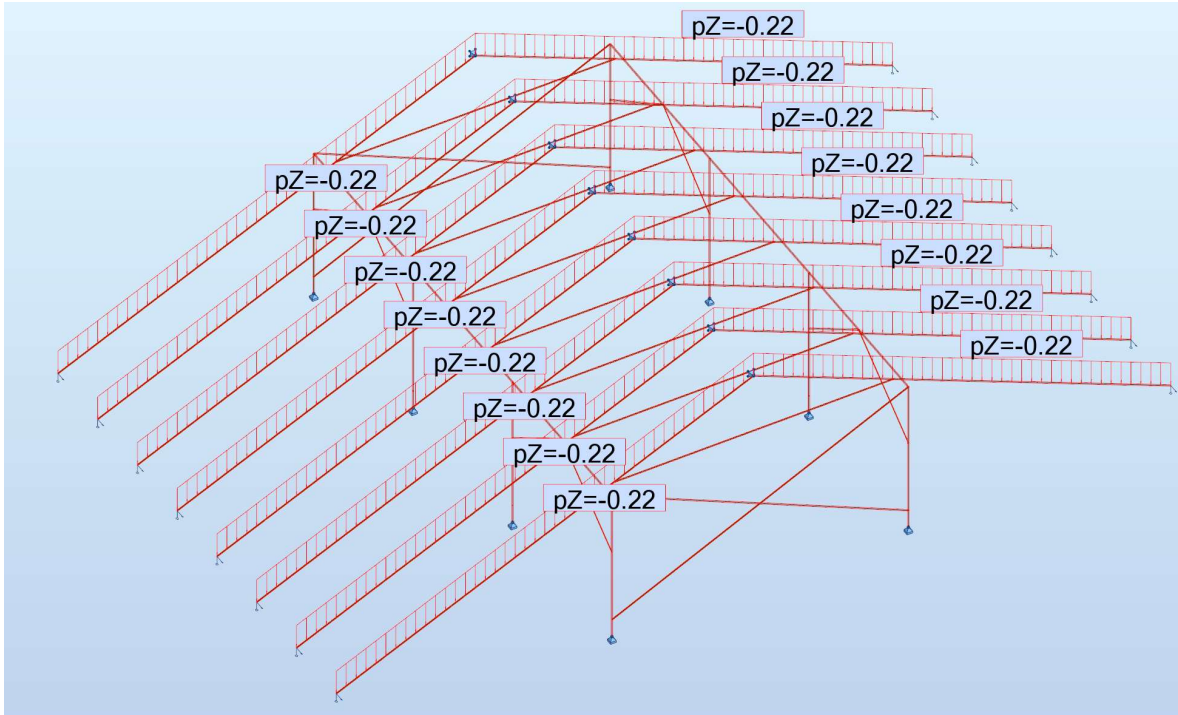
Kadangi numatomas dalies stogo demontavimas, kad įkelti ŠVOK įrenginį, tikrinama esamų stogo konstrukcijų laikomoji galia.

Gegnės galuose remiasi į išorines sienas ir turi tarpinę atramą ant išilginių rėmų, apjungtų tarpusavyje vertikaliais ryšiais kas ketvirtą koloną. Gegnės apjungtos styga. Elementų skerspjuviai išmatuoti vietoje. Gegnių žingsnis 1,2m, kolonų žingsnis išilgai sijos 3m. Priimama mažiausia medienos klasė C18.

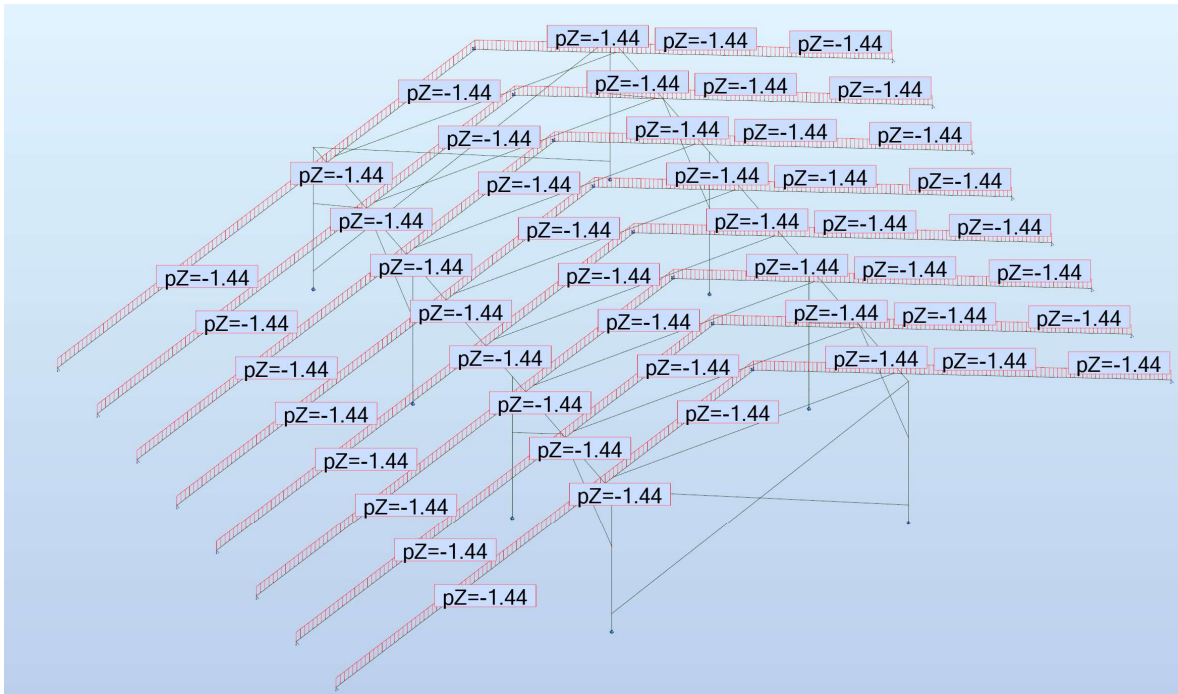
Skaičiuojamoji schema su veikiančiomis apkrovomis:

Charaktristinė nuolatinė apkrova:

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	38	87	0



Charakteristinė sniego apkrova:



Gegnės tikrinimas

CODE: EN 1995-1:2004/A2:2014
ANALYSIS TYPE: Member Verification

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	39	87	0

**CODE GROUP:****MEMBER:** 26**POINT:** 3**COORDINATE:** x = 0.36 L = 2.779889393 m**LOADS:**

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30

MATERIAL C18

gM = 1.30

f m,0,k = 18.00 MPa

f t,0,k = 11.00 MPa

f c,0,k = 18.00 MPa

f v,k = 3.40 MPa

f t,90,k = 0.40 MPa

f c,90,k = 2.20 MPa

E 0,moyen = 9000.00 MPa

E 0,05 = 6000.00 MPa

G moyen = 560.00 MPa

Service class: 1

Beta c = 0.20

**SECTION PARAMETERS: RECT_170x60**

ht=6.0 cm

bf=17.0 cm

tw=3.0 cm

tf=3.0 cm

Ay=68.00 cm²Iy=306.00 cm⁴Wy=102.00 cm³Az=68.00 cm²Iz=2456.50 cm⁴Wz=289.00 cm³Ax=102.00 cm²Ix=-7713.4 cm⁴**STRESSES**

Sig_c,0,d = N/Ax = 1.67/102.00 = 0.16 MPa

Sig_m,y,d = MY/Wy = 0.20/102.00 = 2.00 MPa

Sig_m,z,d = MZ/Wz = 4.85/289.00 = 16.79 MPa

Tau y,d = 1.5*-6.11/102.00 = -0.90 MPa

Tau z,d = 1.5*0.10/102.00 = 0.01 MPa

Tau tory,d = 0.20 MPa, Tau torz,d = 0.15 MPa

ALLOWABLE STRESSES

f c,0,d = 11.08 MPa

f m,y,d = 13.30 MPa

f m,z,d = 11.08 MPa

f v,d = 2.09 MPa

Factors and additional parameters

km = 0.70

kh = 1.20

kmod = 0.80

Ksys = 1.00

kcr = 0.67

**LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:

LY = 0.100000000 m

Lambda Y = 5.77

Lambda_rel Y = 0.10

ky = 0.49

LFY = 0.100000000 m

key = 1.00



About Z axis:

LZ = 2.500000000 m

Lambda Z = 50.94

Lambda_rel Z = 0.89

kz = 0.95

LFZ = 2.500000000 m

kecz = 0.77

VERIFICATION FORMULAS:

Sig_c,0,d/(kc,z*f c,0,d) + km*Sig_m,y,d/f m,y,d + Sig_m,z,d/f m,z,d = 1.64 > 1.00 (6.24)

(Tau y,d/kcr+Tau tory,d/kshape)/f v,d = 0.73 < 1.00 (Tau z,d/kcr+Tau torz,d/kshape)/f v,d = 0.07 < 1.00 (6.13-4)

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

u fin,y = 4.0 cm > u fin,max,y = L/200.00 = 3.9 cm

Not Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2

u fin,z = 0.5 cm < u fin,max,z = L/200.00 = 3.9 cm

Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2

**Displacements (GLOBAL SYSTEM):****Section incorrect !!!**

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	40	87	0

Išvada: sąlyga netenkinama. Reikalingas gegnių stiprinimas

Kolonų tikrinimas

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 22

POINT: 1

COORDINATE: x = 0.40 L = 1.098395700 m

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30

MATERIAL C18

$g_m = 1.30$

$f_{v,k} = 3.40 \text{ MPa}$

$E_{0,05} = 6000.00 \text{ MPa}$

$f_{m,0,k} = 18.00 \text{ MPa}$

$f_{t,90,k} = 0.40 \text{ MPa}$

$G_{moyen} = 560.00 \text{ MPa}$

$f_{t,0,k} = 11.00 \text{ MPa}$

$f_{c,90,k} = 2.20 \text{ MPa}$

Service class: 1

$f_{c,0,k} = 18.00 \text{ MPa}$

$E_{0,moyen} = 9000.00 \text{ MPa}$

Beta c = 0.20



SECTION PARAMETERS: RECT_100x100

ht=10.0 cm

bf=10.0 cm

tw=5.0 cm

tf=5.0 cm

$A_y = 66.67 \text{ cm}^2$

$I_y = 833.33 \text{ cm}^4$

$W_y = 166.67 \text{ cm}^3$

$A_z = 66.67 \text{ cm}^2$

$I_z = 833.33 \text{ cm}^4$

$W_z = 166.67 \text{ cm}^3$

$A_x = 100.00 \text{ cm}^2$

$I_x = 1233.3 \text{ cm}^4$

STRESSES

$\text{Sig}_{c,0,d} = N/A_x = 35.79/100.00 = 3.58 \text{ MPa}$

$\text{Sig}_{m,y,d} = MY/W_y = 1.23/166.67 = 7.36 \text{ MPa}$

$\text{Sig}_{m,z,d} = MZ/W_z = 0.00/166.67 = 0.00 \text{ MPa}$

$\text{Tau}_{y,d} = 1.5 \cdot 0.00/100.00 = -0.00 \text{ MPa}$

$\text{Tau}_{z,d} = 1.5 \cdot 0.74/100.00 = 0.11 \text{ MPa}$

ALLOWABLE STRESSES

$f_{c,0,d} = 11.08 \text{ MPa}$

$f_{m,y,d} = 12.01 \text{ MPa}$

$f_{m,z,d} = 12.01 \text{ MPa}$

$f_{v,d} = 2.09 \text{ MPa}$

Factors and additional parameters

$k_m = 0.70$

$k_h = 1.08$

$k_{mod} = 0.80$

$K_{sys} = 1.00$

$k_{cr} = 0.67$



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About Y axis:

$L_Y = 2.750000000 \text{ m}$

$\text{Lambda}_{rel Y} = 1.66$

$\text{LFY} = 2.750000000 \text{ m}$

$\text{Lambda Y} = 95.26$

$k_y = 2.02$

$k_{cy} = 0.32$



About Z axis:

$L_Z = 2.750000000 \text{ m}$

$\text{Lambda}_{rel Z} = 1.66$

$\text{LFZ} = 2.750000000 \text{ m}$

$\text{Lambda Z} = 95.26$

$k_z = 2.02$

$k_{cz} = 0.32$

VERIFICATION FORMULAS:

$(\text{Sig}_{c,0,d}/k_{cy} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 1.63 > 1.00 \quad (6.23)$

$(\text{Tau}_{y,d}/k_{cr})/f_{v,d} = (0.00/0.67)/2.09 = 0.00 < 1.00 \quad (\text{Tau}_{z,d}/k_{cr})/f_{v,d} = (0.11/0.67)/2.09 = 0.08 < 1.00 \quad (6.13)$

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 1.8 \text{ cm}$

Governing load case: $(1+0.6) \cdot 1 + (1+0.2 \cdot 0.6) \cdot 2$

$u_{fin,z} = 0.9 \text{ cm} < u_{fin,max,z} = L/150.00 = 1.8 \text{ cm}$

Verified

Verified

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	41	87	0



Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$



Displacements (GLOBAL SYSTEM):

Section incorrect !!!

Išvada: sąlyga netenkinama. Reikalingas kolonų stiprinimas

Išilginių sijų tikrinimas

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 61

POINT: 3

COORDINATE: $x = 0.33 L = 3.000000006 \text{ m}$

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30

MATERIAL C18

$g_M = 1.30$

$f_{m,0,k} = 18.00 \text{ MPa}$

$f_{t,0,k} = 11.00 \text{ MPa}$

$f_{c,0,k} = 18.00 \text{ MPa}$

$f_{v,k} = 3.40 \text{ MPa}$

$f_{t,90,k} = 0.40 \text{ MPa}$

$f_{c,90,k} = 2.20 \text{ MPa}$

$E_{0,moyen} = 9000.00 \text{ MPa}$

$E_{0,05} = 6000.00 \text{ MPa}$

$G_{moyen} = 560.00 \text{ MPa}$

Service class: 1

Beta c = 0.20



SECTION PARAMETERS: RECT_170x100

$h_t = 17.0 \text{ cm}$

$b_f = 10.0 \text{ cm}$

$t_w = 5.0 \text{ cm}$

$t_f = 5.0 \text{ cm}$

$A_y = 113.33 \text{ cm}^2$

$I_y = 4094.17 \text{ cm}^4$

$W_y = 481.67 \text{ cm}^3$

$A_z = 113.33 \text{ cm}^2$

$I_z = 1416.67 \text{ cm}^4$

$W_z = 283.33 \text{ cm}^3$

$A_x = 170.00 \text{ cm}^2$

$I_x = 3566.7 \text{ cm}^4$

STRESSES

$\text{Sig}_{t,0,d} = N/A_x = -1.10/170.00 = -0.06 \text{ MPa}$

$\text{Sig}_{m,y,d} = MY/W_y = -9.40/481.67 = -19.51 \text{ MPa}$

$\text{Sig}_{m,z,d} = MZ/W_z = -0.04/283.33 = -0.15 \text{ MPa}$

$\text{Tau}_{y,d} = 1.5*0.02/170.00 = 0.00 \text{ MPa}$

$\text{Tau}_{z,d} = 1.5*-19.97/170.00 = -1.76 \text{ MPa}$

$\text{Tau}_{tory,d} = 0.00 \text{ MPa}$, $\text{Tau}_{torz,d} = 0.01 \text{ MPa}$

ALLOWABLE STRESSES

$f_{t,0,d} = 7.34 \text{ MPa}$

$f_{m,y,d} = 11.08 \text{ MPa}$

$f_{m,z,d} = 12.01 \text{ MPa}$

$f_{v,d} = 2.09 \text{ MPa}$

Factors and additional parameters

$k_m = 0.70$

$k_h = 1.08$

$k_{mod} = 0.80$

$K_{sys} = 1.00$

$k_{cr} = 0.67$



LATERAL BUCKLING PARAMETERS:

$l_{ef} = 8.100000014 \text{ m}$

$\text{Lambda}_{rel m} = 0.82$

$\text{Sig}_{cr} = 27.09 \text{ MPa}$

$k_{crit} = 0.95$

BUCKLING PARAMETERS:



About Y axis:



About Z axis:

VERIFICATION FORMULAS:

$\text{Sig}_{t,0,d}/f_{t,0,d} + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m*\text{Sig}_{m,z,d}/f_{m,z,d} = 1.78 > 1.00 \text{ (6.17)}$

$\text{Sig}_{m,y,d}/(k_{crit}*f_{m,y,d}) = 19.51/(0.95*11.08) = 1.86 > 1.00 \text{ (6.33)}$

$(\text{Tau}_{y,d}/k_{cr} + \text{Tau}_{tory,d}/k_{shape})/f_{v,d} = 0.00 < 1.00 \text{ (Tau}_{z,d}/k_{cr} + \text{Tau}_{torz,d}/k_{shape})/f_{v,d} = 1.26 > 1.00 \text{ (6.13-4)}$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	42	87	0

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$u_{fin,y} = 0.1 \text{ cm} < u_{fin,max,y} = L/150.00 = 6.0 \text{ cm}$

Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$

$u_{fin,z} = 1.1 \text{ cm} < u_{fin,max,z} = L/150.00 = 6.0 \text{ cm}$

Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$



Displacements (GLOBAL SYSTEM):

Section incorrect !!!

Išvada: sąlyga netenkinama. Reikalingas sijų stiprinimas

Spyrių tikrinimas

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 16 styga2_16

POINT: 2

COORDINATE: $x = 0.50 L = 0.970366582 \text{ m}$

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30

MATERIAL C18

$g_M = 1.30$

$f_{m,0,k} = 18.00 \text{ MPa}$

$f_{t,0,k} = 11.00 \text{ MPa}$

$f_{c,0,k} = 18.00 \text{ MPa}$

$f_{v,k} = 3.40 \text{ MPa}$

$f_{t,90,k} = 0.40 \text{ MPa}$

$f_{c,90,k} = 2.20 \text{ MPa}$

$E_{0,moyen} = 9000.00 \text{ MPa}$

$E_{0,05} = 6000.00 \text{ MPa}$

$G_{moyen} = 560.00 \text{ MPa}$

Service class: 1

Beta c = 0.20



SECTION PARAMETERS: RECT_110x40

$h_t = 4.0 \text{ cm}$

$b_f = 11.0 \text{ cm}$

$A_y = 29.33 \text{ cm}^2$

$A_z = 29.33 \text{ cm}^2$

$A_x = 44.00 \text{ cm}^2$

$t_w = 2.0 \text{ cm}$

$I_y = 58.67 \text{ cm}^4$

$I_z = 443.67 \text{ cm}^4$

$I_x = 180.9 \text{ cm}^4$

$t_f = 2.0 \text{ cm}$

$W_y = 29.33 \text{ cm}^3$

$W_z = 80.67 \text{ cm}^3$

STRESSES

$\sigma_{c,0,d} = N/A_x = 2.11/44.00 = 0.48 \text{ MPa}$

$\sigma_{m,z,d} = MZ/W_z = 0.01/80.67 = 0.09 \text{ MPa}$

ALLOWABLE STRESSES

$f_{c,0,d} = 11.08 \text{ MPa}$

$f_{m,z,d} = 11.79 \text{ MPa}$

Factors and additional parameters

$k_h = 1.30$

$k_{h,z} = 1.06$

$k_{mod} = 0.80$

$K_{sys} = 1.00$



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About Y axis:

$L_Y = 1.940733164 \text{ m}$

$\lambda_Y = 168.07$

$\lambda_{rel,Y} = 2.93$

$k_y = 5.06$

$LF_Y = 1.940733164 \text{ m}$

$k_{cy} = 0.11$



About Z axis:

$L_Z = 1.940733164 \text{ m}$

$\lambda_Z = 61.12$

$\lambda_{rel,Z} = 1.07$

$k_z = 1.14$

$LF_Z = 1.940733164 \text{ m}$

$k_{cz} = 0.64$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	43	87	0

**VERIFICATION FORMULAS:**

$$\text{Sig}_{c,0,d}/(k_c \cdot y \cdot f_{c,0,d}) + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.48/(0.11 \cdot 11.08) + 0.70 \cdot 0.09/11.79 = 0.40 < 1.00 \quad (6.23)$$

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

$$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 1.3 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1

$$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 1.3 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2**Displacements (GLOBAL SYSTEM):****Section OK !!!****Išvada: sąlyga tenkinama.****Stygos tikrinimas****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 68 styga3_68**POINT:** 2**COORDINATE:** x = 0.50 L = 2.388824907 m**LOADS:****Governing Load Case:** 3 ULS/1=1*1.35 + 2*1.30**MATERIAL** C18

$$g_M = 1.30$$

$$f_{m,0,k} = 18.00 \text{ MPa}$$

$$f_{t,0,k} = 11.00 \text{ MPa}$$

$$f_{c,0,k} = 18.00 \text{ MPa}$$

$$f_{v,k} = 3.40 \text{ MPa}$$

$$f_{t,90,k} = 0.40 \text{ MPa}$$

$$f_{c,90,k} = 2.20 \text{ MPa}$$

$$E_{0,moyen} = 9000.00 \text{ MPa}$$

$$E_{0,05} = 6000.00 \text{ MPa}$$

$$G_{moyen} = 560.00 \text{ MPa}$$

Service class: 1

$$\text{Beta } c = 0.20$$

**SECTION PARAMETERS: RECT_170x60**

$$h_t = 6.0 \text{ cm}$$

$$b_f = 17.0 \text{ cm}$$

$$A_y = 68.00 \text{ cm}^2$$

$$A_z = 68.00 \text{ cm}^2$$

$$A_x = 102.00 \text{ cm}^2$$

$$t_w = 3.0 \text{ cm}$$

$$I_y = 306.00 \text{ cm}^4$$

$$I_z = 2456.50 \text{ cm}^4$$

$$I_x = 951.8 \text{ cm}^4$$

$$t_f = 3.0 \text{ cm}$$

$$W_y = 102.00 \text{ cm}^3$$

$$W_z = 289.00 \text{ cm}^3$$

STRESSES

$$\text{Sig}_{t,0,d} = N/A_x = -3.56/102.00 = -0.35 \text{ MPa}$$

$$\text{Sig}_{m,z,d} = MZ/W_z = -0.12/289.00 = -0.43 \text{ MPa}$$

ALLOWABLE STRESSES

$$f_{t,0,d} = 8.13 \text{ MPa}$$

$$f_{m,z,d} = 11.08 \text{ MPa}$$

Factors and additional parameters

$$k_h = 1.20$$

$$k_{h_z} = 1.00$$

$$k_{mod} = 0.80$$

$$K_{sys} = 1.00$$

**LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:



About Z axis:

VERIFICATION FORMULAS:

$$\text{Sig}_{t,0,d}/f_{t,0,d} + \text{Sig}_{m,z,d}/f_{m,z,d} = 0.35/8.13 + 0.43/11.08 = 0.08 < 1.00 \quad (6.18)$$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	44	87	0

**LIMIT DISPLACEMENTS****Deflections (LOCAL SYSTEM):**

$$u_{fin,y} = 0.2 \text{ cm} < u_{fin,max,y} = L/150.00 = 3.2 \text{ cm}$$

Verified

$$\text{Governing load case: } (1+0.6)*1 + (1+0.2*0.6)*2$$

$$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 3.2 \text{ cm}$$

Verified

$$\text{Governing load case: } (1+0.6)*1 + (1+0.2*0.6)*2$$

**Displacements (GLOBAL SYSTEM):****Section OK !!!****Išvada: sąlyga tenkinama.****Vertikalių ryšių tikrinimas****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 51 VR_51**POINT:** 2**COORDINATE:** x = 0.50 L = 2.808979722 m**LOADS:**

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30

MATERIAL C18

$$g_M = 1.30$$

$$f_{m,0,k} = 18.00 \text{ MPa}$$

$$f_{t,0,k} = 11.00 \text{ MPa}$$

$$f_{c,0,k} = 18.00 \text{ MPa}$$

$$f_{v,k} = 3.40 \text{ MPa}$$

$$f_{t,90,k} = 0.40 \text{ MPa}$$

$$f_{c,90,k} = 2.20 \text{ MPa}$$

$$E_{0,moyen} = 9000.00 \text{ MPa}$$

$$E_{0,05} = 6000.00 \text{ MPa}$$

$$G_{moyen} = 560.00 \text{ MPa}$$

$$\text{Service class: } 1$$

$$\text{Beta } c = 0.20$$

**SECTION PARAMETERS: RECT_170x60**

$$h_t = 6.0 \text{ cm}$$

$$b_f = 17.0 \text{ cm}$$

$$t_w = 3.0 \text{ cm}$$

$$t_f = 3.0 \text{ cm}$$

$$A_y = 68.00 \text{ cm}^2$$

$$I_y = 306.00 \text{ cm}^4$$

$$W_y = 102.00 \text{ cm}^3$$

$$A_z = 68.00 \text{ cm}^2$$

$$I_z = 2456.50 \text{ cm}^4$$

$$W_z = 289.00 \text{ cm}^3$$

$$A_x = 102.00 \text{ cm}^2$$

$$I_x = 951.8 \text{ cm}^4$$

STRESSES

$$\text{Sig}_{c,0,d} = N/A_x = 0.57/102.00 = 0.06 \text{ MPa}$$

$$\text{Sig}_{m,z,d} = MZ/W_z = 0.15/289.00 = 0.53 \text{ MPa}$$

ALLOWABLE STRESSES

$$f_{c,0,d} = 11.08 \text{ MPa}$$

$$f_{m,z,d} = 11.08 \text{ MPa}$$

Factors and additional parameters

$$k_h = 1.20$$

$$k_{h_z} = 1.00$$

$$k_{mod} = 0.80$$

$$K_{sys} = 1.00$$

**LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:

$$L_Y = 2.808979722 \text{ m}$$

$$\text{Lambda}_{rel Y} = 2.83$$

$$L_{FY} = 2.808979722 \text{ m}$$

$$\text{Lambda } Y = 162.18$$

$$k_y = 4.75$$

$$k_{cy} = 0.12$$



About Z axis:

$$L_Z = 2.808979722 \text{ m}$$

$$\text{Lambda}_{rel Z} = 1.00$$

$$L_{FZ} = 2.808979722 \text{ m}$$

$$\text{Lambda } Z = 57.24$$

$$k_z = 1.07$$

$$k_{cz} = 0.69$$

VERIFICATION FORMULAS:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	45	87	0

$$\text{Sig}_{c,0,d}/(k_c \cdot y \cdot f_{c,0,d}) + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.06/(0.12 \cdot 11.08) + 0.70 \cdot 0.53/11.08 = 0.08 < 1.00 \quad (6.23)$$

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$$u_{fin,y} = 0.3 \text{ cm} < u_{fin,max,y} = L/150.00 = 3.7 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1

$$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 3.7 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2



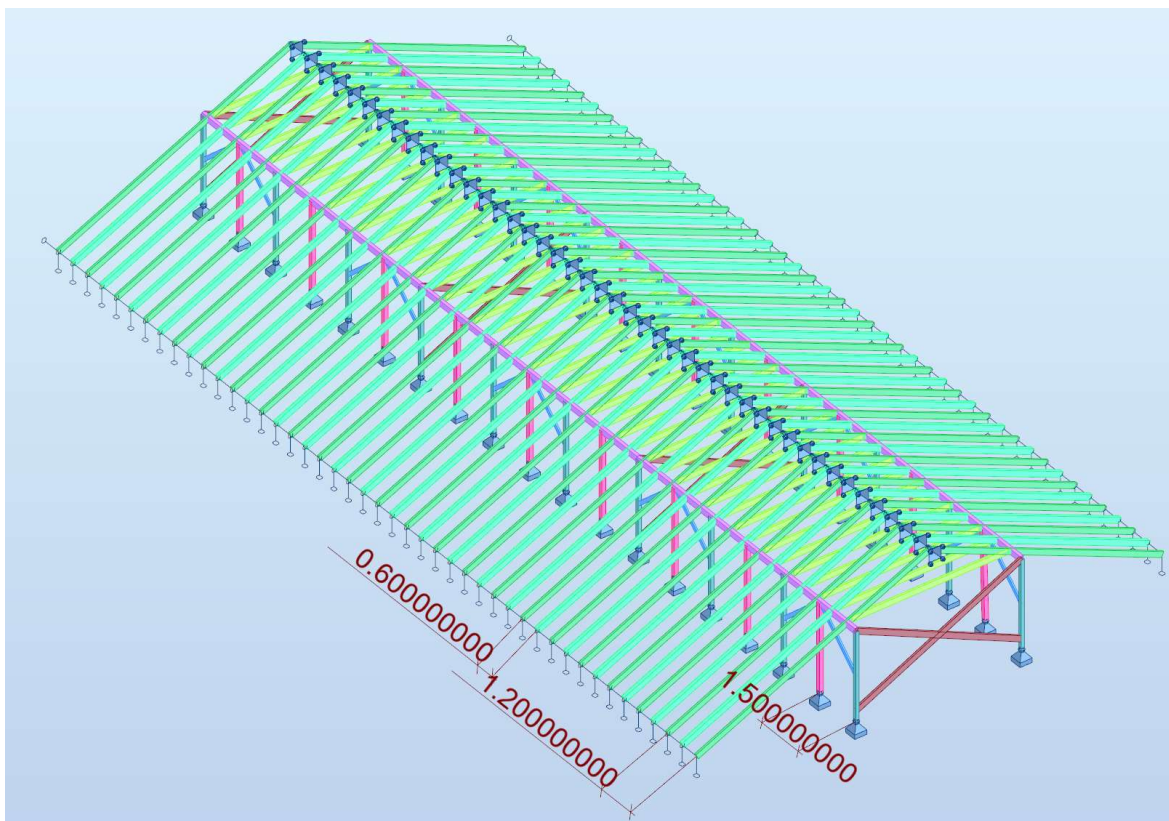
Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

Numatomas stogo stiprinimas. Numatomos gegnės į tarpus 170x100mm skerspjūvio atkartojant skaičiuojamąją schemą. Naujas gegnių žingsnis 600mm. Numatomos naujos kolonos į tarpus 120x120mm skerspjūvio. Naujas žingsnis tarp kolonų išilgai sijos 1,5m. Medienos klasė C18.

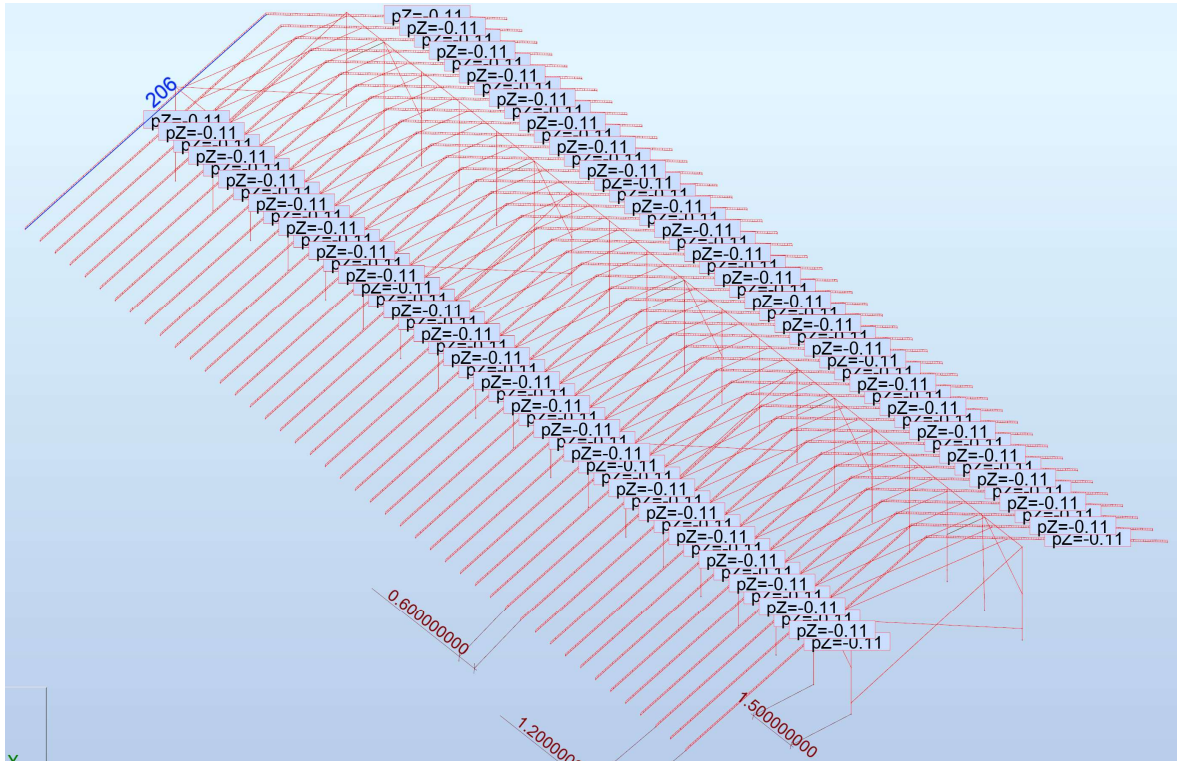
Nauja skaičiuojamoji schema:



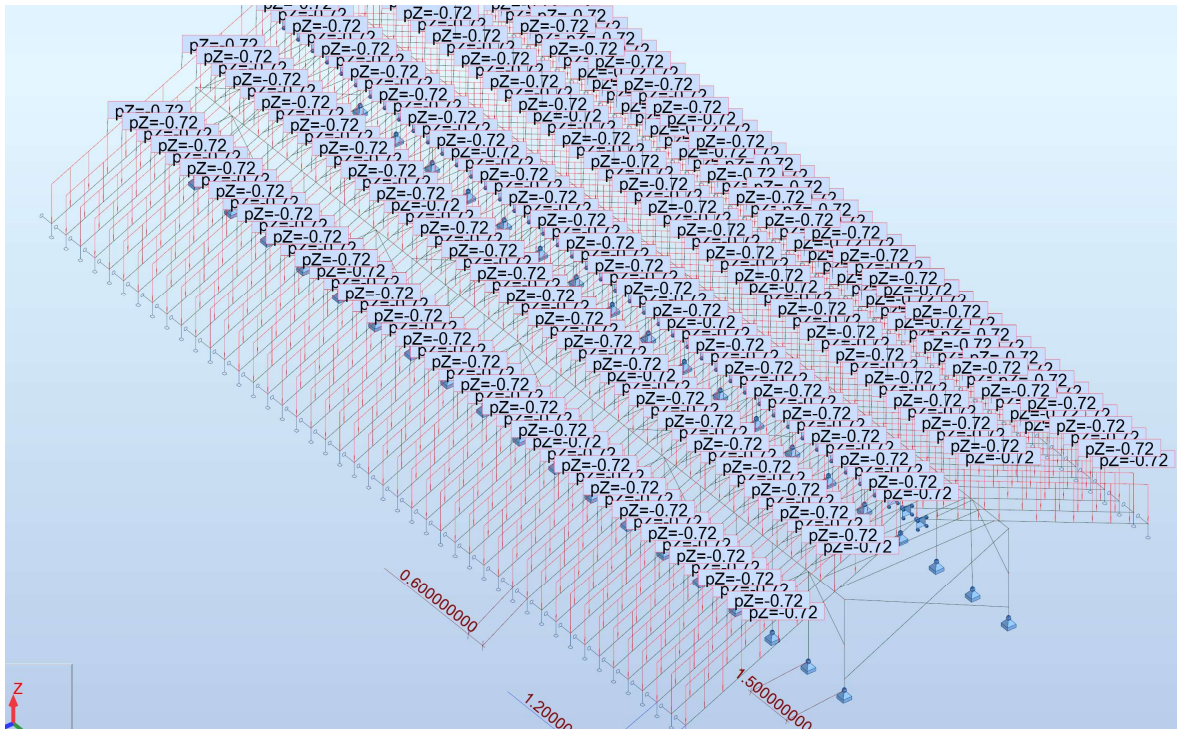
Naujos veikiančios apkrovos:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	46	87	0

Charakteristinė nuolatinė apkrova:



Charakteristinė sniego apkrova:



Esamos gegnės patikrinimas po stiprinimo

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	47	87	0

CODE: **EN 1995-1:2004/A2:2014**
ANALYSIS TYPE: **Member Verification**

CODE GROUP:

MEMBER: 158 Gegnė_158 **POINT:** 1 **COORDINATE:** x = 0.36 L = 2.779946159 m

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL C18

gM = 1.30 f_{m,0,k} = 18.00 MPa f_{t,0,k} = 11.00 MPa f_{c,0,k} = 18.00 MPa
f_{v,k} = 3.40 MPa f_{t,90,k} = 0.40 MPa f_{c,90,k} = 2.20 MPa E_{0,moyen} = 9000.00 MPa
E_{0,05} = 6000.00 MPa G_{moyen} = 560.00 MPa Service class: 1 Beta c = 0.20



SECTION PARAMETERS: RECT_170x60

ht=17.0 cm Ay=68.00 cm² Az=68.00 cm² Ax=102.00 cm²
bf=6.0 cm I_y=2456.50 cm⁴ I_z=306.00 cm⁴ I_x=951.8 cm⁴
tw=3.0 cm Wy=289.00 cm³ Wz=102.00 cm³
tf=3.0 cm

STRESSES

Sig_{t,0,d} = N/Ax = -1.39/102.00 = -0.14 MPa
Sig_{m,y,d} = MY/Wy = -2.55/289.00 = -8.82 MPa
Sig_{m,z,d} = MZ/Wz = -0.00/102.00 = -0.01 MPa
Tau_{y,d} = 1.5*-0.00/102.00 = -0.00 MPa
Tau_{z,d} = 1.5*3.10/102.00 = 0.46 MPa

ALLOWABLE STRESSES

f_{t,0,d} = 8.13 MPa
f_{m,y,d} = 11.08 MPa
f_{m,z,d} = 13.30 MPa
f_{v,d} = 2.09 MPa

Factors and additional parameters

km = 0.70 kh = 1.20 kmod = 0.80 K_{sys} = 1.00 kcr = 0.67



LATERAL BUCKLING PARAMETERS:

l_{ef} = 4.985153521 m Lambda_{rel m} = 1.01
Sig_{cr} = 17.61 MPa k_{crit} = 0.80

BUCKLING PARAMETERS:



About Y axis:



About Z axis:

VERIFICATION FORMULAS:

Sig_{t,0,d}/f_{t,0,d} + Sig_{m,y,d}/f_{m,y,d} + km*Sig_{m,z,d}/f_{m,z,d} = 0.81 < 1.00 (6.17)
Sig_{m,y,d}/(k_{crit}*f_{m,y,d}) = 8.82/(0.80*11.08) = 0.99 < 1.00 (6.33)
(Tau_{y,d}/kcr)/f_{v,d} = (0.00/0.67)/2.09 = 0.00 < 1.00 (Tau_{z,d}/kcr)/f_{v,d} = (0.46/0.67)/2.09 = 0.33 < 1.00 (6.13)

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

u_{fin,y} = 0.1 cm < u_{fin,max,y} = L/200.00 = 3.9 cm Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2

u_{fin,z} = 2.0 cm < u_{fin,max,z} = L/200.00 = 3.9 cm Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	48	87	0



Naujos gegnės tikrinimas

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 96

POINT: 3

COORDINATE: x = 0.36 L = 2.779889393 m

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL C18

gM = 1.30

f_{m,0,k} = 18.00 MPaf_{t,0,k} = 11.00 MPaf_{c,0,k} = 18.00 MPaf_{v,k} = 3.40 MPaf_{t,90,k} = 0.40 MPaf_{c,90,k} = 2.20 MPaE_{0,moyen} = 9000.00 MPaE_{0,05} = 6000.00 MPaG_{moyen} = 560.00 MPa

Service class: 1

Beta_c = 0.20

SECTION PARAMETERS: RECT_170x100

ht=17.0 cm

bf=10.0 cm

tw=5.0 cm

tf=5.0 cm

A_y=113.33 cm²I_y=4094.17 cm⁴W_y=481.67 cm³A_z=113.33 cm²I_z=1416.67 cm⁴W_z=283.33 cm³A_x=170.00 cm²I_x=3566.7 cm⁴

STRESSES

Sig_{c,0,d} = N/A_x = 2.10/170.00 = 0.12 MPaSig_{m,y,d} = MY/W_y = 2.60/481.67 = 5.40 MPaSig_{m,z,d} = MZ/W_z = 0.08/283.33 = 0.27 MPaTau_{y,d} = 1.5*-0.03/170.00 = -0.00 MPaTau_{z,d} = 1.5*-2.70/170.00 = -0.24 MPaTau_{tory,d} = 0.02 MPa, Tau_{torz,d} = 0.02 MPa

ALLOWABLE STRESSES

f_{c,0,d} = 11.08 MPaf_{m,y,d} = 11.08 MPaf_{m,z,d} = 12.01 MPaf_{v,d} = 2.09 MPa

Factors and additional parameters

k_m = 0.70k_h = 1.08k_{mod} = 0.80K_{sys} = 1.00k_{cr} = 0.67

LATERAL BUCKLING PARAMETERS:

le_f = 4.985153521 mLambda_{rel m} = 0.64Sig_{cr} = 44.02 MPak_{crit} = 1.00

BUCKLING PARAMETERS:



About Y axis:

LY = 5.050000000 m

Lambda_Y = 102.90Lambda_{rel Y} = 1.79k_y = 2.26

LFY = 5.050000000 m

k_{cy} = 0.28

About Z axis:

LZ = 0.100000000 m

Lambda_Z = 3.46Lambda_{rel Z} = 0.06k_z = 0.48

LFZ = 0.100000000 m

k_{cz} = 1.00

VERIFICATION FORMULAS:

(Sig_{c,0,d}/k_c + Sig_{m,y,d}/f_{m,y,d} + k_m*Sig_{m,z,d}/f_{m,z,d}) = 0.54 < 1.00 (6.23)Sig_{m,y,d}/(k_{crit}*f_{m,y,d}) = 5.40/(1.00*11.08) = 0.49 < 1.00 (6.33)(Tau_{y,d}/k_{cr} + Tau_{tory,d}/k_{shape})/f_{v,d} = 0.01 < 1.00 (Tau_{z,d}/k_{cr} + Tau_{torz,d}/k_{shape})/f_{v,d} = 0.18 < 1.00 (6.13-4)

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

u_{fin,y} = 0.0 cm < u_{fin,max,y} = L/200.00 = 3.9 cm

Verified

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	49	87	0



Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$
 $u_{fin,z} = 1.3 \text{ cm} < u_{fin,max,z} = L/200.00 = 3.9 \text{ cm}$
Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$

Verified



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

Esamų kolonų tikrinimas po stiprinimo

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 52 kolona 2_52

POINT: 1

COORDINATE: $x = 0.88 L = 2.420000000 \text{ m}$

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL C18

 $g_M = 1.30$ $f_{m,0,k} = 18.00 \text{ MPa}$ $f_{t,0,k} = 11.00 \text{ MPa}$ $f_{c,0,k} = 18.00 \text{ MPa}$ $f_{v,k} = 3.40 \text{ MPa}$ $f_{t,90,k} = 0.40 \text{ MPa}$ $f_{c,90,k} = 2.20 \text{ MPa}$ $E_{0,moyen} = 9000.00 \text{ MPa}$ $E_{0,05} = 6000.00 \text{ MPa}$ $G_{moyen} = 560.00 \text{ MPa}$

Service class: 1

Beta c = 0.20



SECTION PARAMETERS: RECT_100x100

 $h_t = 10.0 \text{ cm}$ $b_f = 10.0 \text{ cm}$ $A_y = 66.67 \text{ cm}^2$ $A_z = 66.67 \text{ cm}^2$ $A_x = 100.00 \text{ cm}^2$ $t_w = 5.0 \text{ cm}$ $I_y = 833.33 \text{ cm}^4$ $I_z = 833.33 \text{ cm}^4$ $I_x = 1405.8 \text{ cm}^4$ $t_f = 5.0 \text{ cm}$ $W_y = 166.67 \text{ cm}^3$ $W_z = 166.67 \text{ cm}^3$

STRESSES

 $\text{Sig}_{c,0,d} = N/A_x = 16.94/100.00 = 1.69 \text{ MPa}$ $\text{Sig}_{m,y,d} = MY/W_y = 0.01/166.67 = 0.08 \text{ MPa}$ $\text{Sig}_{m,z,d} = MZ/W_z = 0.12/166.67 = 0.71 \text{ MPa}$ $\text{Tau}_{y,d} = 1.5 * -0.36/100.00 = -0.05 \text{ MPa}$ $\text{Tau}_{z,d} = 1.5 * 0.04/100.00 = 0.01 \text{ MPa}$

ALLOWABLE STRESSES

 $f_{c,0,d} = 11.08 \text{ MPa}$ $f_{m,y,d} = 12.01 \text{ MPa}$ $f_{m,z,d} = 12.01 \text{ MPa}$ $f_{v,d} = 2.09 \text{ MPa}$

Factors and additional parameters

 $k_m = 0.70$ $k_h = 1.08$ $k_{mod} = 0.80$ $K_{sys} = 1.00$ $k_{cr} = 0.67$ 

LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About Y axis:

 $LY = 2.750000000 \text{ m}$ $\text{Lambda}_Y = 95.26$ $\text{Lambda}_{rel Y} = 1.66$ $k_y = 2.02$ $LFY = 2.750000000 \text{ m}$ $k_{cy} = 0.32$ 

About Z axis:

 $LZ = 2.750000000 \text{ m}$ $\text{Lambda}_Z = 95.26$ $\text{Lambda}_{rel Z} = 1.66$ $k_z = 2.02$ $LFZ = 2.750000000 \text{ m}$ $k_{cz} = 0.32$

VERIFICATION FORMULAS:

 $\text{Sig}_{c,0,d}/(k_{c,z}*f_{c,0,d}) + k_m*\text{Sig}_{m,y,d}/f_{m,y,d} + \text{Sig}_{m,z,d}/f_{m,z,d} = 0.55 < 1.00 \text{ (6.24)}$ $(\text{Tau}_{y,d}/k_{cr})/f_{v,d} = (0.05/0.67)/2.09 = 0.04 < 1.00 \quad (\text{Tau}_{z,d}/k_{cr})/f_{v,d} = (0.01/0.67)/2.09 = 0.00 < 1.00 \text{ (6.13)}$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	50	87	0

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$u_{fin,y} = 0.1 \text{ cm} < u_{fin,max,y} = L/150.00 = 1.8 \text{ cm}$

Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$

$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 1.8 \text{ cm}$

Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

Naujų kolonų tikrinimas

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 120

POINT: 3

COORDINATE: $x = 1.00 \text{ L} = 2.751811229 \text{ m}$

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL C18

$g_m = 1.30$

$f_{m,0,k} = 18.00 \text{ MPa}$

$f_{t,0,k} = 11.00 \text{ MPa}$

$f_{c,0,k} = 18.00 \text{ MPa}$

$f_{v,k} = 3.40 \text{ MPa}$

$f_{t,90,k} = 0.40 \text{ MPa}$

$f_{c,90,k} = 2.20 \text{ MPa}$

$E_{0,moyen} = 9000.00 \text{ MPa}$

$E_{0,05} = 6000.00 \text{ MPa}$

$G_{moyen} = 560.00 \text{ MPa}$

Service class: 1

Beta c = 0.20



SECTION PARAMETERS: RECT_120x120

$h_t = 12.0 \text{ cm}$

$b_f = 12.0 \text{ cm}$

$A_y = 96.00 \text{ cm}^2$

$A_z = 96.00 \text{ cm}^2$

$A_x = 144.00 \text{ cm}^2$

$t_w = 6.0 \text{ cm}$

$I_y = 1728.00 \text{ cm}^4$

$I_z = 1728.00 \text{ cm}^4$

$I_x = 2915.1 \text{ cm}^4$

$t_f = 6.0 \text{ cm}$

$W_y = 288.00 \text{ cm}^3$

$W_z = 288.00 \text{ cm}^3$

STRESSES

$\sigma_{c,0,d} = N/A_x = 19.62/144.00 = 1.36 \text{ MPa}$

$\tau_{v,d} = 1.5 * -0.00/144.00 = -0.00 \text{ MPa}$

ALLOWABLE STRESSES

$f_{c,0,d} = 11.08 \text{ MPa}$

$f_{v,d} = 2.09 \text{ MPa}$

Factors and additional parameters

$k_h = 1.05$

$k_{mod} = 0.80$

$K_{sys} = 1.00$

$k_{cr} = 0.67$



LATERAL BUCKLING PARAMETERS:

BUCKLING PARAMETERS:



About Y axis:

$L_Y = 2.751811229 \text{ m}$

$\lambda_Y = 79.44$

$\lambda_{rel,Y} = 1.38$

$k_y = 1.57$

$L_{FY} = 2.751811229 \text{ m}$

$k_{cy} = 0.43$



About Z axis:

$L_Z = 2.751811229 \text{ m}$

$\lambda_Z = 79.44$

$\lambda_{rel,Z} = 1.38$

$k_z = 1.57$

$L_{FZ} = 2.751811229 \text{ m}$

$k_{cz} = 0.43$

VERIFICATION FORMULAS:

$\sigma_{c,0,d}/f_{c,0,d} = 1.36/11.08 = 0.12 < 1.00 \quad (6.23-4)]$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	51	87	0



$$\text{Sig}_{c,0,d}/(k_c \cdot f_{c,0,d}) = 1.36/(0.43 \cdot 11.08) = 0.28 < 1.00 \quad (6.23-4)$$
$$(\text{Tau}_{y,d}/k_{cr})/f_{v,d} = (0.00/0.67)/2.09 = 0.00 < 1.00 \quad (6.13)$$

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

$$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 1.8 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1

$$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 1.8 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2**Displacements (GLOBAL SYSTEM):****Section OK !!!****Išvada: sąlyga tenkinama.****Išilginės sijos tikrinimas po stiprinimo****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 230 stygal_230**POINT:** 3**COORDINATE:** x = 0.17 L = 1.500000005 m**LOADS:****Governing Load Case:** 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30**MATERIAL** C18

$$g_M = 1.30$$

$$f_{m,0,k} = 18.00 \text{ MPa}$$

$$f_{t,0,k} = 11.00 \text{ MPa}$$

$$f_{c,0,k} = 18.00 \text{ MPa}$$

$$f_{v,k} = 3.40 \text{ MPa}$$

$$f_{t,90,k} = 0.40 \text{ MPa}$$

$$f_{c,90,k} = 2.20 \text{ MPa}$$

$$E_{0,moyen} = 9000.00 \text{ MPa}$$

$$E_{0,05} = 6000.00 \text{ MPa}$$

$$G_{moyen} = 560.00 \text{ MPa}$$

Service class: 1

$$\text{Beta } c = 0.20$$

**SECTION PARAMETERS: RECT_170x100**

$$h_t = 17.0 \text{ cm}$$

$$b_f = 10.0 \text{ cm}$$

$$A_y = 113.33 \text{ cm}^2$$

$$A_z = 113.33 \text{ cm}^2$$

$$A_x = 170.00 \text{ cm}^2$$

$$t_w = 5.0 \text{ cm}$$

$$I_y = 4094.17 \text{ cm}^4$$

$$I_z = 1416.67 \text{ cm}^4$$

$$I_x = 3566.7 \text{ cm}^4$$

$$t_f = 5.0 \text{ cm}$$

$$W_y = 481.67 \text{ cm}^3$$

$$W_z = 283.33 \text{ cm}^3$$

STRESSES

$$\text{Sig}_{t,0,d} = N/A_x = -0.02/170.00 = -0.00 \text{ MPa}$$

$$\text{Sig}_{m,y,d} = M_y/W_y = -2.64/481.67 = -5.49 \text{ MPa}$$

$$\text{Sig}_{m,z,d} = M_z/W_z = -0.06/283.33 = -0.22 \text{ MPa}$$

$$\text{Tau}_{y,d} = 1.5 \cdot -0.35/170.00 = -0.03 \text{ MPa}$$

$$\text{Tau}_{z,d} = 1.5 \cdot -12.53/170.00 = -1.11 \text{ MPa}$$

$$\text{Tau}_{torty,d} = 0.11 \text{ MPa}, \text{ Tau}_{torz,d} = 0.14 \text{ MPa}$$

ALLOWABLE STRESSES

$$f_{t,0,d} = 7.34 \text{ MPa}$$

$$f_{m,y,d} = 11.08 \text{ MPa}$$

$$f_{m,z,d} = 12.01 \text{ MPa}$$

$$f_{v,d} = 2.09 \text{ MPa}$$

Factors and additional parameters

$$k_m = 0.70$$

$$k_h = 1.08$$

$$k_{mod} = 0.80$$

$$K_{sys} = 1.00$$

$$k_{cr} = 0.67$$

**LATERAL BUCKLING PARAMETERS:**

$$l_{ef} = 2.588000014 \text{ m}$$

$$\text{Lambda}_{rel m} = 0.46$$

$$\text{Sig}_{cr} = 84.79 \text{ MPa}$$

$$k_{crit} = 1.00$$

IN2324-01-TP-SK-S

Lapas

Lapų

Laida

52

87

0

BUCKLING PARAMETERS:



About Y axis:



About Z axis:

VERIFICATION FORMULAS:

$$\text{Sig}_{t,0,d}/f_{t,0,d} + \text{Sig}_{m,y,d}/f_{m,y,d} + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.51 < 1.00 \quad (6.17)$$

$$\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 5.49/(1.00 \cdot 11.08) = 0.50 < 1.00 \quad (6.33)$$

$$(\tau_{y,d}/k_{cr} + \tau_{t,ory,d}/k_{shape})/f_{v,d} = 0.07 < 1.00 \quad (\tau_{z,d}/k_{cr} + \tau_{t,orz,d}/k_{shape})/f_{v,d} = 0.85 < 1.00 \quad (6.13-4)$$

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 6.0 \text{ cm}$$

Verified

$$\text{Governing load case: } (1+0.6) \cdot 1 + (1+0.2 \cdot 0.6) \cdot 2$$

$$u_{fin,z} = 0.1 \text{ cm} < u_{fin,max,z} = L/150.00 = 6.0 \text{ cm}$$

Verified

$$\text{Governing load case: } (1+0.6) \cdot 1 + (1+0.2 \cdot 0.6) \cdot 2$$



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

Ryšių tikrinimas po stiprinimo

CODE: [EN 1995-1:2004/A2:2014](#)

ANALYSIS TYPE: [Member Verification](#)

CODE GROUP:

MEMBER: [258 styga2_258](#)

POINT: [2](#)

COORDINATE: [x = 0.50 L = 1.017425206 m](#)

LOADS:

Governing Load Case: [3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30](#)

MATERIAL C18

$$g_M = 1.30$$

$$f_{m,0,k} = 18.00 \text{ MPa}$$

$$f_{t,0,k} = 11.00 \text{ MPa}$$

$$f_{c,0,k} = 18.00 \text{ MPa}$$

$$f_{v,k} = 3.40 \text{ MPa}$$

$$f_{t,90,k} = 0.40 \text{ MPa}$$

$$f_{c,90,k} = 2.20 \text{ MPa}$$

$$E_{0,moyen} = 9000.00 \text{ MPa}$$

$$E_{0,05} = 6000.00 \text{ MPa}$$

$$G_{moyen} = 560.00 \text{ MPa}$$

$$\text{Service class: } 1$$

$$\beta_{c,c} = 0.20$$



SECTION PARAMETERS: RECT_110x40

$$h_t = 4.0 \text{ cm}$$

$$b_f = 11.0 \text{ cm}$$

$$A_y = 29.33 \text{ cm}^2$$

$$A_z = 29.33 \text{ cm}^2$$

$$A_x = 44.00 \text{ cm}^2$$

$$t_w = 2.0 \text{ cm}$$

$$I_y = 58.67 \text{ cm}^4$$

$$I_z = 443.67 \text{ cm}^4$$

$$I_x = 180.9 \text{ cm}^4$$

$$t_f = 2.0 \text{ cm}$$

$$W_y = 29.33 \text{ cm}^3$$

$$W_z = 80.67 \text{ cm}^3$$

STRESSES

$$\text{Sig}_{c,0,d} = N/A_x = 0.15/44.00 = 0.03 \text{ MPa}$$

$$\text{Sig}_{m,z,d} = MZ/W_z = 0.01/80.67 = 0.09 \text{ MPa}$$

ALLOWABLE STRESSES

$$f_{c,0,d} = 11.08 \text{ MPa}$$

$$f_{m,z,d} = 11.79 \text{ MPa}$$

Factors and additional parameters

$$k_h = 1.30$$

$$k_{h_z} = 1.06$$

$$k_{mod} = 0.80$$

$$K_{sys} = 1.00$$



LATERAL BUCKLING PARAMETERS:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	53	87	0

**BUCKLING PARAMETERS:**

About Y axis:

LY = 2.034850412 m Lambda Y = 176.22
 Lambda_rel Y = 3.07 ky = 5.50
 LFY = 2.034850412 m kcy = 0.10



About Z axis:

LZ = 2.034850412 m Lambda Z = 64.08
 Lambda_rel Z = 1.12 kz = 1.21
 LFZ = 2.034850412 m kcz = 0.60

VERIFICATION FORMULAS:

$$\text{Sig}_{c,0,d}/(k_c \cdot y \cdot f_{c,0,d}) + k_m \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.03/(0.10 \cdot 11.08) + 0.70 \cdot 0.09/11.79 = 0.04 < 1.00 \quad (6.23)$$
LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

$$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 1.4 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1
$$u_{fin,z} = 0.0 \text{ cm} < u_{fin,max,z} = L/150.00 = 1.4 \text{ cm}$$

Verified

Governing load case: (1+0.6)*1 + (1+0.2*0.6)*2**Displacements (GLOBAL SYSTEM):****Section OK !!!****Išvada: sąlyga tenkinama.****Stygų tikrinimas po stiprinimo****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 68 styga3_68**POINT:** 2**COORDINATE:** x = 0.50 L = 2.388824907 m**LOADS:****Governing Load Case:** 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30**MATERIAL** C18

gM = 1.30 f_{m,0,k} = 18.00 MPa f_{t,0,k} = 11.00 MPa f_{c,0,k} = 18.00 MPa
 f_{v,k} = 3.40 MPa f_{t,90,k} = 0.40 MPa f_{c,90,k} = 2.20 MPa E_{0,moyen} = 9000.00 MPa
 E_{0,05} = 6000.00 MPa G_{moyen} = 560.00 MPa Service class: 1 Beta_c = 0.20

**SECTION PARAMETERS: RECT_170x60**

ht=17.0 cm Ay=68.00 cm² Az=68.00 cm² Ax=102.00 cm²
 bf=6.0 cm Iy=2456.50 cm⁴ Iz=306.00 cm⁴ Ix=951.8 cm⁴
 tw=3.0 cm Wy=289.00 cm³ Wz=102.00 cm³

STRESSES

Sig_{t,0,d} = N/Ax = -2.41/102.00 = -0.24 MPa
 Sig_{m,y,d} = MY/Wy = -0.12/289.00 = -0.43 MPa

ALLOWABLE STRESSES

f_{t,0,d} = 8.13 MPa
 f_{m,y,d} = 11.08 MPa

Factors and additional parameters

kh = 1.20 kh_y = 1.00 kmod = 0.80 Ksys = 1.00

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	54	87	0



LATERAL BUCKLING PARAMETERS:

$l_{ef} = 4.299884833 \text{ m}$ $\Lambda_{rel} = 0.94$
 $\sigma_{cr} = 20.42 \text{ MPa}$ $k_{crit} = 0.86$

BUCKLING PARAMETERS:



About Y axis:



About Z axis:

VERIFICATION FORMULAS:

$\sigma_{t,0,d}/f_{t,0,d} + \sigma_{m,y,d}/f_{m,y,d} = 0.24/8.13 + 0.43/11.08 = 0.07 < 1.00 \quad (6.17)$
 $\sigma_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 0.43/(0.86 \cdot 11.08) = 0.05 < 1.00 \quad (6.33)$

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 3.2 \text{ cm}$ Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$

$u_{fin,z} = 0.2 \text{ cm} < u_{fin,max,z} = L/150.00 = 3.2 \text{ cm}$ Verified

Governing load case: $(1+0.6)*1 + (1+0.2*0.6)*2$



Displacements (GLOBAL SYSTEM):

Section OK !!!

Išvada: sąlyga tenkinama.

Vertikalių ryšių tikrinimas po stiprinimo

CODE: [EN 1995-1:2004/A2:2014](#)

ANALYSIS TYPE: [Member Verification](#)

CODE GROUP:

MEMBER: 194 VR_194

POINT: 2

COORDINATE: $x = 0.50 L = 2.808979722 \text{ m}$

LOADS:

Governing Load Case: 4 ULS/2=1*1.35 1*1.35

MATERIAL C18

$g_M = 1.30$	$f_{m,0,k} = 18.00 \text{ MPa}$	$f_{t,0,k} = 11.00 \text{ MPa}$	$f_{c,0,k} = 18.00 \text{ MPa}$
$f_{v,k} = 3.40 \text{ MPa}$	$f_{t,90,k} = 0.40 \text{ MPa}$	$f_{c,90,k} = 2.20 \text{ MPa}$	$E_{0,moyen} = 9000.00 \text{ MPa}$
$E_{0,05} = 6000.00 \text{ MPa}$	$G_{moyen} = 560.00 \text{ MPa}$	Service class: 1	Beta c = 0.20



SECTION PARAMETERS: RECT_170x60

$h_t = 17.0 \text{ cm}$	$A_y = 68.00 \text{ cm}^2$	$A_z = 68.00 \text{ cm}^2$	$A_x = 102.00 \text{ cm}^2$
$b_f = 6.0 \text{ cm}$	$I_y = 2456.50 \text{ cm}^4$	$I_z = 306.00 \text{ cm}^4$	$I_x = 951.8 \text{ cm}^4$
$t_w = 3.0 \text{ cm}$	$W_y = 289.00 \text{ cm}^3$	$W_z = 102.00 \text{ cm}^3$	
$t_f = 3.0 \text{ cm}$			

STRESSES

$\sigma_{c,0,d} = N/A_x = 0.06/102.00 = 0.01 \text{ MPa}$
 $\sigma_{m,y,d} = MY/W_y = 0.15/289.00 = 0.53 \text{ MPa}$

ALLOWABLE STRESSES

$f_{c,0,d} = 8.31 \text{ MPa}$
 $f_{m,y,d} = 8.31 \text{ MPa}$

Factors and additional parameters

$k_h = 1.20$ $k_{h,y} = 1.00$ $k_{mod} = 0.60$ $K_{sys} = 1.00$

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	55	87	0


LATERAL BUCKLING PARAMETERS:
 $l_{ef} = 5.056163500 \text{ m}$ $\Lambda_{rel} = 1.02$
 $\sigma_{cr} = 17.37 \text{ MPa}$ $k_{crit} = 0.80$
BUCKLING PARAMETERS:

About Y axis:
 $L_Y = 2.808979722 \text{ m}$ $\Lambda_Y = 57.24$
 $\Lambda_{rel Y} = 1.00$ $k_y = 1.07$
 $L_{FY} = 2.808979722 \text{ m}$ $k_{cy} = 0.69$

About Z axis:
 $L_Z = 2.808979722 \text{ m}$ $\Lambda_Z = 162.18$
 $\Lambda_{rel Z} = 2.83$ $k_z = 4.75$
 $L_{FZ} = 2.808979722 \text{ m}$ $k_{cz} = 0.12$
VERIFICATION FORMULAS:
 $\sigma_{c,0,d}/(k_{cy} \cdot f_{c,0,d}) + \sigma_{m,y,d}/f_{m,y,d} = 0.01/(0.69 \cdot 8.31) + 0.53/8.31 = 0.07 < 1.00 \quad (6.23)$
 $\sigma_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 0.53/(0.80 \cdot 8.31) = 0.08 < 1.00 \quad (6.33)$
LIMIT DISPLACEMENTS

Deflections (LOCAL SYSTEM):
 $u_{fin,y} = 0.0 \text{ cm} < u_{fin,max,y} = L/150.00 = 3.7 \text{ cm}$

Verified

Governing load case: $(1+0.6) \cdot 1 + (1+0.2 \cdot 0.6) \cdot 2$
 $u_{fin,z} = 0.3 \text{ cm} < u_{fin,max,z} = L/150.00 = 3.7 \text{ cm}$

Verified

Governing load case: $(1+0.6) \cdot 1$

Displacements (GLOBAL SYSTEM):
Section OK !!!
Išvada: sąlyga tenkinama.
SUSTIPRINTO RĖMO SKAIČIAVIMŲ BENDRA IŠVADA:

- Įvedus papildomas gegnes į tarpus ir sujungus jas styga, įvedus kolonas į tarpus, išlaikant esamo rėmo skaičiuojamąją schemą visi elementai tenkina saugos ir tinkamumo ribinius būvius nuo projektuojamų apkrovų.

2.6.3. Esamo stogo konstrukcijų ugniaatsparumo tikrinimas

Stogo atsparumas ugniai R20. Kadangi gegnių, kolonų, ryšių ir sijos ugniaatsparumai nepakankami, numatomi jų apkalimai 25 mm storio lenta, kad apsaugoti vieną iš šonų nuo ugnies.

Iš medienos sudarytos apsaugos nuo ugnies 25mm storio apkalos, pritvirtintos prie medinių elementų, irties pradžios laiko momentas t_f turi būti apskaičiuotas taip:

$$t_f = \frac{h_p}{\beta_0} - 4 = \frac{16}{0,65} - 4 = 21 \text{ min} > 20 \text{ min}$$

Neapsaugotų medsraigčių, kuriais tvirtinami atdėklai atsparumas ugniai 15 min, esant $d > 3,5 \text{ mm}$:

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	56	87	0

6.1 lentelė. Neapsaugotųjų jungčių su mediniais antdėklais atsparumas ugniai

	Atsparumo ugniai trukmė $t_{d,fi}$ min	Sąlygos ^a
Vinys	15	$d \geq 2,8 \text{ mm}$
Medsraigčiai	15	$d \geq 3,5 \text{ mm}$
Varžtai	15	$t_1 \geq 45 \text{ mm}$
Kaiščiai	20	$t_1 \geq 45 \text{ mm}$
Jungės pagal EN 912	15	$t_1 \geq 45 \text{ mm}$
^a d yra jungės skersmuo, o t_1 – antdėklo storis.		

Jungčių, sujungtų medsraigčiais su slepiamomis galvutėmis, atsparumo ugniai trukmė $t_{d,fi}$ gali būti pasiekama ilgesnė už nurodytą 6.1 lentelėje (tačiau ne viršijanti 30 min), jei dydžiu a_{fi} padidinamas antdėklų storis ir atstumai nuo elemento galo ir krašto iki jungių:

$$a_{fi} = \beta_n \cdot k_{flux} \cdot (t_{req} - t_{d,fi}) = 0,8 \cdot 1,5 \cdot (20 - 15) = 6 \text{ mm}.$$

Reikalingas minimalus andėklo storis įvertinant neapsaugotų medsraigčių paslėptomis galvutėmis atsparumą ugniai 20min:

$$h = h_p + a_{fi} = 16 + 6 = 22 \text{ mm}.$$

Išvada: 16mm storio medinė apkala pradeda irti po 21 min, naudojant neapsaugotus medsraigčius su paslėptomis galvutėmis antdėklą reikia pastorinti iki 22mm, kad jungtis užtikrintų 20 min atsparumą ugniai. Pasirenkamas medinio antdėklo plotis 25mm>22mm, Tolimesniuose skaičiavimuose apkalimas 25mm storio lenta skaitysis kaip esamo medinio elemento vieno šono pilna apsauga nuo ugnies. Neapsaugoti medsraigčiai su paslėptomis galvutėmis užtikrina 20min atsparumą ugniai, padidinant atstumus nuo elemento galo ir krašto per 6mm.

Skaičiuojami skerspjūvių efektyvieji skerspjūviai įvertinus apkalima lenta iš vienos arba kelių pusių. Gauti skerpejūviai naudojami laikomosios galios skaičiavimuose su gaisro apkrovų deriniais.

Gegnė, apkalta lenta iš dviejų šonų:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	57	87	0

**Gegnių, apkaltų lentyna iš dviejų pusių į plotį apanglėjimas**

Gaisro poveikio trukmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 60 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 170 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{\text{char},n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{\text{char},0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{\text{min}} := \text{if}(d_{\text{char},0} < 13, 8.15 \cdot d_{\text{char},0}^2 \cdot d_{\text{char},0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{\text{ef}} := d_{\text{char},n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{\text{ef}} := b = 60 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{\text{ef}} := h - d_{\text{ef}} = 147 \quad \text{mm}$$

Išvada: gegnės, apkaltos lenta iš dviejų pusių efektyvus skerspjūvis po 20min gaisro yra 147x60mm

Nauja gegnė:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	58	87	0

**Naujų gegnių apanglėjimas**

Gaisro poveikio stūkmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 100 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 170 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{\text{char},n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{\text{char},0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{\text{min}} := \text{if}(d_{\text{char},0} < 13, 8.15 \cdot d_{\text{char},0}^{0.2} \cdot d_{\text{char},0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{\text{ef}} := d_{\text{char},n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{\text{ef}} := b - 2d_{\text{ef}} = 54 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{\text{ef}} := h - d_{\text{ef}} = 147 \quad \text{mm}$$

Išvada: naujos gegnės efektyvus skerspjūvis po 20min gaisro yra 147x54mmKolona, apkalta lenta iš dviejų šonų skirtingomis skryptimis:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	59	87	0

**Kolonų, apkaltų lentyna iš dviejų skirtingų pusių apanglėjimas**

Gaisro poveikio trukmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 100 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 100 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{char,n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{char,0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{min} := \text{if}(d_{char,0} < 13, 8.15 \cdot d_{char,0}^2 \cdot d_{char,0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{ef} := d_{char,n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{ef} := b - d_{ef} = 77 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{ef} := h - d_{ef} = 77 \quad \text{mm}$$

Išvada: kolonos, apkaltos lenta iš dviejų pusių skirtingomis kryptimis efektyvus skerspjūvis po 20min gaisro yra 77x77mm

Nauja kolona:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	60	87	0

**Naujų kolonų apanglėjimas**

Gaisro poveikio stūkmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 120 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 120 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{\text{char},n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{\text{char},0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{\text{min}} := \text{if}(d_{\text{char},0} < 13, 8.15 \cdot d_{\text{char},0}^2 \cdot d_{\text{char},0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{\text{ef}} := d_{\text{char},n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{\text{ef}} := b - 2d_{\text{ef}} = 74 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{\text{ef}} := h - 2d_{\text{ef}} = 74 \quad \text{mm}$$

Išvada: naujos kolonos efektyvus skerspjūvis po 20min gaisro yra 74x74mmSija, apkalta lenta iš apačios:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	61	87	0

**Sijų, apkaltų lentyna iš apačios apanglėjimas**

Gaisro poveikio stumė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 100 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 170 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{\text{char},n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{\text{char},0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{\text{min}} := \text{if}(d_{\text{char},0} < 13, 8.15 \cdot d_{\text{char},0} \cdot 2 \cdot d_{\text{char},0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{\text{ef}} := d_{\text{char},n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{\text{ef}} := b - 2d_{\text{ef}} = 54 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{\text{ef}} := h - d_{\text{ef}} = 147 \quad \text{mm}$$

Išvada: sijų, apkaltos lenta iš apačios efektyvus skerspjūvis po 20min gaisro yra 147x54mmRyšys, apkaltas lenta iš vieno šono:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	62	87	0

Ryšių, apkaltų lentyna iš vienos pusės apanglėjimas

Gaisro poveikio trukmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 40 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 110 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{char,n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{char,0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{min} := \text{if}(d_{char,0} < 13, 8.15 \cdot d_{char,0}, 2 \cdot d_{char,0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{ef} := d_{char,n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{ef} := b - d_{ef} = 17 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{ef} := h - 2d_{ef} = 64 \quad \text{mm}$$

Išvada: ryšio, apkalto lenta iš vieno šono efektyvus skerspjūvis po 20min gaisro yra 64x17mm

Styga ir vertikalūs ryšys:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	63	87	0

**Stygos ir vertikalaus ryšio apanglėjimas**

Gaisro poveikio trukmė

$$t := 20 \quad \text{min}$$

Skerspjūvio plotis:

$$b := 60 \quad \text{mm}$$

Skerspjūvio aukštis:

$$h := 170 \quad \text{mm}$$

Sąlyginė anglijimo sparta (iš 3.1 lentelės):

$$\beta_n := 0.8$$

$$\beta_0 := 0.65$$

Sąlyginis apanglėjimo dydis:

$$d_{char,n} := \beta_n \cdot t = 16 \quad \text{mm}$$

$$d_{char,0} := \beta_0 \cdot t = 13 \quad \text{mm}$$

Pradinis mažiausias skerspjūvio plotas:

$$b_{min} := \text{if}(d_{char,0} < 13, 8.15 \cdot d_{char,0} \cdot 2 \cdot d_{char,0} + 80) = 106 \quad \text{mm}$$

$$k_0 := \text{if}\left(t < 20, \frac{t}{20}, 1\right) = 1$$

Efektyvusis apanglėjimo dydis:

$$d_{ef} := d_{char,n} + k_0 \cdot 7 = 23 \quad \text{mm}$$

Efektyvusis skerspjūvio plotis:

$$b_{ef} := b - 2d_{ef} = 14 \quad \text{mm}$$

Efektyvusis skerspjūvio aukštis:

$$h_{ef} := h - 2d_{ef} = 124 \quad \text{mm}$$

Išvada: stygos ir vertikalaus ryšio efektyvus skerspjūvis po 20min gaisro yra 124x14mm

Skaičiavimų rezultatai su gaisro apkrovų deriniais, skaičiavimuose naudojant elementų efektyviuosius skerspjūvius. Elementų liauniai ypatingų skaičiuotinių situacijų atveju netikrinami.

Esamos gegnės tikrinimas po 20min gaisro**CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 92 Gegnė_92**POINT:** 3**COORDINATE:** x = 0.34 L = 2.779958792 m**LOADS:**

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

$$g_M = 1.30$$

$$f_{m,0,k} = 18.00 \text{ MPa}$$

$$f_{t,0,k} = 11.00 \text{ MPa}$$

$$f_{c,0,k} = 18.00 \text{ MPa}$$

$$f_{v,k} = 3.40 \text{ MPa}$$

$$f_{t,90,k} = 0.40 \text{ MPa}$$

$$f_{c,90,k} = 2.20 \text{ MPa}$$

$$E_{0,moyen} = 9000.00 \text{ MPa}$$

$$E_{0,05} = 6000.00 \text{ MPa}$$

$$G_{moyen} = 560.00 \text{ MPa}$$

Service class: 1

$$\beta_{c0} = 0.20$$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	64	87	0

**SECTION PARAMETERS: RECT_147x60**

ht=14.7 cm

bf=6.0 cm

tw=3.0 cm

tf=3.0 cm

Ay=58.80 cm²Iy=1588.26 cm⁴Wy=216.09 cm³Az=58.80 cm²Iz=264.60 cm⁴Wz=88.20 cm³Ax=88.20 cm²Ix=786.2 cm⁴**STRESSES** $\text{Sig}_{c,0,d} = N/Ax = 0.58/88.20 = 0.07 \text{ MPa}$ $\text{Sig}_{m,y,d} = MY/Wy = 1.21/216.09 = 5.62 \text{ MPa}$ $\text{Sig}_{m,z,d} = MZ/Wz = 0.00/88.20 = 0.00 \text{ MPa}$ $\text{Tau}_{y,d} = 1.5 \cdot 0.00/88.20 = 0.00 \text{ MPa}$ $\text{Tau}_{z,d} = 1.5 \cdot 1.27/88.20 = -0.22 \text{ MPa}$ $\text{Tau}_{tory,d} = 0.00 \text{ MPa}, \text{Tau}_{torz,d} = 0.00 \text{ MPa}$ **ALLOWABLE STRESSES** $f_{c,0,d} = 11.08 \text{ MPa}$ $f_{m,y,d} = 11.12 \text{ MPa}$ $f_{m,z,d} = 13.30 \text{ MPa}$ $f_{v,d} = 2.09 \text{ MPa}$ **Factors and additional parameters**

km = 0.70

kh = 1.20

kmod = 0.80

Ksys = 1.00

kcr = 0.67

**LATERAL BUCKLING PARAMETERS:** $l_{eff} = 7.195378889 \text{ m}$ $\text{Lambda}_{rel} = 1.14$ $\text{Sig}_{cr} = 13.79 \text{ MPa}$

k crit = 0.70

BUCKLING PARAMETERS:

About Y axis:

LY = 0.100000000 m

 $\text{Lambda}_Y = 2.36$ $\text{Lambda}_{rel}_Y = 0.04$

ky = 0.47

LFY = 0.100000000 m

kcy = 1.00



About Z axis:

LZ = 2.500000000 m

 $\text{Lambda}_Z = 144.34$ $\text{Lambda}_{rel}_Z = 2.52$

kz = 3.89

LFZ = 2.500000000 m

kcz = 0.15

VERIFICATION FORMULAS: $(\text{Sig}_{c,0,d}/k_{c,y} \cdot f_{c,0,d}) + \text{Sig}_{m,y,d}/f_{m,y,d} + k_{m,z} \cdot \text{Sig}_{m,z,d}/f_{m,z,d} = 0.51 < 1.00 \quad (6.23)$ $\text{Sig}_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 5.62/(0.70 \cdot 11.12) = 0.72 < 1.00 \quad (6.33)$ $(\text{Tau}_{y,d}/k_{cr} + \text{Tau}_{tory,d}/k_{shape})/f_{v,d} = 0.00 < 1.00 \quad (\text{Tau}_{z,d}/k_{cr} + \text{Tau}_{torz,d}/k_{shape})/f_{v,d} = 0.15 < 1.00 \quad (6.13-4)$ **Section OK !!!****Išvada: sąlyga tenkinama****Naujos gegnės tikrinimas po 20min gaisro****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 187 NAuja Gegnė_187
= 2.779970226 m**POINT:** 1**COORDINATE:** x = 0.34 L**LOADS:**

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

gM = 1.30

 $f_{v,k} = 3.40 \text{ MPa}$ $E_{0,05} = 6000.00 \text{ MPa}$ $f_{m,0,k} = 18.00 \text{ MPa}$ $f_{t,90,k} = 0.40 \text{ MPa}$

G moyen = 560.00 MPa

 $f_{t,0,k} = 11.00 \text{ MPa}$ $f_{c,90,k} = 2.20 \text{ MPa}$

Service class: 1

 $f_{c,0,k} = 18.00 \text{ MPa}$ $E_{0,moyen} = 9000.00 \text{ MPa}$

Beta c = 0.20

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	65	87	0



SECTION PARAMETERS: RECT_147x54

ht=14.7 cm
 bf=5.4 cm Ay=52.92 cm² Az=52.92 cm² Ax=79.38 cm²
 tw=2.7 cm Iy=1429.44 cm⁴ Iz=192.89 cm⁴ Ix=593.0 cm⁴
 tf=2.7 cm Wy=194.48 cm³ Wz=71.44 cm³

STRESSES

Sig_{t,0,d} = N/Ax = -0.64/79.38 = -0.08 MPa
 Sig_{m,y,d} = MY/Wy = -1.21/194.48 = -6.21 MPa
 Sig_{m,z,d} = MZ/Wz = -0.00/71.44 = -0.00 MPa
 Tau_{y,d} = 1.5*0.00/79.38 = 0.00 MPa
 Tau_{z,d} = 1.5*1.42/79.38 = 0.27 MPa

ALLOWABLE STRESSES

f_{t,0,d} = 8.30 MPa
 f_{m,y,d} = 11.12 MPa
 f_{m,z,d} = 13.59 MPa
 f_{v,d} = 2.09 MPa

Factors and additional parameters

km = 0.70 kh = 1.23 kmod = 0.80 Ksys = 1.00 kcr = 0.67



LATERAL BUCKLING PARAMETERS:

lef = 7.195379146 m Lambda_{rel m} = 1.26
 Sig_{cr} = 11.36 MPa k_{crit} = 0.62

BUCKLING PARAMETERS:



About Y axis:



About Z axis:

VERIFICATION FORMULAS:

Sig_{t,0,d}/f_{t,0,d} + Sig_{m,y,d}/f_{m,y,d} + km*Sig_{m,z,d}/f_{m,z,d} = 0.57 < 1.00 (6.17)
 Sig_{m,y,d}/(k_{crit}*f_{m,y,d}) = 6.21/(0.62*11.12) = 0.91 < 1.00 (6.33)
 (Tau_{y,d}/kcr)/f_{v,d} = (0.00/0.67)/2.09 = 0.00 < 1.00 (Tau_{z,d}/kcr)/f_{v,d} = (0.27/0.67)/2.09 = 0.19 < 1.00 (6.13)

Section OK !!!

Išvada: sąlyga tenkinama

Esamos kolonos tikrinimas po 20min gaisro

CODE: EN 1995-1:2004/A2:2014

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 52 kolona1_52 **POINT:** 1 **COORDINATE:** x = 0.88 L = 2.420000000 m

LOADS:

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

gM = 1.30 f_{m,0,k} = 18.00 MPa f_{t,0,k} = 11.00 MPa f_{c,0,k} = 18.00 MPa
 f_{v,k} = 3.40 MPa f_{t,90,k} = 0.40 MPa f_{c,90,k} = 2.20 MPa E_{0,moyen} = 9000.00 MPa
 E_{0,05} = 6000.00 MPa G_{moyen} = 560.00 MPa Service class: 1 Beta_c = 0.20



SECTION PARAMETERS: RECT_77x77

ht=7.7 cm
 bf=7.7 cm Ay=39.53 cm² Az=39.53 cm² Ax=59.29 cm²
 tw=3.9 cm Iy=292.94 cm⁴ Iz=292.94 cm⁴ Ix=433.6 cm⁴

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	66	87	0



tf=3.9 cm

Wy=76.09 cm³Wz=76.09 cm³**STRESSES**

Sig_c,0,d = N/Ax = 7.55/59.29 = 1.27 MPa

Sig_m,y,d = MY/Wy = 0.00/76.09 = 0.02 MPa

Sig_m,z,d = MZ/Wz = 0.03/76.09 = 0.42 MPa

Tau_y,d = 1.5*-0.10/59.29 = -0.02 MPa

Tau_z,d = 1.5*0.00/59.29 = 0.00 MPa

ALLOWABLE STRESSES

f_c,0,d = 11.08 MPa

f_m,y,d = 12.66 MPa

f_m,z,d = 12.66 MPa

f_v,d = 2.09 MPa

Factors and additional parameters

km = 0.70

kh = 1.14

kmod = 0.80

Ksys = 1.00

kcr = 0.67

**LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:

LY = 2.750000000 m

Lambda Y = 123.72

Lambda_rel Y = 2.16

ky = 3.01

LFY = 2.750000000 m

kcy = 0.20



About Z axis:

LZ = 2.750000000 m

Lambda Z = 123.72

Lambda_rel Z = 2.16

kz = 3.01

LFZ = 2.750000000 m

kcz = 0.20

VERIFICATION FORMULAS:

Sig_c,0,d/(kcy*f_c,0,d) + km*Sig_m,y,d/f_m,y,d + Sig_m,z,d/f_m,z,d = 0.62 < 1.00 (6.24)

(Tau_y,d/kcr)/f_v,d = (0.02/0.67)/2.09 = 0.02 < 1.00 (Tau_z,d/kcr)/f_v,d = (0.00/0.67)/2.09 = 0.00 < 1.00 (6.13)

Section OK !!!**Išvada: sąlyga tenkinama****Naujos kolonos tikrinimas po 20min gaisro****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 140 nauja kolona2_140
= 2.749986500 m**POINT:** 3**COORDINATE:** x = 1.00 L**LOADS:**

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

gM = 1.30

f_m,0,k = 18.00 MPa

f_t,0,k = 11.00 MPa

f_c,0,k = 18.00 MPa

f_v,k = 3.40 MPa

f_t,90,k = 0.40 MPa

f_c,90,k = 2.20 MPa

E_0,moyen = 9000.00 MPa

E_0,05 = 6000.00 MPa

G_moyen = 560.00 MPa

Service class: 1

Beta_c = 0.20

**SECTION PARAMETERS: RECT_74x74**

ht=7.4 cm

bf=7.4 cm

tw=3.7 cm

tf=3.7 cm

Ay=36.51 cm²Iy=249.89 cm⁴Wy=67.54 cm³Az=36.51 cm²Iz=249.89 cm⁴Wz=67.54 cm³Ax=54.76 cm²Ix=421.6 cm⁴**STRESSES**

Sig_c,0,d = N/Ax = 8.48/54.76 = 1.55 MPa

ALLOWABLE STRESSES

f_c,0,d = 11.08 MPa

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	67	87	0

**Factors and additional parameters**

kh = 1.15 kmod = 0.80 Ksys = 1.00

**LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:

LY = 2.749986500 m Lambda Y = 128.73
 Lambda_rel Y = 2.24 ky = 3.21
 LFY = 2.749986500 m kcy = 0.18



About Z axis:

LZ = 2.749986500 m Lambda Z = 128.73
 Lambda_rel Z = 2.24 kz = 3.21
 LFZ = 2.749986500 m kcz = 0.18

VERIFICATION FORMULAS:

Sig_c,0,d/f_c,0,d = 1.55/11.08 = 0.14 < 1.00 (6.23-4)]

Sig_c,0,d/(kc*f_c,0,d) = 1.55/(0.18*11.08) = 0.77 < 1.00 (6.23-4)

Section OK !!!**Išvada: sąlyga tenkinama****Sijos tikrinimas po 20min gaisro****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 116**POINT:** 1**COORDINATE:** x = 0.00 L = 0.000000000 m**LOADS:**

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

gM = 1.30 f_m,0,k = 18.00 MPa f_t,0,k = 11.00 MPa f_c,0,k = 18.00 MPa
 f_v,k = 3.40 MPa f_t,90,k = 0.40 MPa f_c,90,k = 2.20 MPa E_0,moyen = 9000.00 MPa
 E_0,05 = 6000.00 MPa G_moyen = 560.00 MPa Service class: 1 Beta_c = 0.20

**SECTION PARAMETERS: RECT_147x54**

ht=14.7 cm Ay=52.92 cm² Az=52.92 cm² Ax=79.38 cm²
 bf=5.4 cm Iy=1429.44 cm⁴ Iz=192.89 cm⁴ Ix=593.0 cm⁴
 tw=2.7 cm Wy=194.48 cm³ Wz=71.44 cm³ tf=2.7 cm

STRESSES

Sig_t,0,d = N/Ax = -0.01/79.38 = -0.00 MPa
 Sig_m,y,d = MY/Wy = -1.01/194.48 = -5.17 MPa
 Sig_m,z,d = MZ/Wz = -0.02/71.44 = -0.25 MPa
 Tau_y,d = 1.5*0.08/79.38 = 0.01 MPa
 Tau_z,d = 1.5*3.72/79.38 = 0.70 MPa
 Tau_tory,d = 0.02 MPa, Tau_torz,d = 0.02 MPa

ALLOWABLE STRESSES

f_t,0,d = 8.30 MPa
 f_m,y,d = 11.12 MPa
 f_m,z,d = 13.59 MPa
 f_v,d = 2.09 MPa

Factors and additional parameters

km = 0.70 kh = 1.23 kmod = 0.80 Ksys = 1.00 kcr = 0.67

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	68	87	0

**LATERAL BUCKLING PARAMETERS:**

$l_{ef} = 8.100013361 \text{ m}$ $\Lambda_{rel m} = 1.34$
 $\sigma_{cr} = 10.09 \text{ MPa}$ $k_{crit} = 0.56$

BUCKLING PARAMETERS:

About Y axis:



About Z axis:

VERIFICATION FORMULAS:

$\sigma_{t,0,d}/f_{t,0,d} + \sigma_{m,y,d}/f_{m,y,d} + k_m \cdot \sigma_{m,z,d}/f_{m,z,d} = 0.48 < 1.00 \quad (6.17)$
 $\sigma_{m,y,d}/(k_{crit} \cdot f_{m,y,d}) = 5.17/(0.56 \cdot 11.12) = 0.83 < 1.00 \quad (6.33)$
 $(\tau_{y,d}/k_{cr} + \tau_{t,0,d}/k_{shape})/f_{v,d} = 0.02 < 1.00 \quad (\tau_{z,d}/k_{cr} + \tau_{t,0,d}/k_{shape})/f_{v,d} = 0.51 < 1.00 \quad (6.13-4)$

Section OK !!!**Išvada: sąlyga tenkinama****Ryšio tikrinimas 20 min po gaisro****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 130 styga2_130**POINT:** 3**COORDINATE:** x = 1.00 L = 1.858973463 m**LOADS:**

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

$g_m = 1.30$ $f_{m,0,k} = 18.00 \text{ MPa}$ $f_{t,0,k} = 11.00 \text{ MPa}$ $f_{c,0,k} = 18.00 \text{ MPa}$
 $f_{v,k} = 3.40 \text{ MPa}$ $f_{t,90,k} = 0.40 \text{ MPa}$ $f_{c,90,k} = 2.20 \text{ MPa}$ $E_{0,moyen} = 9000.00 \text{ MPa}$
 $E_{0,05} = 6000.00 \text{ MPa}$ $G_{moyen} = 560.00 \text{ MPa}$ Service class: 1 $\beta_{ca} = 0.20$

**SECTION PARAMETERS: RECT_64x17**

$h_t = 6.4 \text{ cm}$ $A_y = 7.25 \text{ cm}^2$ $A_z = 7.25 \text{ cm}^2$ $A_x = 10.88 \text{ cm}^2$
 $b_f = 1.7 \text{ cm}$ $I_y = 37.14 \text{ cm}^4$ $I_z = 2.62 \text{ cm}^4$ $I_x = 8.7 \text{ cm}^4$
 $t_w = 0.9 \text{ cm}$ $W_y = 11.61 \text{ cm}^3$ $W_z = 3.08 \text{ cm}^3$

STRESSES $\sigma_{c,0,d} = N/A_x = 0.01/10.88 = 0.01 \text{ MPa}$ $\tau_{z,d} = 1.5 \cdot -0.00/10.88 = -0.00 \text{ MPa}$ **ALLOWABLE STRESSES** $f_{c,0,d} = 11.08 \text{ MPa}$ $f_{v,d} = 2.09 \text{ MPa}$ **Factors and additional parameters** $k_h = 1.30$ $k_{mod} = 0.80$ $K_{sys} = 1.00$ $k_{cr} = 0.67$ **LATERAL BUCKLING PARAMETERS:****BUCKLING PARAMETERS:**

About Y axis:

 $L_Y = 1.858973463 \text{ m}$ $\Lambda_Y = 100.62$ 

About Z axis:

 $L_Z = 1.858973463 \text{ m}$ $\Lambda_Z = 378.80$

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	69	87	0



Lambda_rel Y = 1.75 ky = 2.18 Lambda_rel Z = 6.60 kz = 22.94
 LFY = 1.858973463 m kcy = 0.29 LFZ = 1.858973463 m kcz = 0.02

VERIFICATION FORMULAS:

Sig_c,0,d/f_c,0,d = 0.01/11.08 = 0.00 < 1.00 (6.23-4)
 Sig_c,0,d/(kc*f_c,0,d) = 0.01/(0.02*11.08) = 0.05 < 1.00 (6.23-4)
 (Tau_z,d/kcr)/f_v,d = (0.00/0.67)/2.09 = 0.00 < 1.00 (6.13)

Section OK !!!**Išvada: sąlyga tenkinama****Stygos tikrinimas po 20min gaisro****CODE:** EN 1995-1:2004/A2:2014**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 210 styga3_210**POINT:** 2**COORDINATE:** x = 0.50 L = 2.388824900 m**LOADS:**

Governing Load Case: 4 ULS/2=1*1.00 1*1.00

MATERIAL C18

gM = 1.30 f_m,0,k = 18.00 MPa f_t,0,k = 11.00 MPa f_c,0,k = 18.00 MPa
 f_v,k = 3.40 MPa f_t,90,k = 0.40 MPa f_c,90,k = 2.20 MPa E_0,moyen = 9000.00 MPa
 E_0,05 = 6000.00 MPa G_moyen = 560.00 MPa Service class: 1 Beta_c = 0.20

**SECTION PARAMETERS: RECT_147x14**

ht=14.7 cm Ay=13.72 cm² Az=13.72 cm² Ax=20.58 cm²
 bf=1.4 cm Iy=370.59 cm⁴ Iz=3.36 cm⁴ Ix=12.6 cm⁴
 tw=0.7 cm Wy=50.42 cm³ Wz=4.80 cm³

STRESSES

Sig_t,0,d = N/Ax = -0.09/20.58 = -0.04 MPa
 Sig_m,y,d = MY/Wy = -0.02/50.42 = -0.37 MPa

ALLOWABLE STRESSES

f_t,0,d = 6.60 MPa
 f_m,y,d = 8.34 MPa

Factors and additional parameters

kh = 1.30 kh_y = 1.00 kmod = 0.60 Ksys = 1.00

**LATERAL BUCKLING PARAMETERS:**

lef = 4.299884820 m Lambda_rel m = 3.57
 Sig_cr = 1.41 MPa k_crit = 0.08

BUCKLING PARAMETERS:

About Y axis:



About Z axis:

VERIFICATION FORMULAS:

Sig_t,0,d/f_t,0,d + Sig_m,y,d/f_m,y,d = 0.04/6.60 + 0.37/8.34 = 0.05 < 1.00 (6.17)
 Sig_m,y,d/(k_crit*f_m,y,d) = 0.37/(0.08*8.34) = 0.56 < 1.00 (6.33)

Section OK !!!**Išvada: sąlyga tenkinama**

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	70	87	0

Vertikalaus ryšio tikrinimas po 20min gaisro

CODE: EN 1995-1:2004/A2:2014
ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 36 VR_36

POINT: 2

COORDINATE: x = 0.50 L = 2.808979722 m

LOADS:

Governing Load Case: 3 ULS/1=1*1.00 + 2*0.50 1*1.00+2*0.50

MATERIAL C18

gM = 1.30 f m,0,k = 18.00 MPa f t,0,k = 11.00 MPa f c,0,k = 18.00 MPa
 f v,k = 3.40 MPa f t,90,k = 0.40 MPa f c,90,k = 2.20 MPa E 0,moyen = 9000.00 MPa
 E 0,05 = 6000.00 MPa G moyen = 560.00 MPa Service class: 1 Beta c = 0.20



SECTION PARAMETERS: RECT_147x14

ht=14.7 cm
 bf=1.4 cm Ay=13.72 cm² Az=13.72 cm² Ax=20.58 cm²
 tw=0.7 cm Iy=370.59 cm⁴ Iz=3.36 cm⁴ Ix=12.6 cm⁴
 tf=0.7 cm Wy=50.42 cm³ Wz=4.80 cm³

STRESSES

Sig_c,0,d = N/Ax = 0.12/20.58 = 0.06 MPa
 Sig_m,y,d = MY/Wy = 0.02/50.42 = 0.46 MPa

ALLOWABLE STRESSES

f c,0,d = 11.08 MPa
 f m,y,d = 11.12 MPa

Factors and additional parameters

kh = 1.30 kh_y = 1.00 kmod = 0.80 Ksys = 1.00



LATERAL BUCKLING PARAMETERS:

lef = 2.528081750 m Lambda_rel m = 2.74
 Sig_cr = 2.40 MPa k crit = 0.13

BUCKLING PARAMETERS:



About Y axis:

LY = 2.808979722 m Lambda Y = 66.19
 Lambda_rel Y = 1.15 ky = 1.25
 LFY = 2.808979722 m kcy = 0.58



About Z axis:

LZ = 2.808979722 m Lambda Z = 695.04
 Lambda_rel Z = 12.12 kz = 75.10
 LFZ = 2.808979722 m kcz = 0.01

VERIFICATION FORMULAS:

Sig_c,0,d/(kc,z*f c,0,d) + km*Sig_m,y,d/f m,y,d = 0.06/(0.01*11.08) + 0.70*0.46/11.12 = 0.83 < 1.00 (6.24)
 Sig_c,0,d/(kc,z*f c,0,d) + (Sig_m,y,d/(kcrit*f m,y,d))^2 = 0.06/(0.01*11.08) + (0.46/(0.13*11.12))^2 = 0.90 < 1.00 (6.35)

Section OK !!!

Išvada: sąlyga tenkinama

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	71	87	0



BENDRA IŠVADA:

- Apkalus 25mm storio lenta esamas gegnes iš dviejų šonų, esamas kolonas iš dviejų šonų skirtingomis kryptimis, siją iš apačios ir ryšius iš vieno šono stogo konstrukcijos atiinka R20 ugniaatsparumą.

2.6.4. Esamų pamatų po vidinėmis kolonomis tikrinimas

Tikrinami esami seklieji pamatai. Mažiausios kolonos geometrija 720x630mm. Priimama pamato po kolona geometrija 2,0x1,9m. Statybų metu keičiant grindis atkasti pamatus ir patikrinti jų geometriją. Esami pamatai remiasi 1,5m gylyje ant IGS4. Atrėmimo vietoje grunto mechaniniai rodikliai: $q_c=4,8\text{MPa}$.

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	72	87	0

**Veikiančios įrašos:**

Įrašos atvejui A1:

$$N_{Ed,1} := 1744 \text{ kN}$$

$$V_{Ed,x,1} := 0.1 \text{ kN}$$

$$V_{Ed,y,1} := 0.1 \text{ kN}$$

$$M_{Ed,x,1} := 0.1 \text{ kNm}$$

$$M_{Ed,y,1} := 0.1 \text{ kNm}$$

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$$\gamma_{\varphi,1} := 1$$

$$\gamma_{c,1} := 1$$

$$\gamma_{cu,1} := 1$$

$$\gamma_{qu,1} := 1$$

$$\gamma_{\gamma} := 1$$

Daliniai medžiagų patikimumo koef. atvejui M2:

$$\gamma_{\varphi,2} := 1.25$$

$$\gamma_{c,2} := 1.25$$

$$\gamma_{cu,2} := 1.4$$

$$\gamma_{qu,2} := 1.4$$

$$\gamma_{\gamma} := 1$$

Daliniai stiprumo koeficientai:

	Atvejui R1:	Atvejui R2:	Atvejui R3:
Gniuždymui :	$\gamma_{R,v,1} := 1$	$\gamma_{R,v,2} := 1.4$	$\gamma_{R,v,3} := 1$
Kirpimui :	$\gamma_{R,h,1} := 1$	$\gamma_{R,h,2} := 1.1$	$\gamma_{R,h,3} := 1$

Grunto rodikliai:

$$\rho := 26.5 \frac{\text{kN}}{\text{m}^3}$$

$$E := 10 \text{ MPa}$$

Sankiba :

$$c_c := 0 \text{ kPa}$$

$$q_c := 4.8 \text{ MPa}$$

$$\varphi := 32$$

Geometriniai rodikliai:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	73	87	0

$$h_1 := 0.3 \quad \text{m}$$

$$h := 0.3 \quad \text{m}$$

$$L := 2.0 \quad \text{m}$$

$$B := 1.9 \quad \text{m}$$

Posvyrio kampas (radianais):

$$\alpha := 0$$

Pamato svoris:

$$q_p := L \cdot B \cdot h \cdot 2500 = 2.85 \times 10^3 \quad \text{kg}$$

$$q_{pd} := q_p \cdot 10 \cdot 10^{-3} = 28.5 \quad \text{kN}$$

Preliminarūs pado matmenys:

$$M_1 := V_{Ed,x,1} \cdot h + M_{Ed,y,1} = 0.13 \quad \text{kNm}$$

$$M_2 := V_{Ed,y,1} \cdot h + M_{Ed,x,1} = 0.13 \quad \text{kNm}$$

$$e_1 := \frac{M_1}{N_{Ed,1}} = 7.454 \times 10^{-5} \quad \frac{L}{6} = 0.333$$

$$e_2 := \frac{M_2}{N_{Ed,1}} = 7.454 \times 10^{-5} \quad \frac{B}{6} = 0.317$$

Efektyvusis pado plotas:

$$L_{ef} := L - 2 \cdot e_1 = 2 \quad \text{m}$$

$$B_{ef} := B - 2e_2 = 1.9 \quad \text{m}$$

$$A_{ef} := B_{ef} \cdot L_{ef} = 3.799 \quad \text{m}^2$$

Laikomoji galia:

$$R := 1 \cdot 1 \cdot 0.1 \cdot q_c = 0.48 \quad \text{MPa}$$

Reikalingas plotas:

$$A_r := \frac{N_{Ed,1}}{R \cdot 10^3} = 3.633 \quad \text{m}^2 \quad A_{ef} = 3.799 \quad \text{Gerai!}$$

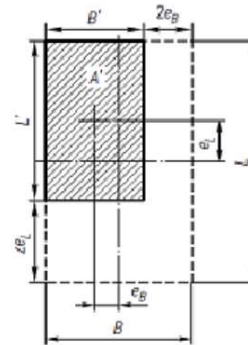
Pirmas projektavimo atvejis:

A1+M1+R1

Drenuojančios sąlygos:

Efektyvioji sankiba:

$$c_1 := \frac{c}{\gamma_{c,1}} = 0 \quad \text{kPa}$$



IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	74	87	0

Priekrovos svoris:

$$q := h_1 \cdot \rho \cdot 1.35 = 10.732 \quad \text{kPa}$$

Efektyvusis grunto slėgis:

$$q = 10.732 \quad \text{kPa}$$

Vienetinis svoris:

$$\gamma_1 := \frac{\rho}{\gamma_\gamma} = 26.5$$

Vidinės trinties kampo tangentas:

$$\tan \varphi := \frac{\tan(\varphi \cdot \text{deg})}{\gamma_{\varphi,1}} = 0.625$$

$$e = 2.718$$

Bedimensiniai koeficientai:

Laikomosios galios:

$$N_{q,1} := e^{\pi \tan \varphi} \cdot \left[\tan \left[\left(45 + \frac{\varphi}{2} \right) \cdot \text{deg} \right] \right]^2 = 23.177$$

$$N_{c,1} := (N_{q,1} - 1) \cdot \frac{\cos(\varphi \cdot \text{deg})}{\sin(\varphi \cdot \text{deg})} = 35.49$$

$$N_{\gamma,1} := 2 \cdot (N_{q,1} - 1) \cdot \tan \varphi = 27.715$$

Pamato pado posvyrio:

$$b_{q,1} := (1 - \alpha \cdot \tan \varphi)^2 = 1$$

$$b_{c,1} := b_{q,1} - \frac{(1 - b_{q,1})}{N_{c,1} \cdot \tan \varphi} = 1$$

$$b_{\gamma,1} := b_{q,1} = 1$$

Pamato pado formos:

$$s_{q,1} := 1 + \frac{B_{ef}}{L_{ef}} \cdot \sin(\varphi \cdot \text{deg}) = 1.503$$

$$s_{\gamma,1} := 1 - 0.3 \cdot \frac{B_{ef}}{L_{ef}} = 0.715$$

$$s_{c,1} := \frac{s_{q,1} \cdot N_{q,1} - 1}{N_{q,1} - 1} = 1.526$$

Apkrovos posvyrio:

$$m_L := \frac{2 + \frac{L_{ef}}{B_{ef}}}{1 + \frac{L_{ef}}{B_{ef}}} = 1.487$$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	75	87	0

$$m_B := \frac{2 + \frac{B_{ef}}{L_{ef}}}{1 + \frac{B_{ef}}{L_{ef}}} = 1.513$$

$$\phi := \text{atan}\left(\frac{V_{Ed,x,1}}{V_{Ed,y,1}}\right) \cdot \frac{180}{\pi} = 45$$

$$m := m_L \cdot \cos(\phi \cdot \text{deg})^2 + m_B \cdot \sin(\phi \cdot \text{deg})^2 = 1.5$$

$$i_{q,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^m = 1$$

$$i_{c,1} := i_{q,1} - \frac{1 - i_{q,1}}{N_{c,1} \cdot \tan \varphi} = 1$$

$$i_{\gamma,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^{(m+1)} = 1$$

$$R_{2,1} := c_1 \cdot N_{c,1} \cdot b_{c,1} \cdot s_{c,1} \cdot i_{c,1} + q \cdot N_{q,1} \cdot b_{q,1} \cdot s_{q,1} \cdot i_{q,1} + 0.5 \cdot \gamma_1 \cdot B \cdot N_{\gamma,1} \cdot b_{\gamma,1} \cdot s_{\gamma,1} \cdot i_{\gamma,1} = 872.701$$

$$A_{2,1} := \frac{N_{Ed,1}}{R_{2,1}} = 1.998 \quad A_{ef} = 3.799 \quad \text{Gerai!}$$

$$\frac{A_{2,1}}{A_{ef}} \cdot 100 = 52.597$$

Išvada: sąlygos tenkinamos.

2.6.5. Esamų pamatų po išorinėmis sienomis tikrinimas

Tikrinami esami seklieji pamatai. Išorinės rūšio sienos plotis 500mm. Priimamas išorinės sienos pamato plotis 800mm. Esami pamatai remiasi 1,5m gylyje ant IGS4. Atrėmimo vietoje grunto mechaniniai rodikliai: $q_c=4,8\text{MPa}$.

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	76	87	0

Veikiančios įrašos:

Įrašos atvejui A1:

$$N_{Ed,1} := 376.4 \text{ kN}$$

$$V_{Ed,x,1} := 0.1 \text{ kN}$$

$$V_{Ed,y,1} := 0.1 \text{ kN}$$

$$M_{Ed,x,1} := 0.1 \text{ kNm}$$

$$M_{Ed,y,1} := 0.1 \text{ kNm}$$

Daliniai koeficientai:

Daliniai medžiagų patikimumo koef. atvejui M1:

$$\gamma_{\varphi,1} := 1$$

$$\gamma_{c,1} := 1$$

$$\gamma_{cu,1} := 1$$

$$\gamma_{qu,1} := 1$$

$$\gamma_{\gamma} := 1$$

Daliniai medžiagų patikimumo koef. atvejui M2:

$$\gamma_{\varphi,2} := 1.25$$

$$\gamma_{c,2} := 1.25$$

$$\gamma_{cu,2} := 1.4$$

$$\gamma_{qu,2} := 1.4$$

$$\gamma_{\gamma} := 1$$

Daliniai stiprumo koeficientai:

	Atvejui R1:	Atvejui R2:	Atvejui R3:
Gniuždymui :	$\gamma_{R,v,1} := 1$	$\gamma_{R,v,2} := 1.4$	$\gamma_{R,v,3} := 1$
Kirpimui :	$\gamma_{R,h,1} := 1$	$\gamma_{R,h,2} := 1.1$	$\gamma_{R,h,3} := 1$

Grunto rodikliai:

$$\rho := 26.5 \frac{\text{kN}}{\text{m}^3}$$

$$E := 10 \text{ MPa}$$

Sankiba :

$$c := 0 \text{ kPa}$$

$$q_c := 4.8 \text{ MPa}$$

$$\varphi := 32$$

Geometriniai rodikliai:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	77	87	0

$$h_1 := 0.3 \quad \text{m}$$

$$h := 0.3 \quad \text{m}$$

$$L := 1 \quad \text{m}$$

$$B := 0.8 \quad \text{m}$$

Posvyrio kampas (radianais):

$$\alpha := 0$$

Pamato svoris:

$$q_p := L \cdot B \cdot h \cdot 2500 = 600 \quad \text{kg}$$

$$q_{pd} := q_p \cdot 10 \cdot 10^{-3} = 6 \quad \text{kN}$$

Preliminarūs pado matmenys:

$$M_1 := V_{Ed,x,1} \cdot h + M_{Ed,y,1} = 0.13 \quad \text{kNm}$$

$$M_2 := V_{Ed,y,1} \cdot h + M_{Ed,x,1} = 0.13 \quad \text{kNm}$$

$$e_1 := \frac{M_1}{N_{Ed,1}} = 3.454 \times 10^{-4} \quad \frac{L}{6} = 0.167$$

$$e_2 := \frac{M_2}{N_{Ed,1}} = 3.454 \times 10^{-4} \quad \frac{B}{6} = 0.133$$

Efektyvusis pado plotas:

$$L_{ef} := L - 2 \cdot e_1 = 0.999 \quad \text{m}$$

$$B_{ef} := B - 2e_2 = 0.799 \quad \text{m}$$

$$A_{ef} := B_{ef} \cdot L_{ef} = 0.799 \quad \text{m}^2$$

Laikomoji galia:

$$R_{\text{red}} := 1 \cdot 1 \cdot 0.1 \cdot q_c = 0.48 \quad \text{MPa}$$

Reikalingas plotas:

$$A_r := \frac{N_{Ed,1}}{R \cdot 10^3} = 0.784 \quad \text{m}^2 \quad A_{ef} = 0.799 \quad \text{Gerai!}$$

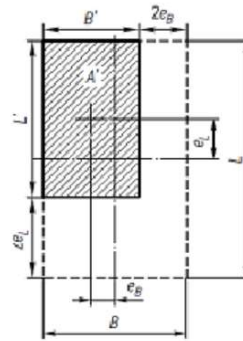
Pirmas projektavimo atvejis:

A1+M1+R1

Drenuojančios sąlygos:

Efektyvioji sankiba:

$$c_1 := \frac{c}{\gamma_{c,1}} = 0 \quad \text{kPa}$$



IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	78	87	0

Priekrovos svoris:

$$q := h_1 \cdot \rho \cdot 1.35 = 10.732 \quad \text{kPa}$$

Efektvusis grunto slėgis:

$$q = 10.732 \quad \text{kPa}$$

Vienetinis svoris:

$$\gamma_1 := \frac{\rho}{\gamma_\gamma} = 26.5$$

Vidinės trinties kampo tangentas:

$$\tan \varphi := \frac{\tan(\varphi \cdot \text{deg})}{\gamma_{\varphi,1}} = 0.625$$

$$e = 2.718$$

Bedimensiniai koeficientai:

Laikomosios galios:

$$N_{q,1} := e^{\pi \tan \varphi} \cdot \left[\tan \left(45 + \frac{\varphi}{2} \right) \cdot \text{deg} \right]^2 = 23.177$$

$$N_{c,1} := (N_{q,1} - 1) \cdot \frac{\cos(\varphi \cdot \text{deg})}{\sin(\varphi \cdot \text{deg})} = 35.49$$

$$N_{\gamma,1} := 2 \cdot (N_{q,1} - 1) \cdot \tan \varphi = 27.715$$

Pamato pado posvyrio:

$$b_{q,1} := (1 - \alpha \cdot \tan \varphi)^2 = 1$$

$$b_{c,1} := b_{q,1} - \frac{(1 - b_{q,1})}{N_{c,1} \cdot \tan \varphi} = 1$$

$$b_{\gamma,1} := b_{q,1} = 1$$

Pamato pado formos:

$$s_{q,1} := 1 + \frac{B_{ef}}{L_{ef}} \cdot \sin(\varphi \cdot \text{deg}) = 1.424$$

$$s_{\gamma,1} := 1 - 0.3 \cdot \frac{B_{ef}}{L_{ef}} = 0.76$$

$$s_{c,1} := \frac{s_{q,1} \cdot N_{q,1} - 1}{N_{q,1} - 1} = 1.443$$

Apkrovos posvyrio:

$$m_L := \frac{2 + \frac{L_{ef}}{B_{ef}}}{1 + \frac{L_{ef}}{B_{ef}}} = 1.444$$

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	79	87	0

$$m_B := \frac{2 + \frac{B_{ef}}{L_{ef}}}{1 + \frac{B_{ef}}{L_{ef}}} = 1.556$$

$$\phi := \text{atan}\left(\frac{V_{Ed,x,1}}{V_{Ed,y,1}}\right) \cdot \frac{180}{\pi} = 45$$

$$m := m_L \cdot \cos(\phi \cdot \text{deg})^2 + m_B \cdot \sin(\phi \cdot \text{deg})^2 = 1.5$$

$$i_{q,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^m = 0.999$$

$$i_{q,1} := i_{q,1} - \frac{1 - i_{q,1}}{N_{c,1} \cdot \tan \varphi} = 0.999$$

$$i_{\gamma,1} := \left(1 - \frac{V_{Ed}}{N_{Ed,1} + q_{pd} + A_{ef} \cdot c_1 \cdot \frac{1}{\tan \varphi}}\right)^{(m+1)} = 0.999$$

$$R_{2,1} := c_1 \cdot N_{c,1} \cdot b_{c,1} \cdot s_{c,1} \cdot i_{c,1} + q \cdot N_{q,1} \cdot b_{q,1} \cdot s_{q,1} \cdot i_{q,1} + 0.5 \cdot \gamma_1 \cdot B \cdot N_{\gamma,1} \cdot b_{\gamma,1} \cdot s_{\gamma,1} \cdot i_{\gamma,1} = 577.061$$

$$A_{2,1} := \frac{N_{Ed,1}}{R_{2,1}} = 0.652 \quad A_{ef} = 0.799 \quad \text{Gerai!}$$

$$\frac{A_{2,1}}{A_{ef}} \cdot 100 = 81.661$$

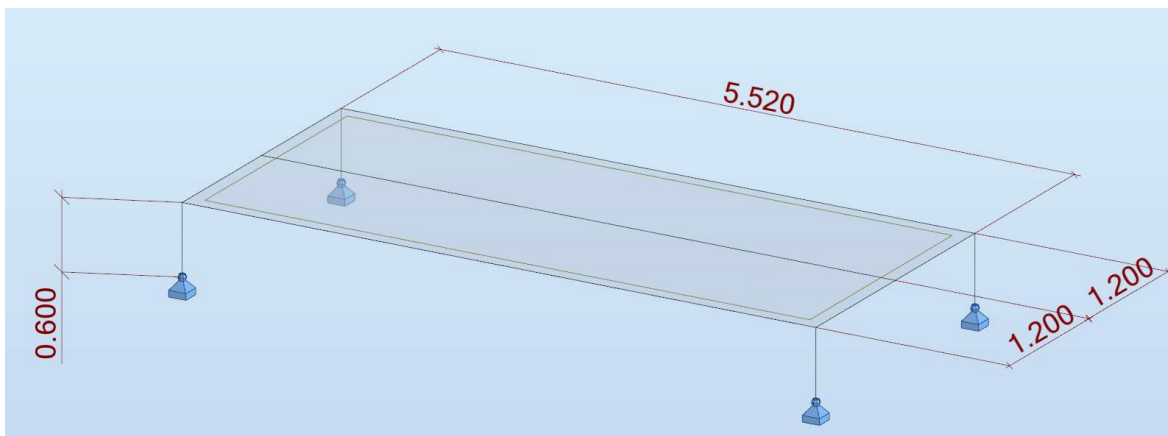
Išvada: sąlygos tenkinamos.

2.7. Rėmo ŠVOK įrenginiui skaičiavimas

Palėpėje projektuojamas rėmas ŠVOK įrenginiui atremti, rėmo atramos atsiremia į esamas pastato kolonas ant 9 ir 10 ašies. Visi elementai tarpusavyje jungiami standžiai. Naudojami dėžiniai skerspjuviai, plieno klasė S355JH.

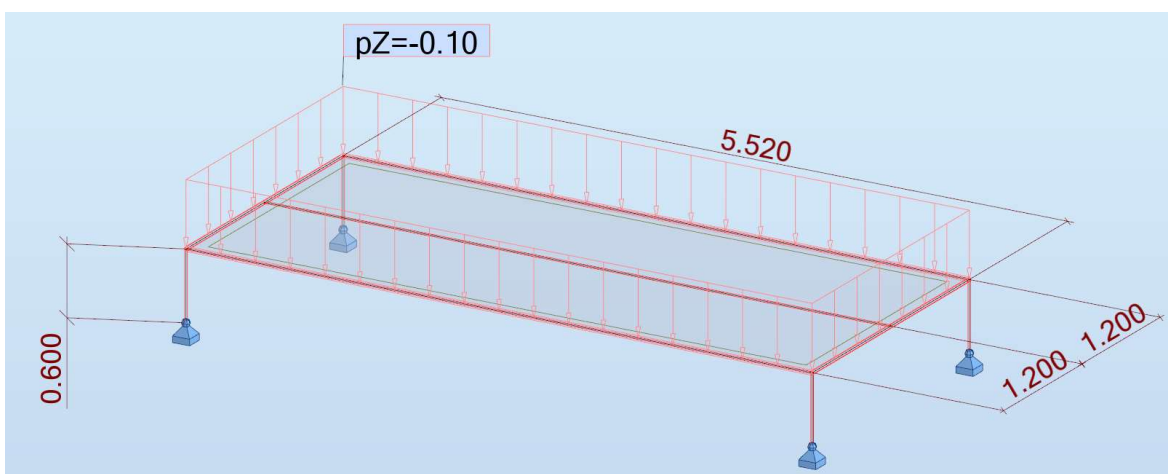
Skaičiuojamoji schema:

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	80	87	0

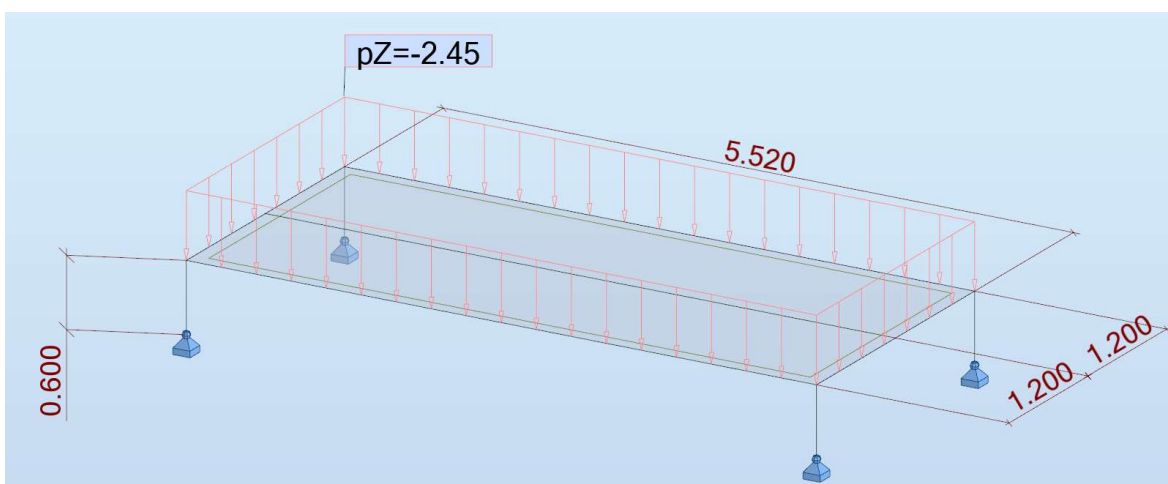


Veikiančios charakteristinės apkrovos:

Nuolatinė apkrova:



Naudojimo apkrova:



Išilginės sijos projektavimas

CODE: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	81	87	0

**ANALYSIS TYPE:** Member Verification**CODE GROUP:****MEMBER:** 10 Sijos_10
m**POINT:** 2**COORDINATE:** x = 0.50 L = 2.760**LOADS:**

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

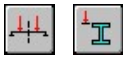
MATERIAL:S 355 (S 355) $f_y = 355.00$ MPa**SECTION PARAMETERS: SQUA 120x120x4**

h=12.0 cm	gM0=1.10	gM1=1.10	
b=12.0 cm	Ay=9.07 cm ²	Az=9.07 cm ²	Ax=18.15 cm ²
tw=0.4 cm	Iy=402.28 cm ⁴	Iz=402.28 cm ⁴	Ix=625.35 cm ⁴
tf=0.4 cm	Wply=78.33 cm ³	Wplz=78.33 cm ³	

INTERNAL FORCES AND CAPACITIES:

N _{Ed} = 0.22 kN	My _{Ed} = 10.00 kN*m
N _{c,Rd} = 585.69 kN	My _{Ed,max} = 10.00 kN*m
N _{b,Rd} = 209.84 kN	My _{c,Rd} = 25.28 kN*m
	MN _{y,Rd} = 25.28 kN*m
	Mb _{Rd} = 25.28 kN*m

Class of section = 1

**LATERAL BUCKLING PARAMETERS:**

z = 1.00	Mcr = 412.39 kN*m	Curve,LT - d	XLT = 1.00
L _{cr,upp} = 5.520 m	Lam _{LT} = 0.26	fi,LT = 0.47	XLT _{mod} = 1.00

BUCKLING PARAMETERS:

About y axis:

Ly = 5.520 m	Lam _y = 1.53
L _{cr,y} = 5.520 m	Xy = 0.36
Lam _y = 117.24	ky _y = 1.00



About z axis:

Lz = 5.520 m	Lam _z = 1.53
L _{cr,z} = 5.520 m	Xz = 0.36
Lam _z = 117.24	kzy = 0.60

VERIFICATION FORMULAS:**Section strength check:**

N_{Ed}/N_{c,Rd} = 0.00 < 1.00 (6.2.4.(1))

My_{Ed}/My_{c,Rd} = 0.40 < 1.00 (6.2.5.(1))

Global stability check of member:

Lam_{b,y} = 117.24 < Lam_{b,max} = 210.00 Lam_{b,z} = 117.24 < Lam_{b,max} = 210.00 STABLE

My_{Ed,max}/Mb_{Rd} = 0.40 < 1.00 (6.3.2.1.(1))

N_{Ed}/(Xy*N_{Rk}/gM1) + kyy*My_{Ed,max}/(XLT*My_{Rk}/gM1) = 0.40 < 1.00 (6.3.3.(4))

N_{Ed}/(Xz*N_{Rk}/gM1) + kzy*My_{Ed,max}/(XLT*My_{Rk}/gM1) = 0.24 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS**Deflections (LOCAL SYSTEM):**

uy = 0.00 cm < uy max = L/150.00 = 3.68 cm Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00

uz = 2.54 cm < uz max = L/150.00 = 3.68 cm Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00**Displacements (GLOBAL SYSTEM):** Not analyzed

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	82	87	0

Section OK !!!

Išvada: sąlyga tenkinama

Galinių skersinių sijų projektavimas

CODE: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 2 Sijos_2

POINT: 1

COORDINATE: x = 0.50 L = 1.200

m

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL:

S 355 (S 355) $f_y = 355.00$ MPa



SECTION PARAMETERS: SQUA 100x100x4

h=10.0 cm

gM0=1.10

gM1=1.10

b=10.0 cm

Ay=7.47 cm²

Az=7.47 cm²

Ax=14.95 cm²

tw=0.4 cm

Iy=226.35 cm⁴

Iz=226.35 cm⁴

Ix=354.71 cm⁴

tf=0.4 cm

Wply=53.30 cm³

Wplz=53.30 cm³

INTERNAL FORCES AND CAPACITIES:

N_{Ed} = 5.02 kN

My_{Ed} = 4.01 kN*m

Mz_{Ed} = 0.10 kN*m

Vy_{Ed} = 0.11 kN

N_{c,Rd} = 482.41 kN

My_{Ed,max} = 4.01 kN*m

Mz_{Ed,max} = 0.10 kN*m

Vy_{T,Rd} = 109.41 kN

N_{b,Rd} = 381.87 kN

My_{c,Rd} = 17.20 kN*m

Mz_{c,Rd} = 17.20 kN*m

Vz_{Ed} = -5.76 kN

MN_{y,Rd} = 17.20 kN*m

MN_{z,Rd} = 17.20 kN*m

Vz_{T,Rd} = 109.41 kN

Mb_{Rd} = 17.20 kN*m

Tt_{Ed} = 2.94 kN*m

Class of section = 1



LATERAL BUCKLING PARAMETERS:

z = 1.00

Mcr = 526.07 kN*m

Curve_{LT} - d

XLT = 1.00

L_{cr,upp} = 2.400 m

Lam_{LT} = 0.19

fi_{LT} = 0.43

XLT_{mod} = 1.00

BUCKLING PARAMETERS:



About y axis:

L_y = 2.400 m

Lam_y = 0.81

L_{cr,y} = 2.400 m

X_y = 0.79

Lam_y = 61.68

k_{yy} = 1.01



About z axis:

L_z = 2.400 m

Lam_z = 0.81

L_{cr,z} = 2.400 m

X_z = 0.79

Lam_z = 61.68

k_{yz} = 0.61

VERIFICATION FORMULAS:

Section strength check:

N_{Ed}/N_{c,Rd} = 0.01 < 1.00 (6.2.4.(1))

My_{Ed}/MN_{y,Rd} = 0.23 < 1.00 (6.2.9.1.(2))

Mz_{Ed}/MN_{z,Rd} = 0.01 < 1.00 (6.2.9.1.(2))

(My_{Ed}/MN_{y,Rd})^{1.66} + (Mz_{Ed}/MN_{z,Rd})^{1.66} = 0.09 < 1.00 (6.2.9.1.(6))

Vy_{Ed}/Vy_{T,Rd} = 0.00 < 1.00 (6.2.6-7)

Vz_{Ed}/Vz_{T,Rd} = 0.05 < 1.00 (6.2.6-7)

IN2324-01-TP-SK-S	Lapas	Lapų	Laida
	83	87	0



$$\tau_{xy,Ed}/(f_y/(\sqrt{3}) \cdot g_{M0}) = 0.21 < 1.00 \quad (6.2.6)$$

$$\tau_{tz,Ed}/(f_y/(\sqrt{3}) \cdot g_{M0}) = 0.21 < 1.00 \quad (6.2.6)$$

Global stability check of member:

$$\lambda_{y,Ed} = 61.68 < \lambda_{y,max} = 210.00 \quad \lambda_{z,Ed} = 61.68 < \lambda_{z,max} = 210.00 \quad \text{STABLE}$$

$$M_{y,Ed,max}/M_{b,Rd} = 0.23 < 1.00 \quad (6.3.2.1.(1))$$

$$N_{Ed}/(X_y \cdot N_{Rk}/g_{M1}) + k_{yy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{yz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.25 < 1.00 \quad (6.3.3.(4))$$

$$N_{Ed}/(X_z \cdot N_{Rk}/g_{M1}) + k_{zy} \cdot M_{y,Ed,max}/(X_{LT} \cdot M_{y,Rk}/g_{M1}) + k_{zz} \cdot M_{z,Ed,max}/(M_{z,Rk}/g_{M1}) = 0.16 < 1.00 \quad (6.3.3.(4))$$

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM):

$$u_y = 0.01 \text{ cm} < u_{y,max} = L/150.00 = 1.60 \text{ cm} \quad \text{Verified}$$

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00

$$u_z = 0.20 \text{ cm} < u_{z,max} = L/150.00 = 1.60 \text{ cm} \quad \text{Verified}$$

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00



Displacements (GLOBAL SYSTEM): Not analyzed

Section OK !!!

Išvada: sąlyga tenkinama

Kolonos projektavimas

CODE: EN 1993-1:2005/A1:2014, Eurocode 3: Design of steel structures.

ANALYSIS TYPE: Member Verification

CODE GROUP:

MEMBER: 5 Column_5
m

POINT: 2

COORDINATE: x = 0.50 L = 0.300

LOADS:

Governing Load Case: 3 ULS/1=1*1.35 + 2*1.30 1*1.35+2*1.30

MATERIAL:

S 355 (S 355) $f_y = 355.00 \text{ MPa}$



SECTION PARAMETERS: SQUA 100x100x4

$$h = 10.0 \text{ cm}$$

$$g_{M0} = 1.10$$

$$g_{M1} = 1.10$$

$$b = 10.0 \text{ cm}$$

$$A_y = 7.47 \text{ cm}^2$$

$$A_z = 7.47 \text{ cm}^2$$

$$A_x = 14.95 \text{ cm}^2$$

$$t_w = 0.4 \text{ cm}$$

$$I_y = 226.35 \text{ cm}^4$$

$$I_z = 226.35 \text{ cm}^4$$

$$I_x = 354.71 \text{ cm}^4$$

$$t_f = 0.4 \text{ cm}$$

$$W_{ply} = 53.30 \text{ cm}^3$$

$$W_{plz} = 53.30 \text{ cm}^3$$

INTERNAL FORCES AND CAPACITIES:

$$N_{Ed} = 12.01 \text{ kN}$$

$$M_{y,Ed} = -3.74 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed} = -1.51 \text{ kN}\cdot\text{m}$$

$$V_{y,Ed} = 5.02 \text{ kN}$$

$$N_{c,Rd} = 482.41 \text{ kN}$$

$$M_{y,Ed,max} = -7.47 \text{ kN}\cdot\text{m}$$

$$M_{z,Ed,max} = -3.01 \text{ kN}\cdot\text{m}$$

$$V_{y,c,Rd} = 139.26 \text{ kN}$$

$$N_{b,Rd} = 459.18 \text{ kN}$$

$$M_{y,c,Rd} = 17.20 \text{ kN}\cdot\text{m}$$

$$M_{z,c,Rd} = 17.20 \text{ kN}\cdot\text{m}$$

$$V_{z,Ed} = -12.46 \text{ kN}$$

$$M_{N,y,Rd} = 17.20 \text{ kN}\cdot\text{m}$$

$$M_{N,z,Rd} = 17.20 \text{ kN}\cdot\text{m}$$

$$V_{z,c,Rd} = 139.26 \text{ kN}$$

$$M_{b,Rd} = 17.20 \text{ kN}\cdot\text{m}$$

Class of section = 1



LATERAL BUCKLING PARAMETERS:

$$z = 0.00$$

$$M_{cr} = 3632.62 \text{ kN}\cdot\text{m}$$

$$\text{Curve,LT} = d$$

$$X_{LT} = 1.00$$

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Lcr,low=0.600 m

Lam_LT = 0.07

fi,LT = 0.38

XLT,mod = 1.00

BUCKLING PARAMETERS:



About y axis:

Ly = 0.600 m

Lam_y = 0.40

Lcr,y = 1.200 m

Xy = 0.95

Lamy = 30.84

ky = 0.79



About z axis:

Lz = 0.600 m

Lam_z = 0.40

Lcr,z = 1.200 m

Xz = 0.95

Lamz = 30.84

kyz = 0.47

VERIFICATION FORMULAS:

Section strength check:

N,Ed/Nc,Rd = 0.02 < 1.00 (6.2.4.(1))

My,Ed/MN,y,Rd = 0.22 < 1.00 (6.2.9.1.(2))

Mz,Ed/MN,z,Rd = 0.09 < 1.00 (6.2.9.1.(2))

(My,Ed/MN,y,Rd)^1.66 + (Mz,Ed/MN,z,Rd)^1.66 = 0.10 < 1.00 (6.2.9.1.(6))

Vy,Ed/Vy,c,Rd = 0.04 < 1.00 (6.2.6.(1))

Vz,Ed/Vz,c,Rd = 0.09 < 1.00 (6.2.6.(1))

Global stability check of member:

Lambda,y = 30.84 < Lambda,max = 210.00 Lambda,z = 30.84 < Lambda,max = 210.00 STABLE

My,Ed,max/Mb,Rd = 0.43 < 1.00 (6.3.2.1.(1))

N,Ed/(Xy*N,Rk/gM1) + kyy*My,Ed,max/(XLT*My,Rk/gM1) + kyz*Mz,Ed,max/(Mz,Rk/gM1) = 0.45 < 1.00 (6.3.3.(4))

N,Ed/(Xz*N,Rk/gM1) + kzy*My,Ed,max/(XLT*My,Rk/gM1) + kzz*Mz,Ed,max/(Mz,Rk/gM1) = 0.37 < 1.00 (6.3.3.(4))

LIMIT DISPLACEMENTS



Deflections (LOCAL SYSTEM): Not analyzed



Displacements (GLOBAL SYSTEM):

vx = 0.01 cm < vx max = L/150.00 = 0.40 cm

Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00

vy = 0.00 cm < vy max = L/150.00 = 0.40 cm

Verified

Governing Load Case: 7 SLS:CHR/1=1*1.00 + 2*1.00 (1+2)*1.00

Section OK !!!

Išvada: sąlyga tenkinama

2.8. Smeigių kiekio laiptinės stogui skaičiavimas

Stogo izoliacijos tvirtinimui naudojamų smeigių kiekis apskaičiuojamas pagal STR 2.04.01:2018 3 priedo 1.1 p. formulę:

$$n_f = \frac{w_{sum}}{W_f} \cdot \gamma_Q; \quad (3.1)$$

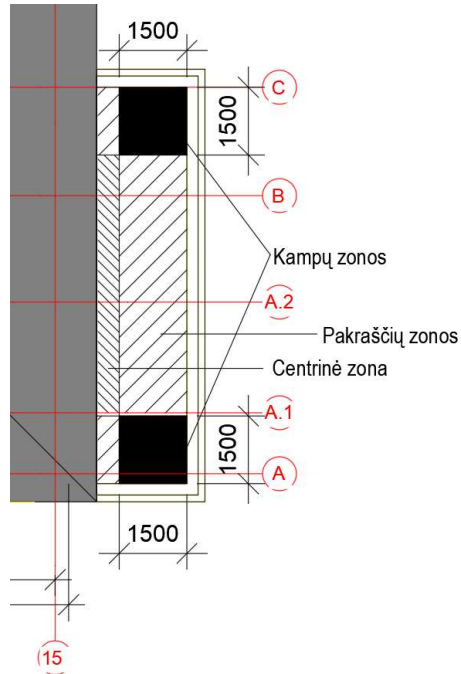
čia: n_f – tvirtinimo elementų kiekis (vnt./m²);

w_{sum} – suminis vėjo slėgis į stogo paviršių atitinkamoje stogo zonoje (kPa). Imamas iš vėjo apkrovų skaičiavimų;

W_f – vieno tvirtinimo elemento projektinis stipris (kN). $W_f = 0,6$ kN;

γ_Q – vėjo poveikio dalinio patikimumo koeficientas ($\gamma_Q = 1,3$).

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	85	87	0



2.6 pav. Laiptinės stogo suskirstymas zonomis.

Kampų zonos:

$c_e = -3,0$ (STR 2.04.01:2018 3 priedo 3.1 pav.).

$$w_{sum1} = q_{ref} \cdot c(17,8) \cdot (c_e + c_i) = 0,64 \cdot 0,81 \cdot (-3,0 - 0,2) = -1,66 \text{ kPa};$$

$$n_{f1} = \frac{w_{sum1}}{W_f} \cdot \gamma_Q = \frac{1,66}{0,6} \cdot 1,3 = 3,6 \rightarrow \text{priimamas smeigių skaičius: } 4 \text{ vnt./m}^2.$$

Pakraščių zonos:

$c_e = -2,0$ (STR 2.04.01:2018 3 priedo 3.1 pav.).

$$w_{sum2} = q_{ref} \cdot c(17,8) \cdot (c_e + c_i) = 0,64 \cdot 0,81 \cdot (-2,0 - 0,2) = -1,14 \text{ kPa};$$

$$n_{f2} = \frac{w_{sum2}}{W_f} \cdot \gamma_Q = \frac{1,14}{0,6} \cdot 1,3 = 2,47 \rightarrow \text{priimamas smeigių skaičius: } 3 \text{ vnt./m}^2.$$

Centrinė zona:

$$w_{sum3} = w_{e1} = w_{e2} = -0,42 \text{ kPa};$$

$$n_{f3} = \frac{w_{sum3}}{W_f} \cdot \gamma_Q = \frac{0,42}{0,6} \cdot 1,3 = 0,91 \rightarrow \text{priimamas smeigių skaičius: } 1 \text{ vnt./m}^2.$$

2.9. Vėdinamos sistemos atplėšimo nuo pagrindo skaičiavimas

Mechaniškai tvirtinamos vėdinamos sistemos projektinis atplėšimo stipris R_{mt} :

$$R_{mt} = \frac{N_{rt} \cdot n}{g_{mt}} = \frac{1,1 \cdot 4}{1,5} = 2,93 \text{ kPa}.$$

Čia:

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	86	87	0

N_{rt} – tvirtinimo prie pagrindo elemento ištraukimo jėga iš pagrindo, kurią pateikia gamintojas (kN);

n – bendras tvirtinimo elementų kiekis pagal gamintojo tvirtinimo elementų išdėstymo schemą (vnt/m²);

g_{mt} – atsargos koeficientas mechaniškai tvirtinamai vėdinamai sistemai. Kai suminis karkaso ir apdailos elementų sistemos svoris be klijų ne didesnis už 30 kg/m², $g_{mt} = 1,5$.

Aukštis h [m]	Vietovės tipas	Atvira sienos dalis mažesnė nei 5 %	Vėjo stiprumas $v_{ref,0}$ [m/s]	Skaičiuojama vieta
17.8	B	Ne	32	Kampas

$c(z)$	c_i	c_e
0.806	0.8	-3

Vėdinamos sistemos atplėšimo nuo pagrindo stipris R_{vent} (kPa) turi būti ne mažesnis už projektinę vėjo apkrovą s_d (kPa): $R_{vent} \geq s_d$

kur:

projektinė vėjo apkrova: $s_d = 0,001 \cdot |w_{sum}| \cdot \gamma_Q = -2.76$ [kPa];

suminis vėjo slėgis į atitvaros paviršių: $w_{sum} = w_{me} - w_i = -2120.14$ [Pa];

vėjo slėgis į išorinį (priešvėjinį) atitvaros paviršių: $w_{me} = q_{ref} \cdot c(z) \cdot c_e = -1673.80$ [Pa];

vėjo slėgis į vidinį (pavėjinį) atitvaros paviršių: $w_{mi} = q_{ref} \cdot c(z) \cdot c_i = 446.35$ [Pa];

atskaitinis vėjo slėgis: $q_{ref} = \frac{\rho}{2} \cdot v_{ref}^2 = 692.22$ [Pa];

atskaitinis vėjo greitis: $v_{ref} = c_{DIR} \cdot c_{TEM} \cdot c_{ALT} \cdot v_{ref,0} \cdot 1,04 = 33.28$ [m/s];

čia: $\rho = 1,25 \text{ kg/m}^3$; $c_{DIR} = 1,0$; $c_{TEM} = 1,0$; $c_{ALT} = 1,0$; $\gamma_Q = 1,3$.

Vėdinamos sistemos tvirtinimo elemento prie pagrindo ištraukimo iš pagrindo jėga arba nutraukimo jėga skaičiuojama pagal:

$$R_{vent} = \frac{N_{(Rt,tv)} \cdot n_{vent}}{\gamma_{vent}} \rightarrow N_{(Rt,tv)} = \frac{s_d \cdot \gamma_{vent}}{n_{vent}} = -1.034 \text{ [kN]};$$

čia:

vėdinamos sistemos tvirtinimo prie pagrindo elementų kiekis: $n_{vent} = 4$ [vnt./m²];

atsargos koeficientas vėdinamai sistemai: $\gamma_{vent} = 1.5$.

Išvada: $R_{mt} = 2,93 \text{ kPa} > s_d = 2,76 \text{ kPa}$, vėdinama fasado sistema prie pagrindo tvirtinama 4 vnt./m² elementais. Vieno elemento ištraukiamoji galia $N_{rt} = 1,1 \text{ kN} < N_{(Rt,tv)} = 1,03 \text{ kN}$.

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	87	87	0